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THE

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During the War, almost exceptionally among technical publications and periodicals of the character of the ELECTRICAL REVIEW, we have refrained from increasing the price. Owing, however, to the constant increases in cost of paper, printing, engraving and production charges generally, we have reluctantly decided that the price from the beginning of this year must be raised to 6d. per copy. The change will not apply to unexpired subscriptions.

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THE OLD YEAR AND THE NEW.

THOUGH it is not our intention to occupy the time of the reader, or to tax his already over-burdened mind, with a detailed review of the events of the year that has just closed, the occasion cannot be passed over without brief reference to some of its outstanding problems and experiences. Nineteen-nineteen has passed into history, and it will be remembered as one of the most momentous years through which any of us has lived.

Many anxious months were occupied with the negotiating of the Terms of Peace; even now the Treaties have not been ratified by all the parties concerned therein, and there yet remain unsettled many World Problems arising in that connection. The demobilisation of millions of men has been continuously in progress, and the British Empire and the Allies have been faced with innumerable difficulties attending the resettlement of the Forces in peaceful avocations. While we have been thus engaged, there have crowded in upon us the accumulated problems of five years of war; these and other matters all seemed to clamour at once for settlement. Though our hands were as full with duty directly connected with the war as at almost any period of actual hostilities, the weight of responsibilities was added to enormously by a desire that was abroad for all the ills of humanity to be removed without delay as by the waving of some magic wand. Nationalisation demands, incessant agitations for higher wages and shorter hours, efforts to secure "control," the railway strike and struggle with the community, the continued increase in the cost of living, the serious developments in rates of exchange, the ever-growing burden of National Finance—these are some of the leading questions of the year. Remembering all that has been involved, and all the dangers through which we have passed, it is impossible to view the situation in its entirety without adopting the tone of optimism of the King's Speech. It is a matter for general thanksgiving that we have passed through so critical a year without greater damage to constitutional and individual interests.

Limiting our survey to matters coming more immediately within the scope of our specialised activities, we recall that for thousands of factories and works no inconsiderable part of the period referred to has been busily occupied with the turnover from war work to commercial production. For some concerns this was naturally an easier operation than for others. During the year it was possible to reveal something of the brilliant war-time record of engineering and electrical factories, of the achievements of scientific men and societies, of the advances in wireless applications, and of the exploits which stand to British credit in submarine telegraphy.

Electrical, engineering, and other scientific bodies have returned to former activity; indeed, are more "live" than ever. The I.M.E.A. and the B.A. have resumed their pre-war programmes. The Whitley Councils are taking shape, and as a result of this movement the E.P.E.A., the S.T.E., the N.A.S.E., and the E.S.C.A. have been stimulated to increased activity with a view to securing the representation of their members—the "middle class" of the industry—on the Councils.

If we turn our thoughts to purely electrical operations, perhaps we must place first and foremost the Electricity Supply Act, which has just received the Royal Assent.

Our pages have told from week to week, as the year has passed on, of gratifying projects which were in course of preparation. Electric railway work is about to advance on a large scale within the United Kingdom, in the Colonies and Dependencies, and in practically all parts of the world. There are hydro-electric schemes ready to be put in hand at

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home and abroad. In wireless and cable telegraphy and telephony, land and sea alike, conditions are ripe for a great move forward. Electricity works in all parts of the kingdom are short of plant, and cannot keep pace with the demand for energy, notwithstanding all the additions of the war period. The domestic load and all that that implies is promising beyond our fondest hopes of earlier days. The Electrical Development Association is getting to work at the right moment. The electric vehicle is coming into its own, as the numerous orders of the year have proved. The outlook for manufacturers in all departments of the industry is unquestionably brighter than it ever has been.

At the beginning of 1919 we wrote looking forward to a period of intensive activity in the electrical industries. If we were justified then we are more than justified to-day, for it is our conviction that the electrical industries are in for a Boom, and for one that should last for years if the menace of industrial unrest and financial stress do not assume serious shape. In a sense, we have carried over to 1920 many of the problems that we had to meet in 1919, but the experience of the latter year fills us with hope.

Dartmoor in Danger?

THE proposal to develop the possibilities of Dartmoor as a source of water-power has aroused the wrath of those who love the district for its æsthetic amenities and its archæological interest, and they are conducting an energetic campaign against the scheme by letters to the Press. We respect their feelings, and their solicitude for the interests of those who, they say, would suffer injury if the scheme were carried through. But are they justified in believing that those natural features or those interests would be prejudiced by the utilisation of the waterpower?

The details of the project are not in our possession, but they are not necessary to our purpose, which is to point out that hydroelectric works do not *consume* the water which passes through their turbines, nor do they contaminate it in any way. The water is still available for use in irrigation or for human consumption when it has yielded up its energy, and by the construction of dams and reservoirs its flow is regulated so that floods and droughts are obviated. At the same time the benefit of a supply of electric power at their doors will accrue to the residents, and the district will be enabled to develop industries without the accompaniment of smoky chimneys, while many thousand tons of coal will be annually saved.

Whether scenic beauties should be preferred to industrial development in these days is a question upon which we hold very decided views, but in this case we doubt whether that question arises at all. A much more weighty objection to the proposal is one to which Mr. H. Davey has given definite shape—namely, the extravagant expenditure which is foreshadowed, and which appears to be out of all proportion to the output obtainable. The chief obstacle to the development of water-power is usually the question of finance, and if the scheme will not hold water from that point of view it is not likely to float.

"Where Angels Fear to Tread."

WHILST uttering a solemn protest against the Dartmoor scheme, on the usual lines—that is, taking for granted that it would necessarily ruin the district as a pleasure resort, which is an unwarranted assumption—the *Daily Mail* does not scruple to give pictorial publicity to a hare-brained scheme emanating from the imagination of a Mr. A. E. Steel, who proposes to generate electricity by means of pumps, water tanks, and turbo-dynamos from the passage of heavy traffic over the street surface. To characterise such a proposal as idiotic is to put it mildly; moderate language is utterly inadequate to the occasion. Yet this preposterous idea is said to be "among the most ambitious inventions of the year," and the *Daily Mail* has evidently taken it quite seriously.

Now, of what value is the opinion of a paper which could entertain such a mad notion, with regard to any engineering or physical question whatever?

We regret to say that the *Morning Post* was similarly fooled, and said the scheme seemed to be "worthy of consideration." We would gladly save our lay contemporaries from these astounding blunders if they would only ring us up and ask our advice.

Stations or Super-Stations.

IT is regrettable that political considerations should be allowed to colour, or at least give a "complexion" to, purely engineering problems. That of super-stations is a case in point. The word has become a party cry. There are the super-stationists and the anti-super-stationists. The latter comprise mainly the reactionary element who profess to pin their faith to the somewhat indefinite process called "linking-up" (which the Board of Trade Electric Power Committee, with perhaps unnecessary gentleness, put aside as not in itself sufficient).

This "sit-still" party has, indeed, a good deal to answer for in giving such a good case for the Government to insist that only the most drastic steps in legislation (*vide* the Electricity Bill as it left the Commons) would be of any use. On the other hand, the word super-station has been exalted by the other party to a sort of fetish. It has stolen some of the etymological glamour attaching to the Nietzschean "super-man." As a matter of fact, there is no real distinction between a station and a super-station. The whole question, the purely engineering question, falls under two heads—one, the problem of concentrating as much plant as possible under one roof; the other, that of making the size of each machine as big as possible. The first question is only one of degree as compared with the practice in existing stations of making one roof cover as many machines as are necessary for a particular district. As to the size of the sets, here again "super-sets" are not something special and unadaptable to existing stations—witness Manchester and its 30,000-KW. set.

The fault of the whole thing is, in fact, largely due to the matter being considered *in vacuo*. There is no question of some universal panacea. Each district with its own special electrical conditions must be dealt with individually. What size of station is, in the individual case, necessary, and what size of set is most economical, under the particular conditions, must be determined by engineering considerations with due regard to the commercial aspect of the question.

German Restrictions on Dumping.

A DECIDED feeling is growing in Germany against the export of various kinds of manufactures at dumping prices in paper marks, examples of this kind being regarded in many circles as a waste of national wealth under the existing circumstances of the heavy depreciation of the mark. In pre-war times many foreign customers became so accustomed to purchasing goods from Germany—goods produced in bulk, and safely protected in the inland market by high import duties—at very low prices, that they consider it only right and proper that they should be able also at the present time to procure similar goods from Germany on the same terms, with the additional advantage of deriving benefit from the low exchange value of the mark. But the representatives of some of these customers have been afforded an opportunity of experiencing the truth of the old saying that even a worm will turn. The first instances of this kind of any importance were recorded at the recent Trade Fair held at Frankfort-on-Main, when the paper mark was still worth twice as much as it is now, and when foreign customers expressed surprise that many German exhibitors refused to accept orders for delivery in German paper exchange, but demanded payment in foreign currency, or in marks of the equivalent amount.

A second instance occurred some weeks ago, when the former Secretary of State to the Ministry for Economy, in

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the course of an address delivered before the Association of German Engineers at Berlin, recommended that engineers should at once increase prices by 300 per cent.—a suggestion which was received with applause by the members of the audience—and at that time, too, the mark was substantially higher than at the present time. Since then the Association of Machine Tool Makers, in the course of a circular distributed privately among the members, advised the latter to raise prices by 700 per cent., this percentage including an increase of 300 per cent. already previously in operation. Leading iron and steel makers are also moving in the direction of obtaining in export markets prices which are practically equivalent to the world's market prices, although a decided leakage of goods sold by merchants continues to take place through the "gap" in the West. In addition, the Government is devoting attention to the waste of national property by dumping, and is determined to stop this practice either by the imposition of export duties, or by extending the control of the export trade to self-governing combinations in the form of duly authorised trade syndicates, and it is probable that the latter remedy will be adopted. Nominally the export and import trade has been under Government control for a long time past by means of the export departments for specified industries, but evasions are easy and numerous; and it is therefore thought that if each branch is self-governed by its own constituents, they will take care that merchandise is not exported at dumping prices which, while being of temporary benefit to the individual manufacturer, are detrimental to the interests of the community, which lie in the direction of securing higher export prices, and thus contributing towards an improvement in the trade balance of the country and consequently in the value of the mark.

As bearing upon the question, we observe in a Copenhagen newspaper, of December 21st, that Danish purchasers of metal goods in Germany have recently found it impossible to secure delivery, as they have been informed by German makers that the State Export Department will not grant an export permit unless the prices are increased by up to 800 per cent. In the case of a Danish importing firm which ordered electrical articles from a wholesaler in Berlin, the prices of the goods which were ordered in September were raised by 45 per cent. in October; but in the middle of November the intimation arrived that the German Government would not permit the export of the articles without the prices being more than doubled.

It is understood that similar instances have arisen in Great Britain. Whatever views we may entertain concerning the advisability or otherwise of importing merchandise of any kind from Germany, at all events we have an interest in seeing German export prices rise considerably beyond their present level. Higher prices imply a reduction in the severity of German competition due to dumping; they indicate a tendency towards an improvement in the German exchange. They show a possibility of the country being able to purchase raw materials more cheaply; and they exhibit a movement towards a manufacturing revival. If these effects are not brought about, the possibility of the Allies ever receiving a monetary war indemnity from Germany will be exceedingly remote.

Fuel Economy.

IN our "Correspondence" columns to-day, "Economy" strikes a true note; the elimination of waste of every kind—including waste of human labour—should be our aim. But the question is a very wide one, and, while we endeavour to promote economy in new ways, we must not neglect methods which are already known to us.

"Economy" rightly deprecates controversy between gas and electrical men, and we had no desire to embark upon it. But a campaign was opened by Sir Dugald Clerk, last spring, in the interests of the gas industry, in the course of which he made statements with regard to the relative merits of gas and electricity from the economical point of view which could not be allowed to pass unchallenged. So long as he affects to compare electrical energy—energy which is directly available for use, far more widely available, in fact, than if it were in the form of actual units of heat—with the potential heat energy which is admittedly present in gas, but which is not capable of utilisation to a degree even remotely approaching that of electrical energy—he is laying a false scent, and his assertions must be fought and refuted. It was for that reason that we published Mr. Klemens's articles, which we believe to be substantially true.

But, as we have said, it is a broad question, and a consideration of the first importance in this relation is almost invariably ignored—namely, the coal itself. Gas suppliers must have coal of a certain kind and quality to work upon; but there are vast quantities of coal from which the by-products cannot be extracted on an economic basis, and which are fit for nothing at all but combustion. This coal can be, and is, utilised by electricity works; otherwise it would be almost wholly wasted—thousands of tons have been dumped in the sea, and large quantities have been left in the pits. Hence, even if the claims of the gas engineers were justified, the case would not be materially altered. Put it this way: Every ton of waste coal used in electricity works saves a ton of good coal that would otherwise be used in gas works. How does the "comparison" stand then?

The Chairman of the A.E.G. Speaks Again.

DR. WALTER RATHENAU, addressing the shareholders at the recent annual meeting of the A.E.G., did not appear to be in a very happy frame of mind, judging from the reports of his speech published in the German newspapers, although he concluded by again emphasising the indispensability of German industry and trade to other countries. He stated that the destruction of property, which was a consequence of the world war, had not ceased with the end of the war, but still continued to-day. A reduction in all visible capital property was taking place, and at the same time there was a decrease in the workmen's efficiency, together with the diminution in the length of the working shift from nine to eight hours. The present low rate of production was inadequate to cope with the problems which the future imposed on world economy, and one of the chief matters of the near future was the restoration of the East and of the North of France and Belgium.

The chairman proceeded to say that, generally speaking, the balance-sheet of world economy was very gloomy. In former times the production was able to meet the consumption, but the conditions were now reversed. Still, it was impossible to refer to a period of high prosperity, as the efficiency had abated as compared with former times. If German industry wished to recover its leading importance in the world's markets, it must be guided in the direction of combination and simplification of working, and for this purpose the A.E.G. had taken up the lamp business with the Auer Co. and the Siemens & Halske Works. A great need of capital had been manifested for the entire German industry owing to the depreciation of money: the A.E.G. had contracted a loan of 100,000,000 marks, and hoped in this way to have sufficient liquid funds without provisionally holding out the prospect of an increase in the share capital.

Coming to consider the question of raw materials, the chairman remarked that at the beginning of the year, lists were prepared by private firms, and by the competent authorities, showing the classes and quantities of raw materials which would be urgently required by the industries in the next few years. The Government, however, had given way to the pressure of wide circles, and permitted free trading for many economic branches. In his opinion the dumping of German goods abroad and the fall in the value of the mark were due to this "dictatorship of free trading," whilst the keeping open of the German frontiers had also been injurious to German economy. It was urgently necessary again to promote the technical efficiency of German industry, and the speaker concluded that when this level of efficiency had again been reached, other countries would also perceive that the world's markets could not manage without German industry and trade.

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THE PRODUCTION OF HYDROGEN AND OXYGEN BY ELECTROLYSIS.

By Lieut.-Col. T. A. ROSS, A.M.I.E.E., late R.A.F. and R.E.

Hydrogen and oxygen were employed in large and ever-increasing quantities by the various Expeditionary Forces during the course of the war, and were obtained from various sources. The needs of the B.E.F., in France, of course, overshadowed all other demands.

Hydrogen was required for dirigible and observation balloons, for carrying propaganda literature by means of free balloons, and for meteorological purposes, whilst oxygen was required for treating medical, particularly asphyxiating and other gas, cases, for pilots of aeroplanes, and for workshop needs. Both hydrogen and oxygen were employed in other ways, which must, for the present, at any rate, remain secret.

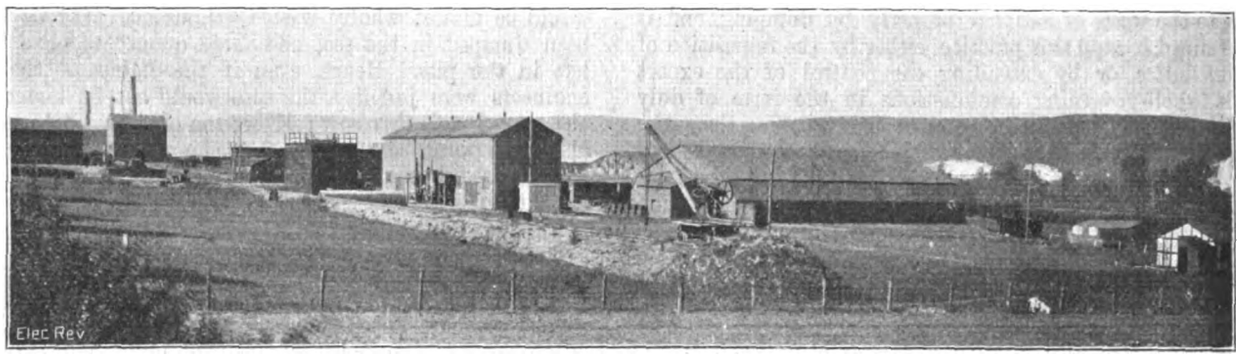

Fig. 11.—General View of the Electrolytic Works.

With the processes of production, or the sources of supply, of these gases up to the latter end of 1917, this article is not concerned. It is sufficient to say that the quantities delivered fell short of the demand and that, with the programme ahead of the British Army, combined with the effects of the enemy submarine campaign, bold measures and rapid execution had to be undertaken in the field to overcome present and future difficulties.

After a survey of the situation it was decided that the production of hydrogen and oxygen by the electrolysis of water was possible in the field, and, taking every disability into consideration, promised the least delay in erection of plant. It will be appreciated that the case presented some features which are not, and never will be, present in civil operation. There were comparatively few existing data to go upon, the workshops of the Allies were more than fully occupied already, and many considerations had to be subordinated or dismissed in view of the need for speed. Nor could the attentions of the enemy by land or air be overlooked. In viewing, then, the means adopted and hereafter described, these points must receive consideration.

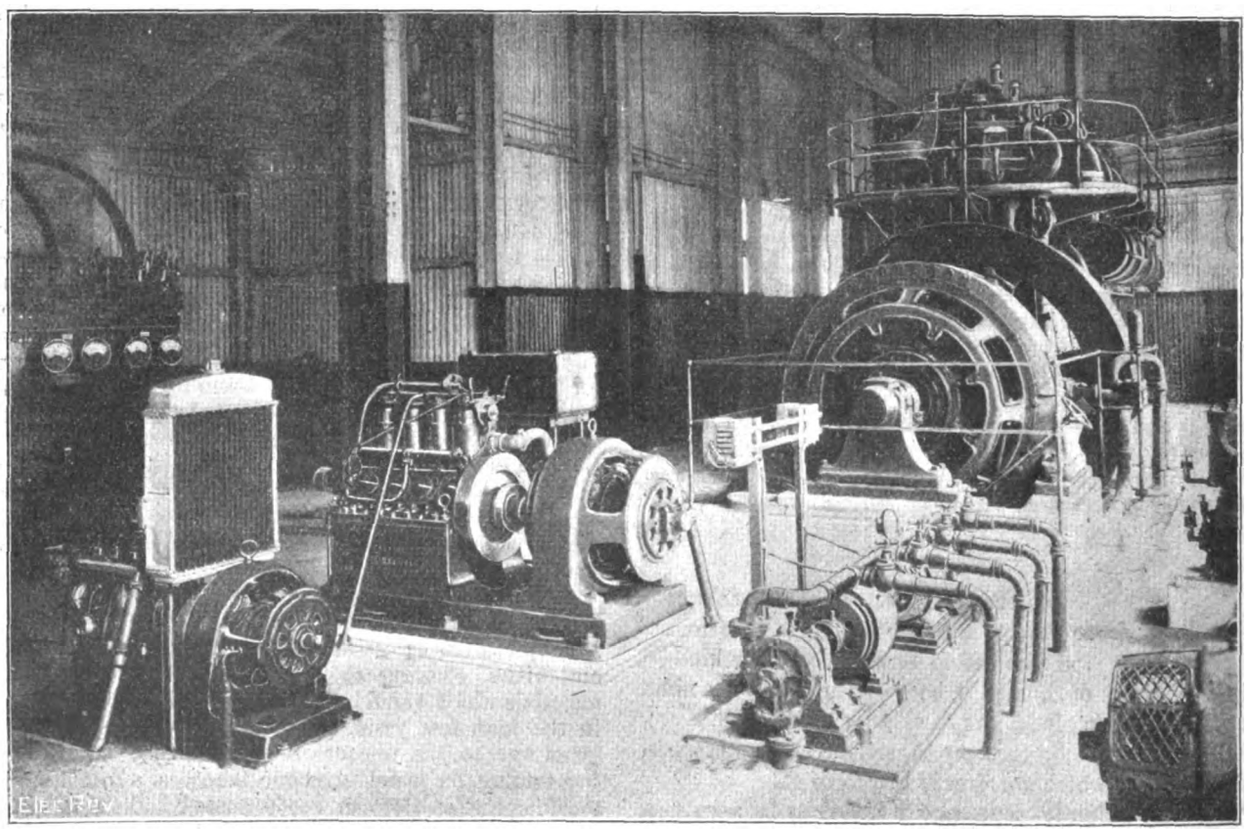

Fig. 2.—Interior of Generating Station.

From many places in France and England suffi-

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cient, if not always suitable, plant was gathered together in February, 1918, to form two widely separated installations in France. The combined installations were estimated to be capable of producing approximately 200,000 cubic feet of hydrogen and 100,000 cubic feet of oxygen each day of 20 working hours. These figures did not represent the total demand, but sufficient to secure the situation only.

Work on both sites was commenced early in February, but most of the effort was, for the time being, concentrated on the southern, and smaller, installation.

Work on buildings, foundations, railways, and water supply was already well advanced when, on March 21st, the German offensive was launched. Prior to that date, bombing operations by the enemy had been somewhat active, but not sufficient to lead to any modifications in the plans.

With this great and progressive offensive, however, all went into the melting pot. Such plant as could be removed was at once taken back to a place of greater safety, though it may be said here that the German wave never quite reached either site.

Eventually, the northern plant was handed over to the Admiralty for erection in England for purposes of its own, and a fresh site was selected for the remaining plant, in France, at Rouen. This is the plant now completed and described below, the plant in England not having been completed.

The site is on a slope of about 1 ft. in 40 ft., and in the lay-out regard was paid to the utilisation of this feature as far as possible. The plant may be considered as consisting of three groups, the first dealing with the production of electric power, the second with the conversion of water into hydrogen and oxygen, and the third with the storage, compressing, and handling of these gases when produced.

In principle the arrangement is that all liquids and solids flow or move by gravity down hill, and all gases travel back uphill.

Power Group.—The general arrangement is shown in fig. 4, and fig. 1 gives a view of the plant.

Buildings.—A steel-frame building houses the power plant, and was designed to be walled by sandbagging between stanchions, and to have concrete traverses, for protecting the machines against flying splinters. It was also made long and narrow so as to reduce the target offered.

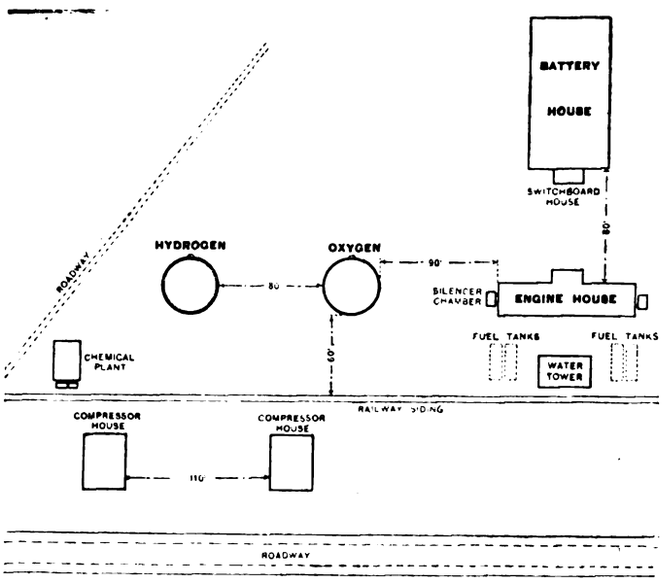

FIG. 4.—ARRANGEMENT OF PLANT.

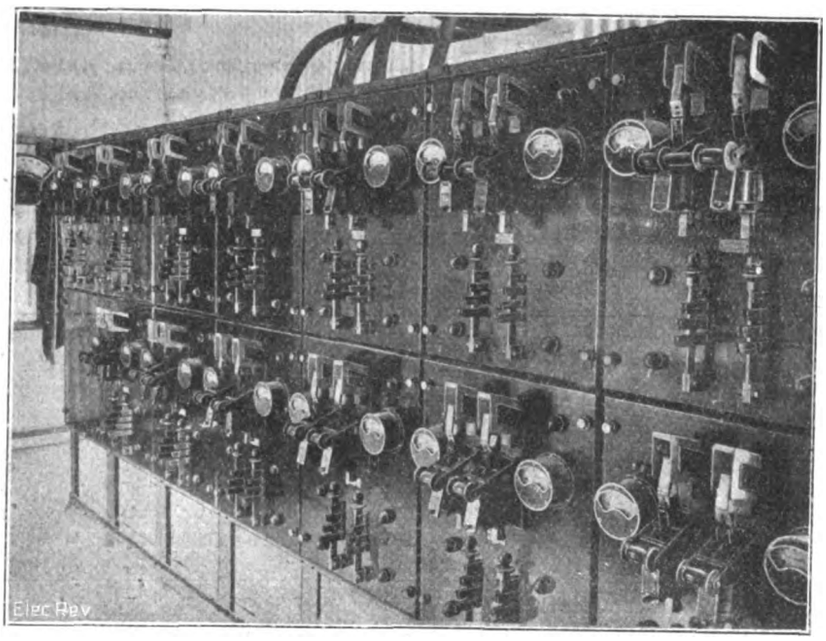

FIG. 5.—DISTRIBUTION SWITCHBOARD.

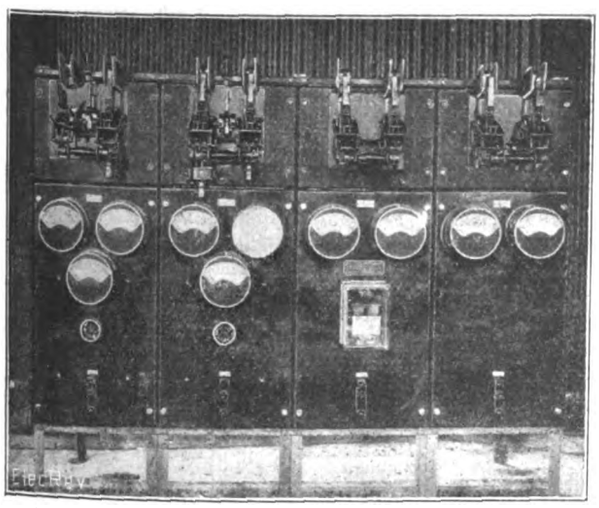

FIG. 3.—MAIN SWITCHBOARD.

Water Supply.—After examination of the geological strata, it was decided to sink a bore-hole of 200 ft., and employ the air-lift system. This proved entirely successful, as a continuous supply of 9,000 gallons per hour is available. The water is of very good quality.

Cooling Tower.—This tower is of the usual drip-board, open-frame type, and was designed to deal with 11,000 gallons of water per hour.

Fuel Oil Tanks.—The tanks are each of 6,500 gallons capacity, and are set at such a level that the oil-fuel, on arrival in railway tank-trucks, flows into them by gravity. They are cross-connected, to ensure continuity of supply. From them the oil is pumped into two ready-use tanks of 500 gallons each, situated on platforms in the power-house.

Engines and Generators.—Two 500-550-B.H.P. Diesel engines, by Mirrlees, Bickerton & Day, drive two 340-KW. compound, interpole D.C. generators, with their windings arranged for static balancing, by Messrs. Crompton & Co., Ltd. (see fig. 2). The voltage is 480, and this is utilised on the ordinary 3-wire system, the out-of-balance load being cared for by two oil-immersed static-balancers, by Johnson and

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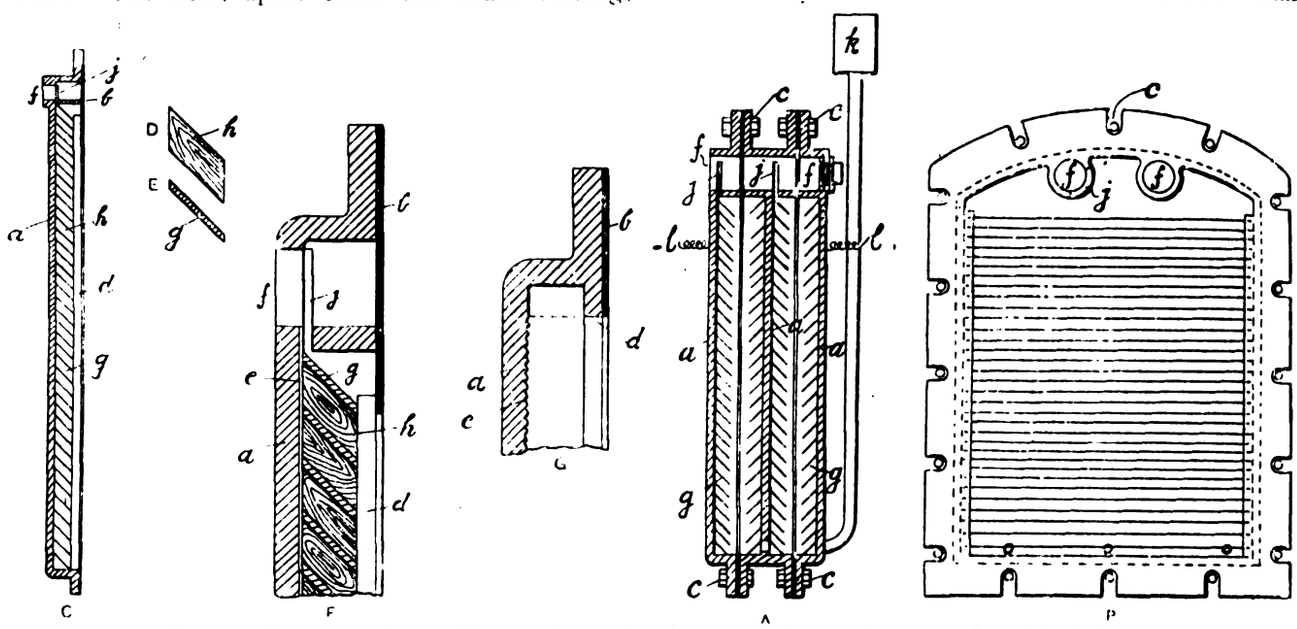
Phillips. These balancers are connected to their respective generators through slip-rings, the armature winding being tapped at three points, and the interpole and series field windings are respectively grouped with their positive and negative poles in series. The field, apart from the shunt-winding, thus becomes divided between the positive and neutral and negative and neutral.

In dealing with the engine auxiliary gear, all starting-air receivers were interconnected and air-piping duplicated where necessary, so as to minimise the effects of possible damage by bomb-splinters.



a, Plate; *b*, Rubber joint; *c*, Bolts; *d*, Flange; *e*, Corrugation; *f*, Passage; *g*, Glass; *h*, Separator; *j*, Port; *k*, Feed; *l*, Leads.

FIG. 6.—DETAILS OF THE ELECTROLYTIC CELLS

A small auxiliary air-compressor, driven by a 4-B.H.P. petrol engine, is provided to recharge a starting cylinder in case of complete loss of air. This proved very useful.

Specially large silencers, built of soft bricks, were provided for the Diesel engines, it being the writer's previous experience that anti-aircraft gunners in the neighbourhood of engines with noisy exhausts invariably demand that they shall be shut down during raids owing to the difficulty of locating aircraft by sound under the circumstances. This is particularly the case with multiple-engined aeroplanes, which more readily synchronise with local noises. The writer had some interesting experiences at the front in this connection. In fine moonlight weather, when bombing was active on both sides, loss of production, consequent upon frequent shut-downs, became a serious matter in the case of certain water-treatment plants in France.

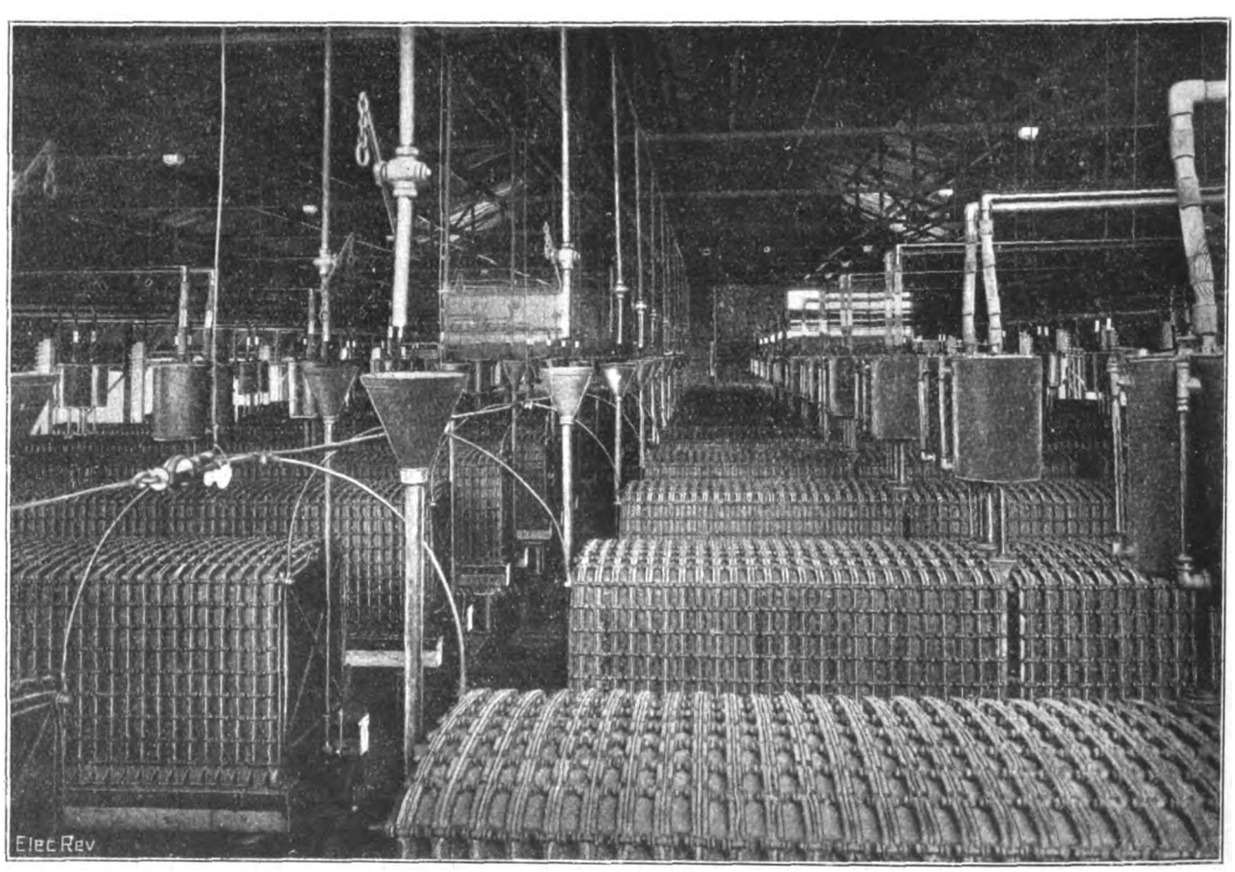


FIG. 7.—INTERIOR OF BATTERY HOUSE, SHOWING THE ELECTROLYSERS.

Auxiliary Machinery.—Petrol sets of 18 KW. and 5 KW. provide power and lighting at 110 volts. Two centrifugal pumps, submerged below the level of the

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cooling tower reservoir, supply water for all purposes, including an auxiliary circulating-water supply to the Diesel engines after the latter have been shut down. This is to minimise deposition in water jackets.

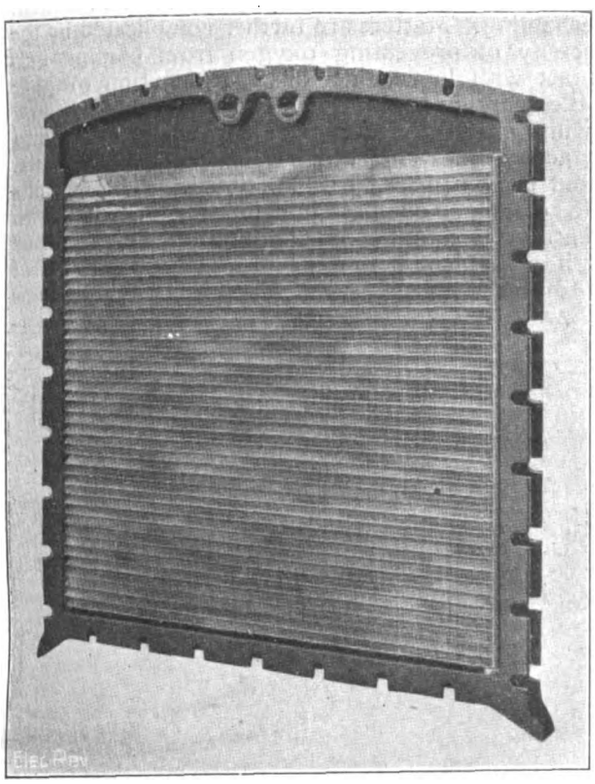

FIG. 8.—CORRUGATED PLATE WITH GLASS VANES.

An air compressor, motor-driven, supplies air for the air-lift system, previously referred to, and was also employed for tools during the erection of the plant.

Switchboards. — Two switchboards, seen in figs. 3 and 5, were supplied by Messrs. Switchgear and Cowans, Ltd. They present no unusual features, and were placed in annexes to the main building, in order to make their protection from bombs an easier matter. The distribution board, fig. 5, had also to be isolated from the battery house in order that flashes might not fire any escaping gases.

Gas-production Group. — The electrolytic cells, of which there are 2,600, are arranged in 52 groups of 50 each, and four groups each are connected in series between positive and negative, with the mid-way point connected to neutral, which, in turn, is earthed. A general view of the interior of the battery house is seen in fig. 7. The electrolyte is a solution of pure caustic soda dissolved in distilled water, of a specific gravity of 30 deg. Beaumé. The action of these cells, which were made on the "Système Geeraerd," can best be followed by a reference to the diagram in fig. 6. It will be noticed that this system does away with the use of a porous screen between the oxygen and hydrogen compartments, thus considerably lowering the internal resistance.

Each cell consists of two dished cast-iron plates (*a*) insulated from each other by a rubber joint and held together by a number of insulated bolts. The faces of these plates are finely corrugated. Placed horizontally across them, for their full width, and held in place by suitable ebonite distance-pieces, are a number of glass vanes (*g*). Referring to fig. 6B,

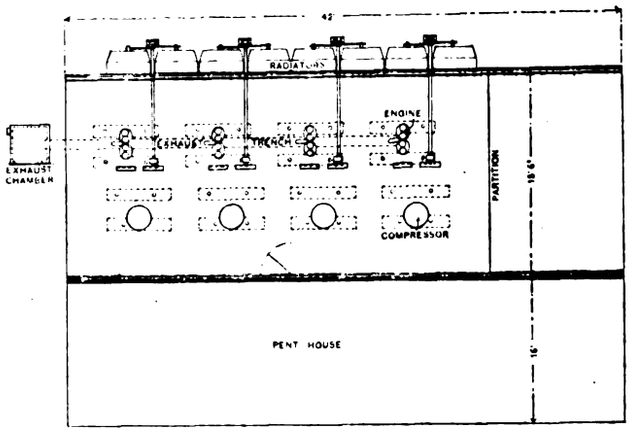

FIG. 9.—LAY OUT OF COMPRESSING PLANT.

it will be seen that these vanes are inclined downward, with one edge resting against the corrugated surface. Assuming that this cell is now filled with the electrolyte, and the plates are connected to a source of current, the water in the electrolyte will be resolved into its constituent gases, hydrogen and oxygen. The whole system is submerged in the electrolyte. Oxygen bubbles will form on the positive plate and hydrogen on the negative. These bubbles on leaving their plates are deflected back by

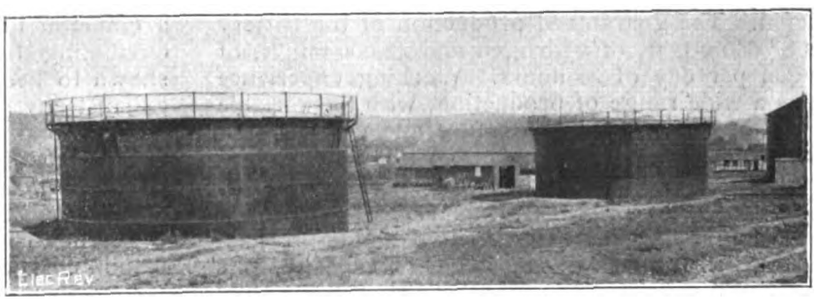

FIG. 10.—GAS-HOLDERS.

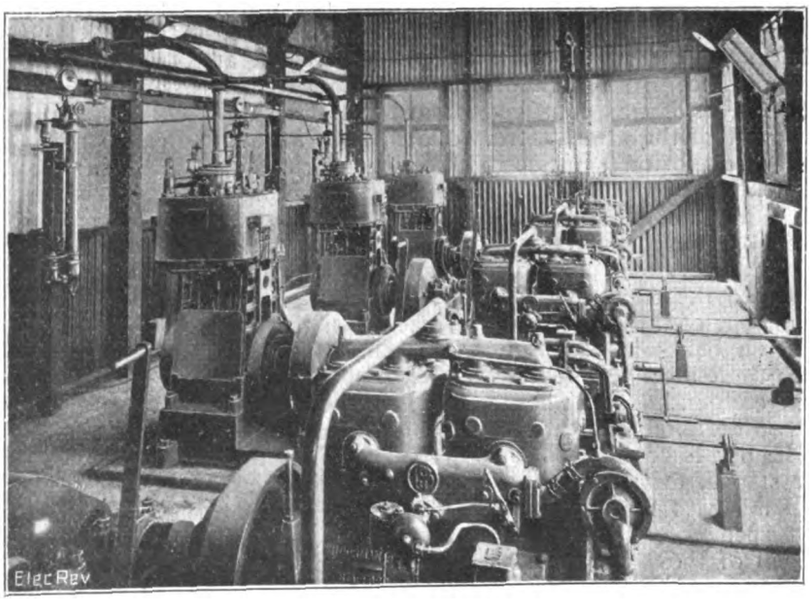

FIG. 11.—GAS COMPRESSING PLANT.

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the glass vanes, and their natural tendency to rise is accommodated by the corrugations previously referred to. They pass along these and find themselves in the respective chambers formed by the rubber joint (*b*), whose lower edge is some inches below the level of the top vane. These chambers have each a port, opening into one of the two passages (*f*). It will be evident that numbers of these cells may be bolted together, with insulated bolts, to form a multiple system, the passages (*f*) thus becoming automatically manifold pipes. Each plate (*a*) has one face connected through its port (*j*) to one passage (*f*), and the other face connects in the same manner to the remaining passage (*f*). It follows that gases formed on these faces will find their way only into the passages with which they are connected. They then pass along them to separators, seen on top of the cells (fig. 7). There any entrained liquid is separated and returned to the cells. From them the gas flows to the purifiers. These purifiers consist essentially of a platinum wire coil, surrounded by a mass of platinised fibre, the whole being kept at bright-red heat by a suitable current. The gas, in its passage through this mass, is relieved by combustion of its impurities, mostly oxygen or hydrogen in each case. By this means its purity can be raised if necessary, above 99.7 per cent.

The make-up water is distilled, in a still supplied with warm water from the main engine jackets, and about 750 gallons per day is normally required. The caustic soda remains unaffected. The guaranteed production of the battery was 84,000 cu. ft. of hydrogen and 42,000 cu. ft. of oxygen per day of 20 hours. Working experience shows a wide range of production, with the variable factors of electrolyte temperature and current density. Normally efficiency grows with increment of current density, but there are several limiting factors.

Gas-handling Group.—Gas-holders.—The purified gases flow by 4 in. mains to two single-lift gas-holders, fig. 10, each of 20,000 cu. ft. capacity. As the sub-soil consisted of coarse gravel, and the total loading was not more than 1,500 lb. per sq. ft., the water tanks were erected without the usual concrete foundations. No trouble was experienced on this score. Provision was made for turning the warm circulating water from the main engines into these tanks in freezing weather. They were erected at some distance from each other and from adjacent buildings, as it was considered that the sudden displacement of the atmosphere, following on a bomb or shell explosion sufficiently close, might lead to the involuntary release and ignition of the very light and highly inflammable gas. This view was confirmed by subsequent experience elsewhere.

Compressors.—From the gas-holders, the gases are led to the compressor-houses, fig. 11. The arrangement of these is similar for each gas, the only variation being in the number of compressors, of which there are five in the hydrogen house and four in the oxygen house. These compressors were made by Brotherhood, and are capable of delivering 20 cu. ft. per hour at 2,500 lb. per sq. in. They have four stages, driven from a single-throw crank, and are similar to those employed for compressing air for torpedoes.

Each of these compressors is mounted on a bedplate with a 35-B.H.P., 4-cylinder petrol engine, and is connected through a clutch and reduction gear. This is, of course, not an ideal drive, but as previously referred to, everything had to be sacrificed to speed of erection and the utilisation of existing and available plant. The compressing of these attenuated and inflammable gases presents some problems. Valves, pistons, piston-rods, and packings must all be of suitable materials and maintained in a state of the utmost efficiency. This means frequent overhauling. Matters are further complicated by the necessity of preventing oxygen from coming into contact with lubricating oils. A solution of pure castile soap is recommended for lubrication of those moving parts of the compressor which come into contact with this gas. To facilitate overhauls the layout shown in fig. 9 was adopted. This permits of a complete compressing unit being withdrawn from service into the repair shop, and a fresh one put into its place within 30 minutes. with the aid of a 2-ton overhead traveller. To facilitate this all gas and water connections to the unit have a rubber-

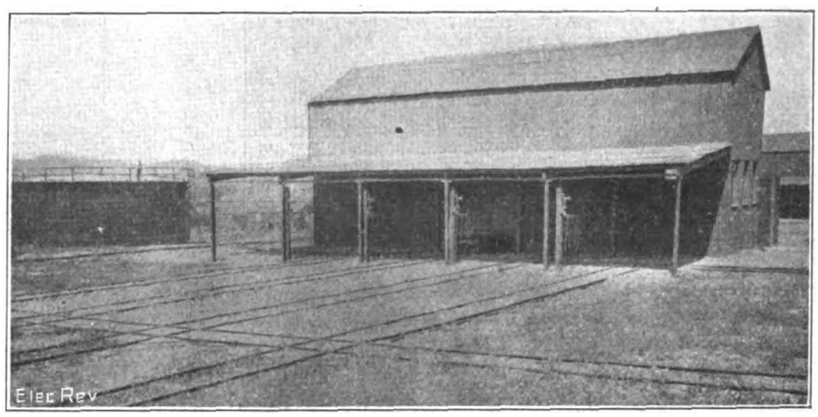

FIG. 12.—TUBE-CHARGING BENCHES AND TRACKWORK.

hose insert fastened with clips. Petrol is piped from a common tank, placed outside, to each set. The circulating fans for the radiators were placed as shown to keep down temperature and dust in, and exhaust any gases outward from, the engine room. The method of silencing the engine exhausts was the same as that employed for the main engines, for the same reasons. The general arrangements ensured the absence of personnel and repair work from the engine room under working conditions, only the man in charge of the shift having reason to be there.

Charging Arrangements.—The compressed gases are conveyed in $\frac{3}{8}$ in. bore, No. 8 gauge, hard-drawn copper piping to the tube-charging benches. These are seen in fig. 12, which also shows the system of turntables and trackwork adopted to permit of continuous charging and handling of gas-tubes, on special trucks capable of holding six tubes, each averaging 260 lb. in weight.

The author has been responsible for the design and erection of this plant, using only military labour.

Gattie Clearing-house Scheme. — The Departmental Committee, presided over by Sir Fortescue Flannery, that inquired into Mr. A. W. Gattie's proposal for a goods clearing house for London is unable to recommend its adoption. The report issued on December 23rd states that even at pre-war figures it might cost 300 million pounds if applied to the whole country. At present-day costs the outlay would be much greater, says the report, which is addressed to the Minister of Transport, and the committee is of the opinion that it cannot recommend such an expenditure of public money. This is only one of the many good reasons why the scheme is disapproved by the committee of inquiry, which, however, considers that the container system has undoubted advantages. The necessity for an improvement in railway terminal arrangements is recognised by the committee, which hopes that benefits will be derived from the institution of a Ministry of Transport.

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ENGINEERING ON BOARD SHIP.

In the course of his presidential address before the JUNIOR INSTITUTION OF ENGINEERS, on "The Influence of the War on Engineering," Sir E. H. Tennyson D'Eyncourt, K.C.B., M.I.N.A., said that there had never been any period during which the work of engineers had been of equal importance or been more indispensable to the community than during the great war, and it would be equally important during the period of reconstruction, and the later period of increased production which must follow, if the British Empire was to continue to prosper. They had learnt a great many things from the war, and were in a splendid position to take advantage of those lessons, if they took care to utilise the knowledge so gained in the proper way. In the next few years the engineers of this country would be called upon to play a part which might be a deciding factor in the future prosperity of the country.

In this connection there was a danger which they should be especially upon their guard against, and that was that with the tremendous shortage of all sorts of manufactured articles at home, whether great or small, this great home demand would keep their own industries well occupied for a considerable number of years; if they were not careful to foster their foreign trade they would lose the foreign market. It was, therefore, doubly incumbent upon them to increase production, so as to be able to meet as far as possible demands from abroad, and in this manner to retain the foreign markets, of which they would be in great need within a certain number of years.

All who were concerned with industry, of whom the engineers of this country were probably the most important body of all, must bend their minds to the task of producing a condition of stable equilibrium in labour. They should all endeavour to exchange views with the actual workers in the shops and try to arrive at a friendly understanding between those in authority and those who were working under them. The young men should take great pains to find out the point of view of the workmen and all concerned. Only in this way, by friendly interchange of views and a knowledge of what both sides were thinking, would they arrive at an understanding and make it clear that the prosperity of all was intimately bound up together.

A few years before the war, Sir Charles Parsons had tackled the problem of combining the desired high speed of revolution of the turbine with the more efficient slow-running propeller by means of mechanical gearing, and the geared turbine design was adopted for destroyers, light cruisers, patrol vessels, and battle cruisers in quick succession, with most gratifying results. For some time past it had been the recognised type of machinery for all classes of warships, and it had proved itself to be suitable in all respects. Never, perhaps, had such an important step in machinery development made such rapid strides. In some of the destroyers they obtained a propulsive coefficient—that was, the ratio of efficient to indicated horse-power—as low as 40 per cent., whereas when they adopted the geared turbines they obtained a propulsive coefficient as high as 60 per cent. This meant that they could obtain either a greater speed with the same power, or obtain the speed which would formerly have taken a much greater power with proportionately less power. This, therefore, gave an immense military advantage to the design. This very marked improvement was to a somewhat less extent also apparent in the larger ships.

So far as they knew, no enemy ship was fitted with mechanically geared turbines, but some of them had been fitted with the Föttinger transformer. The loss of power in the Föttinger gear was 8 or 9 per cent., whereas the loss in the Parsons gear was only 1 or 2 per cent.

Another form of transmission which had come into prominence was the electric transmission which had been adopted by the United States Navy with considerable success, and on a smaller scale in our own Navy. It was being considered with much interest, as although it would appear to offer few advantages and some decided disadvantages for full power working (considering the success they had had with mechanical gearing), yet the advantages for low-pressure working might (if substantiated) prove of considerable value and well worthy of trial by ourselves, especially when it was borne in mind that warships steamed for perhaps 80 per cent. of their time at sea at a small fraction, say one-tenth, of their full power, so that nine-tenths of their power might be regarded as reserve to be used only in emergency. Economy at such powers became of very high importance.

In the largest class of submarines, the K boats, to obtain a surface speed of 24 knots they had to provide steam turbines, as it was impossible to get the 10,000 H.P. necessary with Diesel engines, which had been adopted for the surface drive in all previous submarines. The boats were a great success. It was interesting, in this connection, to point out that besides the steam turbines for full speed on the surface, the K submarines had the electric drive under water, and also a Diesel engine for use just before diving or just after coming to the surface. The transmission from the Diesel engine was through the electric motors, so that these vessels had not only geared turbines for the steam drive, but they also had electrical transmission with a Diesel engine and an electric battery drive when under water, and were therefore quite unique vessels in every way; they were 5 or 6 knots faster on the surface than any vessels the Germans produced.

Great economy had been effected by the use of oil fuel for the Navy during the war. It had been pointed out that it was a most uneconomical thing to burn oil fuel in a boiler for the purpose of steam raising, as very much greater economy could be achieved by burning oil fuel in internal-combustion engines. But, unfortunately, it had been found quite impossible with their present knowledge and experience to design internal-combustion engines burning heavy oils, which would meet the requirements of power, space, and weight demanded in naval ships. But the actual saving in labour by the use of oil for the Navy as against coal resulted in freeing approximately 150,000 men, who would otherwise have been engaged in dealing with the coal, from the time it was won at the face in the pit to the time it was shovelled into the furnace.

During the war more than 400 vessels burning oil fuel only in their boilers, and with an aggregate of some 12 million H.P., were completed for H.M. Navy.

It was up to the engineers of this country to make such improvements in internal-combustion engines as would enable propelling machinery of high power and of weight comparable to that of the present marine types of steam engines to be adopted. This would effect an enormous reduction in the amount of fuel required for the same horse-power. The actual annual production of crude oil in the whole world amounted to only some 75 to 80 million tons per annum, against 1,250 million tons of coal. If the 80 million tons of oil was taken as the equivalent of 100 million tons of coal, the amount of oil produced was still only one-twelfth that of coal. It was evident, therefore, that oil should be used as economically as possible.

Advance in auxiliary machinery was indicated by the recent efforts to adapt rotary driving to the requirements, a noteworthy example being the closed-feed system evolved by Messrs. G. & J. Weir, from which most promising results were expected, combined with a decided diminution in the corrosion of boiler tubes.

In the construction of internal-combustion engines, it was unfortunate that in nearly all cases they were manufactured in this country under foreign licences, necessitating their being always somewhat astern, but it was hoped that this reproach would not long continue, as there must be ability in this country to avoid such deplorable dependence upon the foreigner in such an important industry. It was a stigma that ought to be, could be, and must be removed.

The problem of employing Diesel engines for high-powered installations was a difficult one, requiring considerable thought and investigation. The successful low-speed installations in merchant ships only developed 400 to 700 H.P. per cylinder, and the number of cylinders necessary for a large aggregate power was so considerable as to make the arrangement in a ship almost, if not quite, impracticable. Further, the weight of such installations, being as much as 250 lb. per H.P. or more, was quite prohibitive in any type of warship.

To develop their intellectual resources it was necessary to devote great attention first to education and secondly to research. A point he wished specially to emphasise was that in the education of young engineers the study of psychology and human nature should not be overlooked. To obtain a good result it was absolutely necessary to understand one another and to work all together for the common good.

THE EDISWAN "POINTOLITE" LAMP.

THE "Pointolite" lamp, which was first evolved in the laboratories of the Edison Swan Electric Co., Ltd., in 1915, has undergone important developments during the past four years, and several new features were demonstrated at the meeting of the Illuminating Engineering Society on November 25th. The interest attaching to this wholly British invention, and the importance of the applications for which it is suitable, have led us to bring it before our readers in its latest forms, and we recently had the pleasure of investigating the subject at the company's works at Ponder's End, under the guidance of Mr. P. Freedman, who is conducting the researches and experiments in progress in this connection at the Ediswan Laboratory.

For the benefit of those who are not acquainted with the "Pointolite" lamp, we must explain that it is an arc lamp with one or two tungsten electrodes, the arc burning in a partial vacuum within a glass bulb similar to that of an incandescent filament lamp. The lamp in the smaller sizes has three terminals, and is held in a special type of bayonet holder, which ensures its being inserted in the correct position. To strike the arc, the ionising power of a heated body is utilised; by means of a push-button switch the circuit through the ioniser is first closed, and when the ioniser attains the temperature at which it comes into operation, the push-switch is released, and the current leaps across the gap between the positive electrode—a spherical globule of tungsten—and the ioniser. Practically the whole of the light is emitted from the globule of tungsten, which becomes brilliantly incandescent; the light is nearly pure white in colour,

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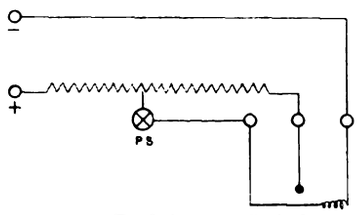
and as the globule is (in the 100-C.P. lamp) only about 2 mm. in diameter, it is practically a point source (hence the name) admirably suited for optical projection. Fig. 1 is a diagram of the connections, and fig. 2 a view of the 100-C.P. lamp, which has been on the market since 1915.

In order to adjust the length of the arc and to avoid undue wear on one part of the ioniser, the tungsten electrode is mounted on a thermal expansion device which moves the globule along the ioniser. Owing to the characteristics of the arc, a ballast resistance is necessary, as shown in fig. 1. The bulb is filled with inert gas at a pressure of about 5 in. of mercury. In the earlier lamps the ioniser took the form



P S, Push-button Switch.
FIG. 1.—DIAGRAM OF CONNECTIONS (2-ELECTRODE LAMP).

of a thick filament composed of tungsten and refractory metallic oxides supported by two stout wires, and trouble arose owing to the tendency of this filament, when repeatedly switched on and off, to buckle and disturb the conditions. An important improvement was made by substituting a tungsten wire filament, wound into a small spiral at one end, with the ionising tube slipped over the straight portion, as in fig. 2. The ioniser is heated by the filament, the arc is struck on the spiral, and the tungsten electrode then moves away from the spiral to a position opposite the ioniser. The elasticity of this arrangement has completely removed the trouble, and greatly increased the life of the lamp, which is from 500 to 1,000 hours. This improvement, developed in 1916 and 1917, put the lamp on a satisfactory commercial basis. The next step was to develop a lamp of higher candle-power, and this was rendered possible by the new ioniser, together with the use of a larger tungsten globule. The latter was essential, as the parts must be in proper proportion; difficulties were met with, but were successfully overcome, and now globules of pure tungsten can be made of any size desired. In fact, the large globule is regarded as the secret of success in producing the high-candle-power lamp. Another departure was the use of two tungsten electrodes for the arc, and all the larger lamps are constructed on this principle; the arc is struck between the ioniser and a small globule, and then a new arc is struck between the latter and a larger globule, which is then the positive electrode—the smaller globule being first positive to the ioniser but finally the negative electrode. The three-electrode lamps having

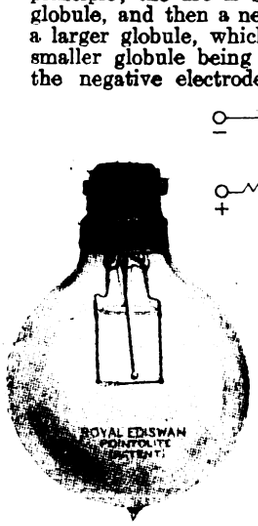
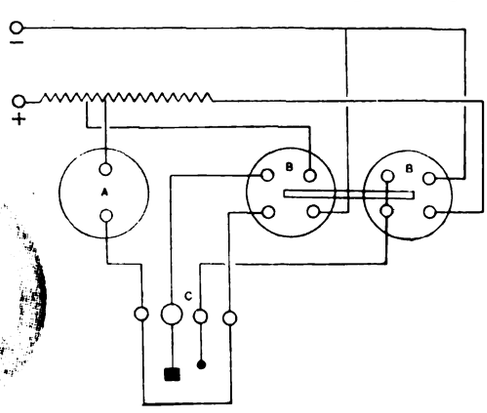


FIG. 2.—POINTOLITE 100-C.P. LAMP.



A, starting switch; B, B, change-over switches; C, lamp terminals.

FIG. 3.—DIAGRAM OF CONNECTIONS (3-ELECTRODE LAMP).

four terminals, it was necessary to substitute an Edison screw holder for the bayonet type, to make room for the four concentric contacts. The arc between the two electrodes is made possible by the double ionising action which takes place—that due to the emission of electrons from the hot negative electrode, and that due to the atomic collisions in the gas.

The first 500-C.P. lamps had positive electrodes of thin tungsten plate, which were quickly perforated; the development of a method of making large thick plates overcame this difficulty. The plate is square in shape, but the negative electrode is a large spherical globule.

The 500-C.P. lamp was introduced in 1916 and 1917. Further experimental work was carried on in 1918, leading to the production of a lamp of 1,000 C.P. in 1919, working on the same lines as the 500-C.P. lamp.

The life of the lamp is limited by the following factors: the derangement of the ioniser; the gradual curvature of the plate electrode; the flattening of the globule; and the blackening of the bulb. The first of these has been mastered, though in the case of the 100-C.P. lamp the deposit of tungsten on the ioniser and the corresponding wastage of the globule have to be reckoned with. The second and third cannot be altogether obviated, but the fourth has been remedied by an ingenious invention of Mr. Freedman's—a glass cup of a particular shape and size, which is welded to the inside of the bulb over the arc, the lamp being fixed bulb uppermost. The connection current of hot gases from the arc rises into the centre of the cup and descends down the sides of it, forming a deposit on the wall of the cup but leaving the glass of the bulb perfectly clean in the case of the large lamps, and nearly as clean in the 100-C.P. lamp. This device doubles the useful life of the lamp, which in the case of the 500-C.P. lamp averages over 500 hours. It also checks the volatilisation of the electrodes by keeping them surrounded by an atmosphere saturated with tungsten vapour.

Not only has 1,000 C.P. been successfully attained; a lamp of no less than 4,000 C.P. is now being developed, with a view to its substitution for the carbon arc in bioscope projectors, a most important application. A fixed-focus lamp has been produced during the past year, in which the positive electrode is hemispherical in shape, with the convex side opposed to the ioniser; the electrode in this case remains stationary. The flat side presents a perfectly uniform disk

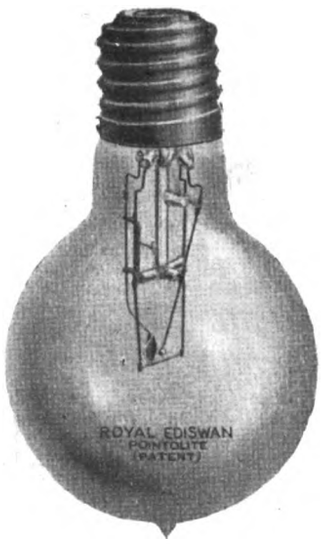


FIG. 4.—POINTOLITE 500-C.P. LAMP.

FIG. 5.—FIXED-FOCUS LAMP.

of light, and is 1 cm. in diameter. This lamp has been found extremely useful at the National Physical Laboratory as a pyrometric standard, the pyrometer being focused on the disk. The temperature of the latter can be varied, by adjusting the current, from a dull red to brilliant incandescence, and thus, once the lamp has been calibrated, the readings on an ammeter give a perfect measure of the temperature.

The minimum practicable voltage across the arc itself is 45 volts, and the "Pointolite" can be worked off nay D.C. circuit above 50 volts; but lower voltages have been rendered possible by a recent improvement, bringing the minimum arc voltage down to 15 volts, so that a portable 100-C.P. set can be made, working with a 30-volt storage battery.

The lamp alone (without the external resistance) consumes 0.65 watt per candle in the case of the 100-C.P. lamp; 0.5 W./C.P. at 500 C.P.; and 0.42 W./C.P. at 1,000 C.P. The last-named lamp takes 7 amperes for starting up, 3 amperes for the first arc, and 8 amperes when fully in operation.

The candle-power of the "Pointolite" depends on the nature and pressure of the gas in the bulb, the length of the arc, and the size of the electrodes; it follows a law of the form (for 100 C.P.) $C.P. = K(I - C)^n$; where I is the current in amperes, C is a constant (about 0.2 amp.), $n = 1.8$, and K is a constant.

It should be observed that the candle-power mentioned, being approximately the same in all directions, is practically the mean spherical C.P. The intrinsic brilliancy of the electrode is about 16,000 C.P. per sq. in. in the 500-C.P. lamp, and 12,000 in the 100-C.P. lamp, but the latter can be run up to 60,000 C.P. per sq. in., when the globule is practically molten.

The bulb of the 1,000-C.P. lamp is 6 in. in diameter. An important feature of the "Pointolite" is that it can be used in a deep parabolic reflector, utilising an enormous proportion of its flux of light, to produce a parallel beam. Used for projection in the ordinary way, the light utilised is only that which falls on the condenser of the projector, but by placing the arc at the focus of an ellipsoidal reflector, and masking the direct rays, a converging beam can be obtained without using a condenser. During the war the 100-C.P. fixed-focus lamp was largely used with a parabolic reflector for signalling purposes. We have already mentioned the application of the "Pointolite" to the bioscope and other projectors; it is also suitable for microscopy, surgery, galvanometers and oscillographs, the shadow-projection of gauges, photography, colour-matching, and theatrical purposes.

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CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Appointments in India and Burma.

I have read with interest the various letters on the above subject, and the letter signed "G. Y. M." represents my views.

To it, however, might be added, that, as it will take 20 years or more of careful living to make one's independence one should not go out to the East much older than 30 years in the first instance.

Some of your readers may have heard of "The Call of the East"; I can assure them it is a real one. I am at present in England, and shall be glad to find myself shortly in the East again; as Kipling says: "Ship me somewheres east of Suez."

The life of the East is a much more luxurious one than that of the West. A large house, a number of servants, and a table equal to that of the best London hotels, are what one usually gets after a few years out there.

The social life is also very attractive, and on a higher plane than many electrical engineers can aspire to in England.

The general opinion prevalent in England of the ill-effects of the heat is a very exaggerated one, and with plenty of changes of clothing, electric fans in office and home, and the easier time one usually obtains at business, there is no valid reason why with occasional visits to a hill station, one should not keep as fit, if not fitter, than one keeps in England.

It is, however, quite a good thing to come to England for, say, six months in every three years. It not only tones one up somewhat, but it forces one to appreciate the many advantages of living in the East, which one would perhaps otherwise not do to the extent that the circumstances merit.

Gymkhana.

England,
December 22nd, 1919.

The Fuel of the Future.

I do not profess to be an expert on the above subject; by that I mean that I cannot trot out data with such fluency as Mr. Klemens displays. I am not a "gas man," but have been engaged for a number of years in experimenting with a view to retrieving some of that 80 per cent. waste heat you mention in your article on fuel economy.

Instead of attempting to prove that you obtain more B.TH.U.'s by obtaining only 20 per cent. effective energy from each pound of coal than the gasworks is capable of, why does not Mr. Klemens approach the question from a broad-minded point of view?

In his article on "The Fuel of the Future" he entirely leaves out, excepting coke and tar, the valuable by-products obtained from coal. We have to consider the question from an economic basis; thus, is it more efficient to the community to burn coal as we now do in producing electricity, or to pass it first through a sieve, as it were, as is done in a gasworks, extract its by-products, and with the remaining gas generate your electricity? Let us have a discussion on these lines, for I am convinced where one gas exponent is, figuratively, trying to tear out the eyes of an equally perfervid electrical expert, progress will always be very slow, *and figures merely evasions*. Only by an exchange of ideas can we eat into that deplorable figure—80 per cent.

Economy.

A Scandalous Waste of Coal.

Travelling from Canterbury by the S.E. & C. Railway on Wednesday night, the 10th inst., I saw a primitive method of burning coal, which would have been a discredit to the ancient Britons had they used coal. To keep the stand-pipes (for supplying the locomotives with water) from freezing, one, and sometimes two, braziers were in use. Each measured about 15 in. wide, 15 in. deep, by 2 ft. long, and each had a large coal fire in it weighing perhaps 1 cwt. The heat from these was chiefly warming the air of Kent, but at times the wind carried a small fraction of it towards the stand-pipes, and some reached them by radiation. If the stand-pipes were encased with sheet iron, leaving a 2-in. space all round, closed at the bottom, with a suitable outlet at the top, and the flue from a small slow combustion stove were connected to the lower end of this casing, probably one-fifth the quantity of coal would more effectively prevent the freezing. The amount of coal burnt by these large braziers throughout Great Britain during a windy, frosty 24 hours can be imagined.

Alfred S. E. Ackermann.
B.Sc. (Eng.), M.Cons.E., A.M.I.C.E.

London, S.W.
December 19th, 1919.

[*Electric* railways do not require stand-pipes.—EDS. ELEC. REV.]

Merchant Ships as Generating Stations.

The determining factors in ship design are tonnage (or carrying capacity) and speed, only sufficient power being provided to propel the ship at a pre-determined speed at the least cost per ton-mile. Ships with large carrying capacity and great bulk have often only moderately powerful engine units. Thus a ship of 5,000 tons would have engines indicating about 1,500 I.H.P., and would probably cost anything between £100,000 and £120,000, according to age and general condition, and would be capable of an output of 1,000 KW. (approximate). Thus the capital sunk for such an output would be out of all reason, especially as the greater part of the vessel would have no earning capacity. Again, marine engines would be unsuited for the generation of electricity, being very heavily built and of slow speed, the latter necessitating the use of a multipolar alternator of large dimensions half the diameter of which would most likely be too great for the space between the line of shafting and ship's bottom. Marine boilers are designed for hand firing and the fitting of mechanical stoking gear would prove rather a costly matter. Engines are also unsuited for use with superheated steam and are ungoverned. One can hardly understand a person considering such a scheme seriously. Such a vessel moored in a dock or harbour would be liable for dock or harbour fees. Coaling would be costly, and all ashes would have to be transported outside the dock area for disposal. There would also be liability to damage from other shipping and the consequent interruption of supply. Of course, a smaller and higher powered vessel could be obtained, such as an old turbine-driven destroyer or torpedo boat, where the I.H.P. per cu. ft. of capacity of hull would be greater. However, even in this class of craft the machinery would be unsuited for the generation of electricity, as the turbines (unless of geared type) would be less efficient than those of the higher speed type as used in generating stations ashore. By far the better plan, where it was essential to have the generating unit afloat, would be to have the engines erected in a barge after the style of the floating station recently offered for sale by H.M. Government, which consisted of two turbine-driven alternators and D.C. generators, together with boilers and necessary auxiliaries, in fact, a complete floating generating unit. High-speed turbines could then be used, keeping the space per kilowatt generated down to a minimum and the efficiency could be made to compare favourably with any generating station ashore of the same capacity.

L. P. Morinan.

Cardiff.
December 29th, 1919.

Combined Lighting and Ignition Set.

I have to thank you for inserting my letter of the 5th inst., and for the ample apology to The Rotax Motor Accessories Co., Ltd., contained in your footnote.

With regard to the letter from Messrs. C. A. Vandervell and Co., Ltd., in your issue of the 19th inst., the ignition dynamo made by The Rotax Motor Accessories Co., Ltd., is essentially different from that described in the 1910 patent mentioned. I have taken the advice given and searched the patent files, but beyond noting that our "rival" is prolific in compiling a certain type of combination patent, I have found nothing helpful. I am glad to see that the type described has been abandoned in favour of the type made by Messrs. Rotax.

With regard to the kind offer of information, I am always glad to acquire knowledge, and any information given me will be gratefully received—and acknowledged.

For the **Rotax Motor Accessories Co., Ltd.,**
H. F. PARISH.

London, N.W.
December 22nd, 1919.

THE LAY-OUT OF SWITCHGEAR.—Mr. W. J. Webber asks us to point out that his name has been incorrectly quoted by our correspondents as "A. J. Webber."

Representation of British Firms in Norway.—We learn that there is a strong feeling in Norway in favour of dealing with agents resident in Norway in preference to agents resident in one of the neighbouring countries. The Norwegian Chamber of Commerce, London, Inc. (Kingsway Chambers, W.C. 2), has been asked to bring the matter to the attention of British manufacturers and exporters. It has sent us a copy of a circular issued in English by the various Agents' Associations in Norway, on "The Securing of Sole Agencies in Norway to Norwegians," the views expressed in which are endorsed by important trade associations. Obviously the interests of manufacturers and exporters should be better served by an agent in the importing country than by one whose headquarters are in an adjacent country. It is reasonable to assume that the former is naturally better acquainted with the requirements and tastes of his country, and with the purchasers themselves. Furthermore, he is more likely to have an established organisation properly covering his district, and will regularly work his ground.

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BUSINESS NOTES.

The "Electrical Review" Index.—As it is still necessary to effect every possible economy in paper consumption, the index to Vol. 85 of the ELECTRICAL REVIEW, which will shortly be printed, will be supplied only to those who, through the post, specially apply for it. To such it will be supplied for 3d., post free. Any reader or advertiser at home or abroad who requires a copy for binding, or for other purposes, is asked to make early application therefor, to the publisher, ELECTRICAL REVIEW, 4, Ludgate Hill, E.C. 4.

Mining Safety Lamps.—The *London Gazette* for November 23rd publishes an order made by the Secretary of State, Home Department, approving of a number of types of safety lamps, including the "Ceag" electric safety lamp bull's-eye type (for officials, or in case of emergency only).

Census of Production, 1921.—The Board of Trade has issued an order determining that a Census of Production shall be taken in the year 1921, limited to certain trades, including the following :—

Coal and ironstone mines under the Coal Mines Regulation Acts.
Coke works at collieries.
Iron mines under the Metalliferous Mines Regulations Act, and iron quarries.
Iron and steel trades (smelting, rolling, and founding).
Engineering trades (including electrical engineering).
Shipbuilding and marine engineering trades.
Cycle and motor trades.
Railway carriage and wagon trades.
Copper, brass, lead, tin, zinc, and other metal trades (except the gold and silver refining trade.)
Chemicals, coal tar products, and drugs trades.
Building and contracting trades.
Brick and fireclay trades.
China and earthenware trades.
Gas undertakings.
Electricity undertakings.

New Belgian Electrical Company.—La Société des Cableries et Trefileries Liegeoises is the name of a new company which has lately been formed at Renory-Angleur, near Liege, with a capital of 1,200,000 fr. (nominally £48,000), to manufacture cables and wire.

New French Electrical Company.—A new company has lately been formed in Lyons, with a capital of £40,000 and the title La Société Nationale d'Entreprises Electriques.

Bradford Corporation Contract for Car Motors Cancelled.—The Bradford Corporation placed an order with Messrs. Brown, Boveri & Co., Ltd., in 1915, for the supply of 200 car motors, which the contractors subsequently were unable to fulfil on account of conditions arising out of the war. It has now been mutually agreed, as the result of friendly discussion between the parties, that as the contractors cannot guarantee delivery of the motors by next summer, the work shall not be proceeded with. The Tramways Committee has accordingly passed a resolution recommending that the contract in question shall be cancelled by the mutual consent of the parties.

A Birmingham Celebration.—At the Queen's Hotel, Birmingham, on December 19th, Messrs. J. H. Tucker & Co., Ltd., manufacturers of tumbler switches, accessories, and switchgear, entertained their chiefs of departments and outside representatives to dinner. It was the first function of the kind given by the firm since the war, and was really a celebration of the completion of a wonderful record of war work and of the resumption of peace activities on a scale which already eclipses its pre-war activities. The function provided a pleasing manifestation of the good relations prevailing between Messrs. Tucker and their staff. Members of the staff present included the following :—Messrs. H. E. Bateman (production manager), W. J. Line (chief of technical department), J. J. Evans (cashier), G. T. Baker and E. J. Brothers (London representatives), G. E. Gibson (South-Coast representative), S. G. Smith (Scottish representative), and G. L. Thorburn (New Zealand representative). Mr. W. Y. Smith (superintendent of Assembly) was absent owing to illness. The following were among the guests :—Lord Torphichen, late Director of Fuse Production, Ministry of Munitions; Mr. F. R. Wade, late Inspection Department, Woolwich Arsenal; Mr. N. B. Rosher, Inspector Munitions Areas, Ministry of Munitions; Mr. R. D. Summerfield, Inspector Munitions Areas, Ministry of Munitions; Mr. H. Evans, Ministry of Munitions; Mr. J. R. Baxter (Baxter and Impey), past president, Electrical Contractors' Association; Mr. H. E. Walker (Walker Bros.), chairman (Midland Section), Electrical Contractors' Association; Mr. E. A. Reynolds (Reynolds and Bradwell), honorary secretary, Electrical Contractors' Association. Mr. J. B. Tucker, joint managing director, presided, and he was supported by Mr. T. R. Martin, his energetic colleague in the managing directorship; Mr. C. F. J. Tranter, director; and Mr. J. Tucker, the father of the founder, and the Grand Old Man of the firm. During the evening, Mr. Tucker proposed, and Mr. Tranter seconded, the toast of "The Visitors," which was responded to by Lord Torphichen and Mr. Walker. Mr. Wade and Mr. Rosher proposed and seconded respectively, "The Electrical Industry," and Mr. Baxter replied. "The Firm" was given by Mr. Bateman, seconded by Mr. Baker, and supported by Mr. Smith. Mr. Martin responded. Finally, the health of the chairman, Mr. Martin, and Mr. Tranter, were proposed by Mr. Wade and Mr. Evans, and responded to by all three. In the course of the speeches it was mentioned that during the war Messrs. Tucker manufactured for the Government two million articles of various special kinds for war purposes. This was in addition to the production, as far as circumstances permitted, of their normal products. When the question of the supply of high-explosive fuses became acute, Messrs. Tucker were amongst the earliest invited to make them, and those in authority testified to the excellence of their workmanship and finish. In the references that were made to the future of the industry, stress was laid upon the development that could be looked forward to when the production of power was centralised; the speakers emphasised the severity of foreign competition. Germany, it was pointed out, would rehabilitate herself. She could at this moment produce electrical goods at a price at which we could not even buy the raw material. American and Japanese competition added to the difficulties of the position. One or two speakers advocated Protection as the only possible solution of the problem, with preferential treatment for the Colonies. Despite these warnings, however, there was a ring of confidence in the speeches, suggesting that the resource, initiative, and energy of the firm would enable it to surmount all difficulties.

On the previous evening, Messrs. Tucker gave a Christmas social and welcome home to demobilised employés. Some 70 of the staff were in the Army, and seven made the supreme sacrifice. The social was held in the works canteen, which was divided into two sections—one for a whist drive and the other for a dance. In addition, a musical entertainment was given. The artists were all employés of the company. Mr. J. B. Tucker occupied the chair, and Mrs. Tucker distributed the whist and dancing prizes, as well as those won in the recent air-gun competition. A vote of thanks was passed by the 500 members of the staff and works present to Mr. and Mrs. J. B. Tucker for their presence.

Plant for Disposal.—Leeds Corporation Tramways and Highways Committee invites offers for about 150 tons of worn-out tramway rails, a quantity of scrap manganese tramway points and crossings, one hand crane on truck, and three second-hand smith's bellows. For full particulars see our advertisement pages to-day.

The Moulders' Strike.—It was stated on Tuesday that new efforts were being made to bring about a settlement of the above dispute, which has now lasted for three months, and is most seriously hampering various branches of the engineering and allied trades, 100,000 employés in which have been thrown out of work, in addition to the moulders themselves. The assistance of the Prime Minister was being invoked, and the Minister of Labour was returning hurriedly from Scotland.

Railway Rates Advance.—The Ministry of Transport has publicly announced the alterations of rates for goods traffic on the railways, which take effect as from January 15th, 1920. The advances vary from 25 per cent. in the case of coal, coke, and patent fuel, to 100 per cent. for small parcels conveyed by merchandise train. The provision of trucks for traders advances by 50 per cent., with a minimum charge of 9d. per ton. A new schedule of charges is issued for the detention of wagons and sheets.

Engineering Profit-Sharing Scheme.—*The Times* states that a profit-sharing scheme has been set in operation by MESSRS. GEORGE RICHARDS & CO., LTD., machine tool makers, Broadheath, Altrincham, by which the whole of the 1,000 employés are practically admitted into co-partnership and given an equal share in the profits of the concern. The scheme, after making provision out of the profits for a deduction of 7½ per cent. on the present day valuation of the firm's business, allocates the profits on the year between the shareholders and the workpeople, and it is anticipated that the addition to the earnings of the latter will not be less than 50 per cent. Employés may invest the bonus in shares, upon which the directors guarantee a payment of 7½ per cent.

Rising Prices of Electrical Plant.—An illustration of the difficulty of giving a correct estimate owing to the rapid rise in the price of materials, &c., is afforded in the case of Falkirk. Recently Mr. W. W. Lackie, of the Glasgow Corporation Electricity Department, reported regarding the proposal of Falkirk burgh to obtain further borrowing powers to the extent of £30,000 for new plant. To the last meeting of the Town Council, Mr. Lackie wrote intimating that in his statement showing the estimated additional capital expenditure, he said that a 1,500-KW. alternator set complete, would cost £5 per KW., or £7,500. He had just seen an approximate quotation for a 1,500-KW. set, and the price was given as £14,000. If it was not too late, he suggested that the Council add £7,000 to the £29,872 mentioned in his statement.

Meters for Holland.—*The Times* contained the following advertisement on Tuesday last :—"Quotations wanted for electrical meters for export to Holland in large quantities: complete descriptions, illustrations, prices, and delivery dates requested by the Technical Commercial Office, Joh. Visset, Beeklaan, 470, The Hague, Holland.

The Price of Coal in France.—The Paris correspondent of the *Times* stated on December 29th, that the coal situation was very bad. "One cannot expect to purchase a cargo of coal at much less than 430 fr. a ton (over £12 a ton at 35), which is, of course, a ruinous price for industry to have to pay."

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Christmas Entertainments, &c.—The St. Helens Cable and Rubber Co., Ltd., Warrington, and some of their employés, last week entertained to dinner the near relatives of employés of the firm who were killed in the war. The children were provided with an illuminated Christmas tree with presents of toys.

Both the Tramways Committee and their employés at Oldham were agreed that no cars should be run on Christmas Day, and instead the men held a social gathering at which they welcomed home their colleagues who had been on war service. The men had themselves raised £100, and the Committee gave an additional £75. A memorial tablet at the Mumps Depôt to fallen tramwaymen was unveiled in the morning by Councillor Cheetham, chairman of the Committee, who was accompanied by the Mayor and Mayoress, and afterwards some 450 of the men attended a memorial service at St. Mary's Church. The social gathering took place in the afternoon, and the children present received gifts.

On Christmas Eve at the Sterling Works, Dagenham, Mr. Guy Burney, managing director of the Sterling Telephone & Electric Co., Ltd., on behalf of himself and the company, presented the members of the Sterling Ladies' Football Team with medals in commemoration of their achievement in going through 1917-1918, 1918-1919 undefeated, during which period they assisted to raise some £800 for charitable objects. The men's team wound up the half-season by qualifying for the final of the Barking Hospital Cup, defeating N.U.R. by 12 goals to nil. They have reached the divisional semi-final of the London Junior Cup.

MESSRS. CHAMBERLAIN & HOOKHAM, LTD., Solar Works, Birmingham, held a staff ball on the evening of Friday, December 19th, at the Imperial Hotel, Birmingham. Some 130 members of the staff and their friends were present, many of the former having only recently returned from the fighting services. The music for a varied programme of dances was rendered by Miss Coxen's orchestra. The evening was in every way a pronounced success. Mr. W. S. Sprague, the managing director of the company, acted in the capacity of M.C.

Calendars, &c.—MESSRS. MAWDSLEY'S, LTD., of Zone Works, Dursley, Glos., have sent us a wall calendar with monthly slips for 1920. "Gladys" is obviously a favourite, for all that we said about her last week is confirmed by her adoption for a year by this firm also.

Greeting cards have been received from the STERLING TELEPHONE AND ELECTRIC CO., LTD., and the AUTOMATIC TELEPHONE MANUFACTURING CO., LTD.

From the KEIGHLEY GAS AND OIL ENGINE CO., LTD., of Keighley, we have received a wall calendar for 1920, which consists of a block of boldly printed date slips upon a stout card base in the form of one of their Imperial engines.

THE WHITE ELECTRICAL INSTRUMENT CO., LTD., of 2 to 6, Gloucester Street, Clerkenwell, E.C. 1, have sent us a vest pocket court-plaster case, with calendar for 1920 printed thereon.

A small calendar, with monthly slips, has been received from MESSRS. H. WOGAN & Co., of 71, Stockport Road, Ardwick, Manchester.

MESSRS. E. P. ALLAM & Co., of 107-109, Gray's Inn Road, W.C. 1, have issued a desk-standing calendar, with monthly slips in red and gilt framework which will brighten all around for 1920: calendar for the entire year pasted on the back.

MR. W. H. SUGDEN, of Wakering Road, Barking, Essex, has also prepared a desk calendar, with monthly date-cards.

From MESSRS. ALEXANDER HAWKINS & SONS, of 125-128, London Road, Southwark, S.C. 1, there has come to hand a wall calendar, with monthly slips below a poultry picture entitled "Queueriosity."

MESSRS. J. H. WOOLLISCROFT & Co., of New Quay, Liverpool, have prepared a calendar, with daily slips, with figuring in red, mounted on a stout card base.

MESSRS. PIRELLI, 144, Queen Victoria Street, London, E.C., have again issued one of their very serviceable wall calendars for the new year. A block of date and engagement slips, printed boldly in red, is mounted on a strong metal base. The design appearing above the block shows an aeroplane holding a Pirelli tire over a bird's-eye view of the company's works.

Trade Announcements.—MESSRS. FITT BROS. & DAVIES, LTD., of Swansea and Cardiff, have added to their mechanical engineering works an electrical engineering department, which will be devoted to general works and colliery electrical repairs and supplies. The management of the branch will be in the hands of Mr. B. T. Davies as works manager. The head office will be at 17, Wind Street, Swansea.

MR. F. C. EDWARDS has commenced business as an electrical engineer at High Street, Tenterden (Kent).

THE CANADIAN NATIONAL CARBON CO., LTD., and the NATIONAL CARBON CO., INC., have had their commandeered premises returned to them by the Government, and they are now back at Imperial House, 15-19, Kingsway, London, W.C. 2.

MR. H. B. ARNOLD has resigned his position with the "Z" Lamp Manufacturing Co., Ltd., and is commencing business on his own account for the supply of electrical accessories, &c. He desires to receive lists of A.C. and D.C. motors, switchgear, fittings, &c., at 135, Kingsway, Ponders End, Middlesex.

MR. B. E. CROW (late London representative of the Sterling Telephone and Electric Co., Ltd.), and MR. R. C. TOOGOOD (late assistant manager of the Electrical Supplies Co.), have resigned their positions with these companies and commenced business on their own account as wholesale electrical suppliers, at 15, Wardour Mews, D'Arblay Street, Wardour Street, London, W. 1.

THE BRITISH AND ALLIED ELECTRICAL AGENCY, LTD., has removed to larger offices and showrooms at Ely House, 13, Charterhouse Street, London, E.C. 1.

Bankruptcy Proceedings.—E. BOHM, electric lamp manufacturer, 5, Boxworth Grove, Barnsbury, London.—Application for debtor's discharge, to be heard at Carey Street, W.C., on January 21st.

A Municipal Electrical Loan.—We observe that the Aylesbury Municipal Council is inviting, through advertisement in the financial Press, tenders for loans amounting to £80,000, in sums not less than £5,000, for a period of 19 years, for the electricity undertaking.

Book Notices.—It is announced in the December number of the *Industrial League and Council Journal*, which completes its first volume, that commencing with January, 1920, the publication will appear monthly. The present number contains a report of the annual meeting of the Council and of other meetings held in October, including that at which Mr. Benn delivered an address on "Should Wages be Lowered?"; also of one held at the Guildhall in November, when Sir Auckland Geddes spoke on the "Industrial Outlook." There are some interesting notes on the "Apprentice Problem," setting forth the views collected before the war from educational, industrial, Trade Union and commercial organisations, and other authorities.

"*Journal* of the Institution of Electrical Engineers," Vol. LVIII, No. 286. December, 1919. London: E. & F. N. Spon, Ltd. Price 10s. 6d.—This issue contains the inaugural address by the President (Mr. R. T. Smith), and the Chairman's addresses at the following Centres:—North-Eastern (Mr. W. Cross), Irish (Mr. R. Tanham), Western (Mr. A. Ellis), North Midland (Mr. W. M. Selvey), Scottish (Mr. W. B. Hird), North-Western (Mr. J. A. Robertson), South Midland (Dr. C. C. Garrard), and a paper on "The Calculation of Tooth Reluctance: A Suggested Improvement on Hird's Method," by Mr. S. Neville.

"The M. & C. Apprentices' Magazine." Vol. 3, No. 12. Pp. 259 + xvii.—This is the Christmas number of the very able quarterly magazine published at the works of Messrs. Mavor & Coulson, Ltd., of Glasgow. The production includes a number of well-written articles of both technical and literary value, and is copiously illustrated by photographs and pen and ink sketches.

"Technical Book Review Index." Vol. 3, No. 1. Pp. 68. 50 cents per annum. Published by the Technology Department of the Carnegie Library, Pittsburgh, U.S.A.—A comprehensive index of reviews that have appeared in various trade and technical journals, giving a brief description of the nature and scope of each work. It is concerned mainly with pure and applied science, but a few works on allied subjects are included. Books are indexed under authors' names arranged alphabetically.

"The Life and Letters of Silvanus Phillips Thompson, D.Sc., F.R.S.," has been prepared by his wife and his daughter, Helen G. Thompson, B.Sc., and will be published by T. Fisher Unwin, in the spring, at 21s.

"Neglected Revenue: A Suggestion to the Prime Minister." By Sir Guilford Molesworth. London: Vacher & Sons, Ltd. Price 1d.

"*Proceedings* of the American Institute of Electrical Engineers." Vol. XXXVIII, No. 12. December, 1919. New York: The Institute. Price $1.

"*Transactions* of the Institution of Civil Engineers of Ireland." Vol. XLIV. Dublin: The Institution.

"Precis d'Electricité Theorique." By L. Bloch. Paris: Gauthier Villars et Cie.

"Jahrbuck der Elektrotechnik." By Dr. K. Strecker. Berlin-München: R. Oldenbourg. Price 24 marks.

Electricity Undertaking for Disposal.—The Receiver for the Weaverham Electricity Supply Co., Ltd., invites offers for the undertaking, with the whole of the effects, including the provisional order for the districts of Weaverham and Acton and Sandiway and Cuddington. See our advertisement pages to-day.

Catalogues and Lists.—MESSRS. FULLER'S UNITED ELECTRIC WORKS, LTD., Woodland Works, Chadwell Heath, Essex.—Price leaflet of the "Popular" dry battery; also a list of reduced prices of "Kwik-Lok" lamp shade carrier. The reduction is possible owing to increased manufacturing facilities reducing the cost of production. Copies of the list over-printed will be supplied to traders.

NATIONAL X-RAY REFLECTOR CO., Chicago, U.S.A.—Pamphlet illustrating and describing the "Tru Dalight," a lamp specially designed for use in shop interiors.

THE BRITISH THOMSON-HOUSTON CO., LTD., Mazda House, 77, Upper Thames Street, E.C. 4, have sent us two attractively coloured wall showcards, advertising the "Mazda" lamps. One is a painting of an oak tree, symbolising strength and emphasising British manufacture. The other is headed "The Electric Lamp for the Home," and depicts a shaded lamp throwing its rays upon a table. Both are brass-stiffened at top and bottom, and provided with eyelets for hanging. Copies can be obtained from Mazda House.

ATHOL ENGINEERING CO., 9, Peru Street, near Broughton, Manchester.—Leaflet describing the "Athol" outline template.

THE GENERAL ELECTRIC CO., 67, Queen Victoria Street, E.C. 4.—Up-to-date catalogue of electric heating and cooking appliances, priced and illustrated. Also Specifications Nos. 15A and 74A, detailing "Salford" automatic circuit-breakers and G.E.C. motor starters respectively.

THE STERLING TELEPHONE AND ELECTRIC CO., LTD.—A novel show card, advertising the "Sterling" sanitary glass telephone mouthpiece. This is a very effective cardboard model of a desk set with an actual sample of the mouthpiece fitted to it.

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Patent Restoration.—An order has been made restoring Letters Patent No. 9,151, of 1914, granted to Mavor & Coulson, Ltd., and S. M. Mavor, for "Improvements in, or connected with, machines for use in mining minerals, particularly adapted for use in mining coal and the like."

Patent Extension.—A petition presented by Mr. C. Smith for the extension of Patents Nos. 16,242, of 1906, and 22,525, of 1907, for inventions of improvements in fire and temperature alarms or indicators, is to be heard on February 3rd.

New Belgian Electrical Company.—Les Cableries Belges, Société pour la Fabrication des Cables et Fils Electriques et l'Industrie du Caoutchouc is the name of a new company which has lately been formed in Brussels (33, Rue de Luxembourg).

The Export Credits Scheme.—The Board of Trade announces that Rumania has been added to the list of countries to which this scheme applies.

LIGHTING AND POWER NOTES.

Australia.—SYDNEY.—To cheapen the supply of electricity the Local Government Department contemplates making large increases in plant and the area of distribution, and it has been stated that the price per unit would decrease from the present rate of 5½d. to about 3d.

VICTORIA.—A total of £3,000,000 is to be spent in developing the Morwell brown-coal field to provide electricity at cheaper rates for the city of Melbourne and other districts.

Barnes.—PROPOSED EXTENSIONS.—The electrical engineer has submitted two alternative schemes for extending the plant. Proposal (*a*), involving an expenditure of £20,000, provides for additions to existing plant, but (*b*) will mean changing over from the reciprocating plant at present in use to a turbine-driven unit of 3,000-KW. capacity and from D.C. to A.C. The cost of the latter scheme is given as £77,000.

Brazil.—INDUSTRIAL DEVELOPMENT.—Many extensions in the industries of Brazil were projected by the Minister of Agriculture, Commerce and Industry, in a recent speech. The steel and iron trades can be made to produce twice the present revenue if advantage is taken of the opportunities presented by the ease with which the South American markets can be supplied. The chief difficulty in iron and steel production is the supply of fuel, but it is considered that the application of electricity will eliminate this to a great extent. Water power is obtainable from the Serra do Mar between Victoria and Itabira and between Rio and Sao Paulo, for supplying many smelting works, and also the principal ports of the country. The Federal Government would bear the expense of erection of the necessary hydro-electric plant, and by selling power cheaply to consumers, would encourage the establishment of all classes of factories.

Dundee.—WATER POWER.—The latest development in the Tummel hydro-electric scheme is marked by a joint report to the Corporation of the city by C. S. Meik & Buchanan and Sir Alex. Binnie, Son & Deacon, together with a report dealing mainly with the conclusions arrived at by these firms, prepared by Mr. H. Richardson, the city electrical engineer and manager. The joint report is most exhaustive. It is divided into three main heads :—(1) A general description of the complete scheme ; (2) an indication of how the complete scheme can be best developed to meet the growing demand for electricity, with the estimate of cost ; and (3) the effect of the scheme when developed on the flow of the River Tay, and other general considerations. Commenting on the joint report, Mr. Richardson states that comparisons between steam plant and water power might lead to the conclusion that there was not sufficient probable saving to decide in favour of using the water power, but there were many other factors to be considered. If the first instalment were completed, the possibility of extension up to the likely requirements of Dundee would be assured for many years to come, whereas it appears doubtful whether the Harbour Trustees will grant facilities for the next extensions of the present Carolina Port generating station. Refusal to grant sufficient facilities will mean that a new station will have to be built some distance from the city, as no other sites are available at present. Even if the present estimated cost, as given by Messrs. Meik and Binnie, of the first instalment of the water scheme, proves approximately sufficient to cover the actual cost, then it seems clear that the ultimate advantages to be gained warrant proceeding with the water-power extension. One million and a quarter in cash is involved in the first instalment of this water-power scheme, and as the present capital account is £340,180, the huge extension contemplated will bring up the capital account to £1,577,180. By an alternative extension scheme (steam plant) the capital cost would be £1,026,880, a figure less than the Tummel Valley scheme, but it is pointed out that while under it the cost per unit at Dundee would be ·83d., the cost under the Tummel Valley scheme would be ·472d. or ·583d. if the existing capital expenditure is included.

HOUSING SCHEME.—It has been decided that the dwellings in the new Corporation housing scheme at Logie shall be lit electrically, and that the charge shall be a fixed one of £2 per annum, with ¾d., plus 15 per cent. per unit consumed.

Falkirk.—LOAN.—The Town Council is to apply to the Secretary for Scotland for powers to borrow £30,000, which it is proposed to expend in extending the electrical plant and mains. It was pointed out that it was necessary that the additional plant should be installed at an early date.

Grantham.—PRICE INCREASE.—The Urban Electric Supply Co. has increased the charges for energy as under :—Power, first 100 units per quarter, 7d. per unit ; next 3,000, 3½d. ; beyond, 2½d. Heating, first 100 units per quarter, 3½d. ; beyond, 2½d.

Godalming.—PRICE INCREASE.—The Urban Electric Supply Co. has adopted the following scale of charges :—Heating, first 100 units per quarter. 4d. ; beyond, 3d. ; power, first 100 units per quarter, 7d. ; next, 3,000, 4d. ; beyond, 3d.

Glossop.—PRICE INCREASE.—The Urban Electric Supply Co. announces that from the December meter readings, the charges for electricity will be :—Power, first 100 units per quarter, 7d. ; next 3,000, 4d. ; beyond, 2½d. Heating, first 100 units per quarter, 4d. ; beyond, 2½d.

Great Harwood.—PROV. ORDER.—The Council has applied to the Board of Trade for an extension of the Electric Lighting Provisional Order, and has also appointed a sub-committee to make arrangements for an electric lighting scheme, with power to act.

Gourock.—BULK SUPPLY.—Negotiations are proceeding between the Town Councils of Greenock and Gourock for the supply of electricity for the latter. The supply is now being offered at a cheaper rate, owing to the fact that the original main extends to the torpedo factory, and, when laid down, it was capable of providing a greater supply for these works than was necessary.

Halifax.—BREAKDOWN.—The electric light failed for 20 minutes on December 17th, consequent on a defect in the main switch of one of the principal machines at the generating works.

High Wycombe.—PRICE INCREASE.—The Electric Light and Power Co. has increased charges for electricity as under :—Power, first 100 units per quarter, 7d. ; next 3,000, 4d. ; beyond, 3d. ; and heating, first 100 units, 4d. ; beyond, 3d.

Huddersfield.—AREA EXTENSION.—Application is to be made to the Board of Trade for an order authorising extensions of electric lighting to the districts of Kirkheaton, Kirkburton, Lepton, and Meltham.

Hull.—INADEQUATE SUPPLY.—The situation caused by the restrictions recently imposed upon power consumers has become so acute that the Lord Mayor invited representatives of employers and employés of the iron trades to a conference. This was refused, an independent inquiry being insisted upon. The fuel overseer had given shortage of coal as the reason for deficiencies in supply, but the electrical engineer stated that the trouble was due to lack of boiler power. In view of these conflicting statements, the Electricity Committee has decided to appoint an outside expert to report on the matter.

Ipswich.—YEAR'S WORKING.—The report on the electricity department for the year ended March 31st, 1919, shows a total expenditure of £62,748, including £12,441 capital charges, and a total income of £55,140, representing a loss of £7,608. Total units sold decreased by 1,059,413, or 15·6 per cent. to 5,737,961 ; lighting decreased by 18·2 per cent. to 687,220 ; power by 14·46 per cent. to 4,486,810 ; traction by 23 per cent. to 545,578 ; and public lighting increased by 15,323 to 18,353 units. A sum of £1,338 was received from the rates towards providing working capital. The number of consumers increased by 35 to 1,996 ; kilowatts connected increased by 28 to 8,360 ; maximum load recorded was 2,205 KW. for lighting and power, and 424 KW. for traction. The year under review was, so far as operating the plant was concerned, the most difficult in the history of the undertaking. The conditions under which the station had to be run were reflected by the cost of repairs which increased by £1,662, or 46·8 per cent.

ELECTRIC VEHICLES.—The working expenses of the electric vehicle garage were £555 ; the expenses increased by £289, or 109 per cent. The revenue increased by £537, or 173 per cent., which does not include electricity sold for charging vehicles, the quantity being 58,065 units, which brought in an amount of £380.

NEW PLANT.—The Electric Supply and Tramways Committee have reported that, unless extra plant is installed, there will be an insufficient reserve to provide against breakdown. In view of the heavy demands which will have to be met during the winter 1920-21, additions costing the estimated amount of £30,000 are urged. The proposals include an expenditure of £25,800 for a 3,000-KW. turbo-alternator with necessary condensing plant and inter-connecting pipes.

London.—FULHAM.—The Borough Council has been recommended by the Electricity and Lighting Committee to revive the shop-lighting agreements suspended during the war. The proposed annual charge per lamp is £3 12s., including cleaning and renewals. Energy will be supplied through the ordinary consumers' meters.

STEPNEY.—Acting upon the advice of the borough electrical engineer and manager, the Electric Supply Committee has submitted to the Borough Council a proposal to erect a new sub-station in the north-east part of the borough. It is proposed to install two 1,000-KW. converters. The approximate cost is given as £99,850.

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HACKNEY.—The new street lighting system, recently installed, consists of over 400-B.T.H. "Efracta" lanterns, each containing a 300-watt, ½-watt type lamp. The majority of the rays from these lamps are re-directed at an angle slightly below horizontal, and efficiently illuminate the areas between the standards, which generally make a sharp contrast with the illuminated area in the lamp's immediate vicinity. The Hackney system will ultimately total 500 of these lamps. The "Efracta" was described in our "New Devices" columns on December 27th, 1918.

ST. PANCRAS.—The London County Council Finance Committee has recommended the Council to sanction the borrowing of £89,209 by the Borough Council for extensions. This amount includes £17,000 for completion of buildings, and £33,000 for a 5,000-KW. turbine.

The Council Labour majority promises electric light, with free wiring, in working-class homes.

Manchester.—NEW PLANT.—The new steam turbo-alternator at the Stuart Street generating station commenced its work on December 15th. It is the most powerful set so far installed by any municipality in Great Britain. The turbine is of 35,000 H.P., and the alternator develops 25,000 KW., or two and a-half times the amount of electricity needed to propel the 700 tramcars in Manchester. The city's three generating stations have now a capacity of about 120,000 KW., Stuart Street alone having 92,000-KW. capacity. The largest boiler in Great Britain, a Babcock & Wilcox water-tube boiler, which evaporates over 100,000 lb. of water per hour, has been installed recently at the Stuart Street works. The new plant was inspected by the members of the Corporation, and later Alderman W. T. Dagnall, chairman of the Committee, referred to the work of the department during the past five years. They had never let down the munition manufacturers in the area, and the Armistice meant a reduction of 25 per cent. of the demand for electricity. During the past 10 years the plant had been increased by 120 per cent., and the maximum demand had increased in the same ratio. The average cost of production per unit gradually fell until 1914, but since then, owing to the war, it had risen, and was still rising, and to-day the cost was the same as in 1909. On December 9th last, the output for the first time exceeded a million units. There were now 2,000 people waiting connection to the system, and the Committee could not get the meters and the labour to connect them as quickly as it wished.

Masham.—BILL.—A meeting is to be held on January 7th to consider the promotion by the Urban District Council of a Bill in the ensuing session of Parliament, to acquire, among other things, the undertaking of the Masham and District Electric Supply Co., and to supply electricity in the district.

Melrose.—PROPOSED PRICE INCREASE.—The Electric Supply Corporation has applied to the Board of Trade for an order to increase the charges for electricity.

Newport (Mon.).—STRIKE.—A serious situation was created at the docks on December 18th, when work was brought to a standstill by a lightning strike of the men employed at the power stations. The men claim the whole of the conditions applying to shopmen, although the company's view is that they are not shopmen; the matter has been under the consideration of the Railway Executive Committee for some time. With the exception that the electric light was kept on, the whole of the power available for working the docks was suspended.

New Zealand.—HYDRO-ELECTRIC DEVELOPMENTS.—The Horahora Electric Power Works, erected by the Waihi Gold Mining Co., at a cost of £200,000, a few years ago, have been purchased by the Government. Water power to the extent of 9,000 H.P. is used there, and the Government intends to supply the southern part of the Auckland province as well as the Waihi Co. It is expected that two additional units will be installed to take part of the Auckland city load. Further developments are projected in North Island hydro-electric schemes, including the Arapuni plant, which will consist of several generators capable of developing 13,000 H.P. each.

Paisley.—VISIT OF COMMITTEE.—The burgh electrical engineer recently received the Second Municipal Ward Committee, and conducted the party round the Corporation power station, and the leading particulars of the plant were explained. Total plant capacity, 7,100 KW.; two-phase A.C. is generated at a pressure of 2,000 volts and transformed down to 200 at the various sub-stations. A new 2,500-KW. turbo-alternator was installed last April, and an addition of two new boilers was made during November.

Peterborough.—RECONSTRUCTION.—The Town Council has discussed the report of Mr. W. M. Selvey on the electricity undertaking, and has decided to proceed with the first stage of reorganisation which will involve an outlay estimated at £40,000. It is expected that it will eventually be necessary to carry out the rest of the scheme at a cost of £100,000.

Ramsgate.—PRICE INCREASE.—The Electric Supply Co. has, from the December meter readings, increased the price of electricity as under:—Power, first 100 units per quarter, 7d.; next 3,000, 4d.; beyond, 3d. Heating, first 100 units per quarter, 4d.; beyond, 3d.

Richmond-on-Thames.—PRICE INCREASE.—The Board of Trade has granted an order to the Electric Light and Power Co. authorising an advance in the price of electricity to 6d. per unit for lighting, 2d. for heating, and 3½d. for power.

Rochdale.—SUPPLY OF POWER TO FACTORIES.—Since the Corporation undertook to supply electricity in bulk for power purposes, quite a number of firms in the district have availed themselves of the opportunity to convert their methods of driving to electricity. There have been quite a large number of partial conversions during the past 10 years, but the first of the large cotton mills in the district to make a complete change over in every department and drive the mill throughout by electricity is that of Messrs. Holt & Ogden, Ltd. Electricity will be supplied at 3,000 volts, to be transformed on the premises and distributed through motors varying in size from 20 H.P. to 125 H.P., each being under separate control. Messrs. William Tatham, Ltd., who are making further extensions to their works at Belfield, have decided to adopt a mixed system of alternating and continuous-current electric power. The supply, in the first place, will be taken from the Corporation main, transformed from high to low pressure, and again converted from alternating to direct current for meeting the calls of the variable-speed machines. The design of Mr. W. D. Watson, electrical engineer, has been approved in both these cases, and the tenders have been let to the Rochdale Electric Co., Ltd. The Ensor No. 3 Mill, now under construction, is also to be run by electric power supplied by the Corporation.

Southend.—ELECTRIC HEATING.—With regard to an application for a supply of electricity required for heating radiators, and in view of the great demand for energy for lighting purposes, it has been decided that the Committee is unable to supply consumers at the present time for the purpose indicated.

Stoke-on-Trent.—MAINS EXTENSIONS.—Application is being made to the Ministry of Health for sanction to borrow £29,936 for mains extensions, &c.

Ventnor.—STREET LIGHTING.—The Urban District Council has accepted the tender of the Isle of Wight Electric Light Co. for lighting public lamps used prior to the war, until March 31st, 1921, and in the meantime tenders for the whole of the public lighting are to be obtained from the Electric Light Co. and the Gas Co.

Wallasey.—EXTENSIONS.—Acting upon the recommendation of Sir John Snell, the Council proposes to temporarily reduce its extension scheme and its cost from £111,300 to £66,240. The electrical engineer has put forward an amended scheme for the installation of a 5,000-KW. set, which will be sufficient for the next two years.

Wareham.—ELECTRIC LIGHT SCHEME.—Owing to the present inadequacy of the town lighting, the Mayor has been asked to call a public meeting to consider the formation of an Electric Lighting Company.

Warrington.—YEAR'S WORKING.—The report for the year ending March 31st, 1919, shows a gross revenue of £63,388; working expenses, £48,395; out of the balance £4,908 was paid as interest on loans, and £6,075 to sinking fund, thus leaving a net profit of £3,720. The units generated numbered 9,682,154, an increase of 11·5 per cent. The units sold to private consumers numbered 7,093,205; public lighting, 61,417; traction, 502,532; private lighting increased by 33,262 to 494,924 units; and power by 774,063 to 6,598,281 units; 895 consumers are now connected to the mains.

West Ham.—LOAN.—Application has been made for sanction to borrow £164,500 for extension purposes; in the course of an inquiry by Col. T. C. Ekin, it was stated that owing to the insufficiency of the borough supply, it had been necessary to borrow from East Ham, Leyton, and the London County Council.

Wolfhill (Queen's Co.).—ELECTRICITY IN MINING.—Good progress is being made in the construction of modern machinery for installation in the Moderheagh Colliery, which includes electric pumping, haulage and coal-cutting plant underground. The colliery is expected to be producing coal early this year.

Wolverhampton.—PURCHASE OF PLANT.—In May, 1917, negotiations were commenced between the Ministry of Munitions and the Electricity Committee for the supply of electricity to H.M. phosphorus factory. The agreement entered into provided that the Ministry should contribute £50,000 towards the cost of the plant, the total cost of which was £78,000, the Corporation to find £28,000 under sanction from the Local Government Board. In addition the Ministry agreed to pay £3,270 towards existing boiler-house alterations. When the armistice was signed the supply ceased. As a result of negotiations, the Corporation offered to purchase the plant at its cost price, less depreciation amounting to £10,000. The Ministry agreed to "write off" the sum of £3,270 paid towards the alterations, and the building now becomes the property of the Corporation. The Committee now recommends application for a loan of £40,000 to effect the purchase, the Director of Electric Power Supply having promised to advise the Ministry of Health to grant a long period of repayment.

PRICE INCREASE.—The Committee also proposes that a further increase of 15 per cent. be made in the charges for electricity on all accounts (including meter rent), making a total increase of 100 per cent., and that this increase be applied to the gross total of all accounts after the meter readings taken at the end of the December, 1919, quarter, and that for the purpose of removing doubts the increases hitherto made in the charges for the supply of electricity, amounting in the aggregate to 85 per cent., shall apply to meter rents.

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TRAMWAY AND RAILWAY NOTES.

Argentina.—RAILWAY ELECTRIFICATION.—The Western Railway is about to proceed with the electrification of its system as far as Castelar, 20 miles out of Buenos Ayres. The estimated cost is £1,000,000, but it is considered that the results will entirely justify the expenditure. The Southern Railway is expected to announce its intention to electrify its lines to La Plata shortly.

Australia.—VICTORIA.—The Railway Co.'s report for the year 1918-9 states that much has yet to be done to complete the plant of the Newport power station, and the Jolimont, Newmarket, and Middle Brighton sub-stations. The total cost of the electrification work in hand at present is £2,997,415, exclusive of the cost of new carriages and structural alterations to existing stock, and it is not expected that the programme will be completed before the end of 1921.

MELBOURNE.—The Railway Commissioners have reported that up to June 30th this year, a total of £2,867,000 had been expended upon the electrification of suburban lines.

Barrow-in-Furness.—TRAMWAY SALE.—In connection with the purchase of the tramway system by the Town Council, as already announced, the track is reported to be in fairly good condition, but the cars are unsatisfactory. After allowing for expenditure to be incurred in bringing the system up to greater efficiency, the sum of £96,250 was agreed upon as the purchase price. The company will continue to carry on the undertaking until it is handed over to the Council on January 1st. Mr. J. R. Groves, the company's engineer will retain his post under the Town Council at a salary of £600 per annum.

Belfast.—SUPPLY FAILURE.—On two or three occasions recently the tramway services were interrupted by want of power in the evenings when the "peak" point was reached, coinciding with low tide in the Lagan, when the condensers were not able to work properly. This, it is stated, may recur till the new power station at the harbour is in going order. In November, 1918, the output was 1,852,414 units: last October it was 2,730,621, or an increase of nearly 50 per cent. At the present time one-third of the electricity is going to the shipyards, one-third to the tramways, and one-third to the general consumers.

Blackpool.—EXTENSIONS.—The Fleetwood tramroad is to be connected up with the local system at the Glynn and Talbot road. Owing to cost, estimated at £90 per week, the Tramways Committee has decided not to run cars from Marton to South Shore.

Bolton.—NEW CABLES.—The Tramways Committee has approved a report submitted by the borough electrical engineer concerning the existing feeder cables and distributors, which he considers are overloaded, recommending the provision of cables of larger capacity, in order to safeguard the tramway supply. The work is to be carried out as soon as practicable.

Bradford.—NEW MOTORS.—The order placed by the Corporation in 1915 with Messrs. Brown, Boveri & Co. for 200 tramcar motors, which, by reason of the conditions arising out of the war, it has been unable to fulfil, is by mutual agreement not to be proceeded with, and the Corporation is at liberty to secure motors from another source. The contractors were unable to promise delivery until next summer.

Cardiff.—NEW CARS.—The Electric Light and Tramways Committee is to invite tenders for 15 complete tramway cars and for 15 chassis. In the tramway manager's opinion, unless the moulders' strike ends, the service will have to be withdrawn; scrapped brake blocks are now being re-used.

Continental.—SPAIN.—Owing to the refusal of the Madrid tramway companies to make any concessions to the strikers, negotiations between the employers and the men have been broken off. Some cars are being run under police protection.

SWEDEN.—A proposed scheme for the electrification of the Stockholm-Gothenburg line will probably be placed before the Riksdag next year. It is calculated that the work will take three years to complete, and will involve a total expenditure of 60,000,000 kronen. Efforts are also being made to speed up the electrification of the Gellivara-Svartön Railway, which has already received Government approval.

Halifax.—TRAMWAY LOSSES.—The borough treasurer has informed the Electricity Committee that during the eight months ended November 30th the loss in working was £12,085, although a higher revenue than was estimated had been received. It was considered that the increased fares yielded very little extra revenue, as the people took shorter journeys. A further increase to 2d. a mile is contemplated, the Corporation being of opinion that unless such measures are taken the resultant loss for the year will be £20,000.

On Christmas Eve a small landslide close to St. Thomas's tramway stopping stage covered the line with several tons of stone and gravel and stopped all vehicular traffic. After four hours there was sufficient clearance for a single-line car service. Investigation as to the cause of the slide and as to responsibility is being made

Hastings.—CHANGE OF SYSTEMS.—The Tramway Co. is considering the substitution of the overhead system for the Tilling-Stevens petrol-electric system at present in use on the front-line Esplanade. Experts who reported on the existing system expressed the opinion that the only way to obtain an efficient system was to change over immediately to overhead working. Apart from inherent defects in the present system, the reason of its being unsatisfactory was the lack of power, and this could not be overcome, as it was impossible to increase the size of the equipment of the cars. The Tramway Co. is again making efforts to obtain the necessary powers from Parliament for the suggested improvement, a previous application having been unsuccessful.

Ipswich.—YEAR'S WORKING.—The report for the year ended March 31st, 1919, on the tramway department, shows that the revenue increased by £3,958 to £38,775; working expenses by £3,208 to £30,279; leaving a net profit of £2,295, against £1,478 last year. The passengers carried increased by 154,831 to 6,224,608; units used decreased by 163,075 to 546,578.

Jamaica.—STRIKE.—The Kingston tramway employés struck work on December 26th, and the whole service was suspended. The men demand 2d. per hour increase in wages.

Lancaster.—EXPERT ADVICE.—The Town Council has decided to call in Mr. A. R. Fearnley, tramway manager, Sheffield, to submit a report on the question of mechanical transport in the borough, and as to what, in the financial interests of the undertaking, would be the best system of traction to adopt. There are both tramways and electric 'buses, neither of which really pays because of restricted services. Mr. Chorlton's services as traffic manager are to terminate, and Mr. J. Patterson will take over the tramways superintendency at the end of January, at a salary of £300.

London.—LONDON COUNTY COUNCIL.—Before the Advisory Committee on London Traffic, dealing with the financial position of passenger-carrying undertakings in the metropolitan area, Sir Harry Howard, controller of the L.C.C., said that the deficiency on the working of the tramways was at present £137,000, and it was anticipated that next year it would be £580,000. Relief could only be obtained by means of legislation in regard to the rating of tracks, road maintenance, &c. He did not consider that the debt charges constituted an unusual burden, and it would be possible, instead of repayment by equal instalments, to set up an annuity on the cumulative sinking fund principle. That would save over £100,000 a year. The capital commitments at the present moment were in the neighbourhood of two millions of money, and he believed that the revenue could not meet that figure. If there were less competition with motor-omnibuses they could probably meet the expenses on the present fares. Sir Albert Stanley, on behalf of the Traffic Combine, said that, excluding the subsidy of £560,000 which the District Railway, a controlled line, received from the Government, and approximately a reasonable sum as allowed for renewals, the operating results from all the 10 companies for the current year would show a loss of £600,000. That was without making provision for fixed charges and interest. The estimated loss in 1920 would be £2,600,000. The total expenditure for 1920 over that of 1919 would be £2,650,000, and that sum would have to be raised in increased earnings. There was not the remotest chance, Sir Albert continued, of meeting the loss except by an increase of fares. The services carried 1,300,000,000 passengers in the year, and an addition of a halfpenny each passenger for each journey would realise £2,500,000 yearly.

Sir Albert Stanley, speaking at a dinner at the Savoy Hotel recently, said that the underground railways combined undertakings were now carrying about four million passengers per day, or 1,300 millions per year. They had 35,000 employés, 2,578 omnibuses, 894 tramcars, and 1,360 railway carriages. Their commitments in the way of improvements represented six millions of money, which sum had to be raised.

PASSENGER TRAFFIC.—Sir Albert Stanley stated last week that for the last 10 years records of the passengers carried in London showed the following aggregate totals:—Omnibuses, 5,818,374,141; trains, 2,881,264,160; tramcars, 1,760,720,397; a total of 10,460,358,698. During 1918 alone, 652,562,327 passengers were carried by the omnibuses; 379,438,072 by the tubes and underground railways; and 198,334,499 by the tramcars; a total of 1,230,334,898, or an average of 3,370,780 passenger per day, including Sundays. The 1919 figures are estimated to be still larger.

UNDERGROUND INTERRUPTION.—Owing to cable trouble, traffic ceased for some time on the evening of December 23rd, on the Underground Railway between East Ham and Campbell Road Junction. Passengers were taken meanwhile *viâ* Mark Lane and Fenchurch Street.

Lytham.—TRAMWAY PURCHASE.—It is proposed to promote a Bill in Parliament to acquire the section of the Lytham and St. Anne's Tramway Co.'s line within the Council's area. St. Anne's Council has also taken similar steps, and has fixed the purchase price.

Manchuria.—PROPOSED TRAMWAY.—Applications have been made by an ex-minister for permission to construct an electric tramway between Dairen and Port Arthur, and another one at the latter town. The first proposal will effect a reduction of 14 miles, compared with the railway route, but is not expected to receive official sanction. The other will probably meet with approval.

New Zealand.—AUCKLAND.—The total receipts of the tramway undertaking for the year ending June 30th, 1919, were £292,503, and the number of passengers carried, 73,785,594. Last year's figures were £294,564, and 44,823,967 respectively.

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Preston.—YEAR'S WORKING.—The total income for the year ending March 31st, 1919, was £77,930, the total expenditure being £52,877, resulting in the transfer of £25,054 to the net revenue account. The revenue increased by £14,433. A considerable portion of the single track requires immediate renewal for which service the present renewals fund is inadequate. Working expenses increased by £9,433, or 22·2 per cent. The increased rates came into operation in August, and resulted in an increase in revenue of 20 per cent., with a decrease in passengers of 15 per cent. During the year the passengers carried numbered 15,126,474, against 15,455,163; working expenses per car-mile were 10·66d., against 9·14d.; units generated numbered 1,767,154, against 1,833,816, at a cost of 0·855d., against 0·798d.

Rawtenstall.—THROUGH RUNNING.—An intimation has reached Accrington tramways authority, from Rawtenstall Corporation, to the effect that employés on Rawtenstall tramways have decided that the through running of cars between Accrington and Rawtenstall shall cease after December 31st. This decision was taken by Rawtenstall tramway workers without waiting for the approval or endorsement of the Tramways Committee.

South Lancashire.—FARE INCREASE.—The Board of Trade has sanctioned an order empowering the South Lancashire Tramways Co. to increase 1d., 1½d., 2d. and 2½d. fares by ½d., and 3d., 4d., 5d. and 6d. fares by 1d., as from January 1st. This does not apply to workmen's fares.

South Shields.—LIGHT RAILWAY.—The Light Railway Commissioners who inquired into the application of the Corporation for sanction to construct a light railway from the borough boundary to Cleadon Village, to serve its housing scheme, have announced their decision as follows:—That the application be granted so far as it relates to the construction of one mile of light railway from its commencement at a junction with the authorised tramway in the borough. The Commissioners, in arriving at this conclusion, have attached weight to the importance of reducing capital expenditure, and of economising in the consumption of material, at the present time. In their opinion the evidence at the inquiry indicated that a light railway co-terminus with the boundary of the housing site at Cleadon Park would adequately meet the immediate needs of the case, and that the construction of nearly a mile of line (involving an expenditure of, say, £30,000), which is cut out from the scheme by this decision, will be avoided without material detriment to the objects and the interests of the Corporation. This decision has been come to without relation to the proposed new thoroughfare on the line of the light railway, and the alternative scheme of the Durham County Council for widening the main road to Sunderland.

Walthamstow. — SECOND-HAND CARS.—The Town Council is buying eight second-hand tramway cars from Rotherham Corporation.

Wolverhampton.—FARES.—The Town Council is to reconsider the question of the increase of fares throughout the system, with a view to reinstating penny fares for short stages.

BILL.—The Corporation is promoting a Bill in Parliament to extend the boundaries of the borough, and also the tramway system.

TELEGRAPH AND TELEPHONE NOTES.

Automatic Exchanges. — Mr. Pike Pease, Assistant Postmaster-General, replying to a question in the House of Commons, said that a number of automatic telephone exchanges had been installed, and others would be installed in places where efficiency and economy were likely to be secured. He regretted to find in the recent tenders that the prices asked by manufacturers for automatic apparatus were extremely high.

Brazil.—According to *Commerce Reports*, the Brazilian Government has granted concessions to the Central and South American Telegraph and Cable Co., for the laying of submarine cables (1) linking the cities of Santos and Rio de Janeiro to any part of the territory of Uruguay; and (2) from Rio de Janeiro to Cuba *viâ* the Island of Fernando de Noronha.

Cable Delays.—Serious cable delays are still reported between the Far East and this country. The claim that by the end of September last the normal period of transmission had been reduced to 2 or 2½ days in the case of India, 2 to 3 days for the Straits Settlements, 1½ to 2 days for China, and between 5½ and 7 hours in the case of Australia, does not appear to have been substantiated.

Canada.—The Canadian Landline Companies have adopted the same arrangements as the United States Companies as to the formation of a Registration Bureau, and will charge for local telegraphic registrations $2.50 per annum. Reversible addresses will not be registered.

Sweden.—A Swedish engineer has invented a method of ensuring secrecy in connection with wireless telegraphy. Patents have been taken out in several countries, and a company, A.-B. Cryptograph, has been formed to exploit the invention.—*Economic Review.*

United States.—War-time operation of the telephone and telegraph systems of the country cost the Federal Government $14,418,237, according to a report of Postmaster-General Burleson, transmitted to Congress on November 13th by President Wilson. This sum represents the difference between the net earnings of the companies taken over and the compensation guaranteed by the Government. Total net earnings of the telephone and telegraph lines during federal control were reported to be $70,387,532, while the compensation assured was $83,055,769. The total deficit included an estimated $3,000,000 for settlement of future claims. Small independent companies operated by the Government reported a surplus of $57,428. Reported deficits of the American Telephone and Telegraph Co., operating 36 subsidiary companies, were $9,290,170.31, while the Western Union Telegraph Co. asked an adjustment of $921,511. The Ohio State Telephone Co., of Columbus, Ohio, operating four subsidiary companies, showed a deficit of $392,123. The Government claim against the Postal Telegraph-Cable Co. was listed at $2,123,392. "If the unadjusted claims of the Government against the Mackay companies be taken into consideration," said Mr. Burleson, "the estimated obligations of the Government will be substantially reduced."

The U.S. Navy Department has removed the ban on wireless transmitting stations as far as non-commercial installations are concerned. All amateurs, however, must secure licences from the Radio Service Bureau of Navigation. Apparatus manufacturers are expecting an increased volume of business as a consequence of this decision.

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the ELECTRICAL REVIEW *in which the "Official Notice" appeared.)*

OPEN.

Australia.—SYDNEY.—February 18th. One electrically-controlled tower clock and four dials, for Sydney sub-station. Chief Electrical Engineer's Office, 61, Hunter Street, Sydney.

PERTH, W.A. — February 10th. P.M.G.'s Department. 340 accumulators (schedule W.A.647.) (December 19th.)

Barnes.—January 20th. Urban District Council. Electricity Department. Supply of water-tube boilers, economisers, draught plant, turbo-alternators, condensers, air and circulating pumps, transformers and rotary converters. (December 12th.)

Barking. — Urban District Council. Second-hand air compressor (electric or steam). (See this issue.)

Battersea. — January 21st. Borough Council. One 5,000-KW. turbo-alternator, with condensing plant; one 1,500-KW. rotary converter; pipework for the 5,000-KW. turbo-alternator; switchgear for the 5,000-KW. turbo-alternator and 1,500-KW. rotary converter.

Belgium.—January 17th. Belgian Post and Telegraph Authorities, La Salle Madeleine, Brussels. Telegraph and telephone cables.

Bootle.—January 7th. Corporation. Wiring 34 houses under the housing scheme. (December 26th.)

Bradford.—January 28th. Corporation. Two electric battery locomotives. (December 26th.)

Chile.—March 15th. Comision de Puertos, Santiago. Electrical machinery (power and lighting) for the Port of Valparaiso. Comision de Puertos, Santiago, Chile. Copies of the specifications can be seen at the Chilean Legation, 94, Gracechurch Street, London, between 3 and 5 p.m.

Cavan.—January 12th. Electric Light & Power Co. Suction gas engine and plant; alternative tender for duplicates, electric generator and motor booster; alternative tender for duplicate, generator, electric storage battery, D.C. switchboard. (December 26th.)

Dundee. — January 23rd. Corporation. Electricity Department. Three 750-KW. converter sets; one 300-KW ditto; 11,000 V., E.H.T. switchboard; two 750-KW., D.C. control panels; one 300-KW. ditto. (December 19th.)

Halifax.—January 5th. Electricity Department. Supply of stores (including lighting fittings and electrical accessories, cables, meters, &c.), from February 1st, 1920, to March 31st, 1921. (December 19th.)

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Kingston-upon-Hull.—January 23rd. Electricity Committee. One 10,000-KW. turbo-alternator, with exciter, and one condenser outfit complete. (See this issue.)

London.—ISLINGTON.—January 28th. Electricity Committee. Stores, including cables, meters, electric lamps, &c., for 12 months. (December 19th.)

FULHAM. — January 13th. Electricity Committee. Manufacture, delivery and laying, complete, duct, E.H.T. cable, &c., between the generating stations of Fulham and Hammersmith. (December 19th.)

STEPNEY. — January 22nd. Electricity Supply Committee. Two water-tube boilers, chimneys, economisers, &c., and one 5,000-KW. turbo-alternator, with condenser, accessories and switchgear. (December 19th.)

CAMBERWELL.—February 2nd. Borough Council. 12 months' maintenance of the private telephones and electric bells at the Town Hall. Mr. F. J. Slater, Borough Engineer, Town Hall, Camberwell, S.E.

Manchester.—January 14th. Electricity Committee. One 2-ton electric lorry (specification No. 23); one 10/15-cwt. electric van (specification No. 24). (December 26th.)

Rhondda.—January 5th. Urban District Council. Electricity Committee. Steel or wood poles and the completion of overhead lines. (December 19th.)

Sheffield. — January 2nd. Electric Supply Department. Supply and laying of six-core, E.H.T., split-conductor cable (contract No. 268). (December 12th.)

Tynemouth. — January 12th. Electricity Department. Ten 250-K.V.A. transformers. (December 19th.)

Venezuela.—June 30th. The Government *Gazette* of Venezuela publishes a decree inviting tenders for the installation of a wireless telegraphic station near Caracas.

It is to be of sufficient capacity to communicate with similar stations in the United States and Europe. It must have one installation for emission of continuous waves served by high-frequency alternators, and another for the emission of damped waves to communicate with wireless stations not provided with the system of continuous waves. Alternating tri-phase electric current now distributed at 190 volts and 50 cycles is available, but the plant must have a reserve motor.

Tenders to Ministerio de Fomento de los Estados, Unidos de Venezuela.

CLOSED.

Bedford.—Electricity Committee :—

Electrician's work for six months.—R. H. Crawley.

Belgium.—Tenders were recently invited by the municipal authorities of St. Gilles, Brussels, for the supply and installation of a new 1,000-H.P. engine and continuous-current generator. The lowest tender for the engine was that of the Société des Ateliers Bollinckx, of Brussels, and for the dynamo that of the Société des Ateliers de Constructions Electriques de Charleroi.

Bolton.—Electricity Committee :—

E.H.T. switchgear for Back-o'-th'-Bank generating station.—Metropolitan Vickers Electrical Co., Ltd.
12,000-KW., 8,000-R.P.M. turbine.—Escher Wyss Co., Zurich, Switzerland.
12,000-KW. alternator for above.—Metropolitan-Vickers Electrical Co., Ltd.

Government Contracts.— The following Government contracts were placed during November, 1919 :—

DIRECTOR OF NAVY CONTRACTS DEPARTMENT.

Searchlight motor generators.—Newton Bros. (Derby), Ltd.
Switchgear.—Switchgear & Cowans, Ltd.
Torch batteries.—Sunlight Manufacturing Co., Ltd.
Impulse gear for torpedo tubes.—Armstrong, Whitworth & Co., Ltd.

MINISTRY OF MUNITIONS.

Rewinding alternator.—Metropolitan-Vickers Electrical Co., Ltd.
Batteries.—Chloride Electrical Storage Co., Ltd.
Battery boxes.—Bond Bros.
Electrical equipment of aircraft.—Austin Motor Co., Ltd.
Generating sets and motors.—English Electric Co., Ltd.
Spares for magnetos.—W. H. Johnson.
Turbo alternator.—Brush Electrical Engineering Co., Ltd.

INDIA OFFICE, STORES DEPARTMENT.

Baudôt apparatus.—Elliott Bros.
Balancers.—Lancashire Dynamo Co.
Insulator cups.—Bullers, Ltd.; Taylor, Tunnicliffe & Co.
Dynamos.—Belliss & Morcom.
Telegraph instruments (parts of).—Creed & Co
Electric motors.—English Electric Co., Ltd.
Power board.—Erskine, Heap & Co., Ltd.
Switchboards.—Erskine, Heap & Co., Ltd.
Boiler tubes.—Muntz Metal Co., Ltd.; J. Wilkes, Sons & Mapplebeck; Broughton Copper Co., Ltd.; Perfecta Seamless Tube Co.; Talbot, Stead Tube Co.

POST OFFICE.

Boiler equipment, Mount Pleasant.—Fraser & Fraser, Ltd.
Pipework with accessory plant, ditto.—Foster Bros., Ltd.
Boiler plant, Leafield Wireless Station.—Babcock & Wilcox, Ltd.
Electrical equipment, Mount Pleasant sub-station.—Siemens Bros. Dynamo Works, Ltd.
Cables for ditto.—Pirelli-General Cable Works, Ltd.
Engine and electrical plant, Leafield Wireless Station.—W. H. Allen, Son and Co., Ltd.
Laying conduits and manufacturing, supplying, drawing-in and jointing cables in P.O. engineering districts as follows, for six months from November 21st, 1919 :—
Scotland, N. & N.E.—Siemens, Bros. & Co., Ltd.
N.W. & S. Lancashire.—Callender's Cable & Construction Co., Ltd.
N.W.a, S.W.a, & N. Mid.; S.W., S. Mid., E. & S.E.—Western Electric Co., Ltd.
London (cabling only).—W. T. Henley's Telegraph Works Co., Ltd.
Laying short lengths of conduits, &c., Hammersmith, &c.—J. A. Ewart, Ltd.
Laying ducts, Esher.—Greig & Matthews.
Laying ducts and pipes, Hop-East junction work.—J. A. Ewart, Ltd.
Acton (Horn Lane).—Hardy & Co.
Laying pipes, St. Thomas Street, S.E.—J. Mowlem & Co., Ltd.
Manufacturing, supplying drawing-in and jointing cable :—
Kensington exchange; Western exchange.—W. T. Henley's Telegraph Works Co., Ltd.
London-Manchester (Derby, Hazel Grove).—B.I. & H. Cables, Ltd.
London-Manchester (Old Stratford-Leicester).—Johnson & Phillips, Ltd.
Hornsey-Muswell Hill.—Western Electric Co., Ltd.
Repairing battery, Gerrard Telephone Exchange.—Hart Accumulator Co., Ltd.
Protective apparatus.—International Electric Co., Ltd.; British L. M. Ericsson Co., Ltd.; Western Electric Co., Ltd.
Telephone apparatus.—Automatic Telephone Manufacturing Co., Ltd.; British L. M. Ericsson Manufacturing Co., Ltd.; North British Rubber Co., Ltd.; Peel-Conner Telephone Works, Ltd.; Phœnix Telephone & Electric Works, Ltd.; Western Electric Co., Ltd.
Telegraph and telephone cable.—B.I. & Helsby Cables, Ltd.; Callender's Cable & Construction Co., Ltd.; Connollys (Blackley), Ltd.; Johnson and Phillips, Ltd.; Macintosh Cable Co., Ltd.; New Gutta-Percha Co., Ltd.; Siemens, Bros. & Co., Ltd.; Union Cable Co., Ltd.; Western Electric Co., Ltd.
Telephone cords.—Siemens, Bros. & Co., Ltd.; Phœnix Telephone and Electric Works Co., Ltd.
Earthenware ducts.—Albion Clay Co., Ltd.; Sutton & Co.; J. Woodward, Ltd.; T. Wragg & Sons, Ltd.
Insulators.—Bullers, Ltd.
Telephone lamps.—Edison Swan Electric Co., Ltd.; General Electric Co., Ltd.
Motor generators.—Crompton & Co., Ltd.
Cable plugs.—Siemens, Bros. & Co., Ltd.
Insulator spindles.—Bullers, Ltd.
Insulated tails.—Siemens Bros. & Co., Ltd.
Copper wire.—B.I. & Helsby Cables, Ltd.; Wilkes, Son & Mapplebeck, Ltd.
Enamelled and silk-covered wire.—Concordia Electric Wire Co., Ltd.
Flame-proof wire.—Macintosh Cable Co., Ltd.; Western Electric Co., Ltd.

CROWN AGENTS FOR THE COLONIES.

Fittings for Siemens' meters.—Guest & Chrimes, Ltd.
Tramway track rails.—W. Jones.
Switchboard, &c.—British L.M. Ericsson Manufacturing Co., Ltd.
Telephone material.—British L.M. Ericsson Manufacturing Co., Ltd.

Ipswich.—Town Council :—

One 3,000-KW. Ljungström type steam turbo-alternator, with condensing plant, wet-air filter, &c., £24,675.—Brush Electrical Eng. Co., Ltd.

Stirling.—Town Council :—

Electrician's work for a year.—Lockhart & Macnab.

FORTHCOMING EVENTS.

Junior Institution of Engineers.—Friday, January 2nd. At 39, Victoria Street, S.W. At 7.30 p.m. Paper on "Automatic Electric Weighing Machines, as used with Machine Packers," by Mr. A. V. Sims.

Royal Institution of Great Britain.—Saturday, January 3rd. At Albemarle Street, Piccadilly, W. At 3 p.m. Xmas lectures on "The World of Sound" (III); "Sounds of the Country."
Tuesday January 6th. (IV) "Sounds of the Town."
Thursday, January 8th. (V) "Sounds of the Sea."
Saturday, January 10th. (VI) "Sounds in War."

Chief Technical Assistants' Association.—Saturday, January 3rd. At 3 p.m. At Anderton's Hotel, Fleet Street, E.C. Resumed discussion on "Improving the Thermal Efficiency of Generating Stations," by Mr. H. F. J. Thompson.

Liverpool Engineering Society.—Wednesday, January 7th. At the Royal Institution, Colquitt Street. At 8 p.m. Adjourned discussion on Mr. H. T. Newbiggin's paper on "The Science and Art of Lubrication."

Institution of Electrical Engineers. — Thursday, January 8th. At the Institution of Civil Engineers, Gt. George Street, S.W. At 6 p.m. Paper on "Failures of Turbo-generators and Suggestions for Improvements," by Mr. J. Shepherd.
(**Preston Sub-Centre.**)—Monday, January 5th. Address on "Electric Traction," by Col. O'Brien.

Electro-Harmonic Society.—Friday, January 9th. At 8 p.m. Holborn Restaurant. Smoking Concert.

Magnetic Separators.—An interesting series of articles dealing with magnetic separators is being published in *Le Génie Civil*. The first appeared in the issue dated December 13th, and gives a good deal of valuable information regarding the permeability of various ores, &c. The articles give exhaustive details and diagrams of several types of separators.

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NOTES.

Parliamentary.—ROYAL ASSENT.—The following Acts have received the Royal Assent :—

Trade Marks Act, 1919.
Patent and Designs Act, 1919.
Workmen's Compensation (War Addition) Amendment Act, 1919.
Electricity (Supply) Act, 1919.
Shropshire, Worcestershire and Staffordshire Electric Power Act, 1919.

Appointments Vacant.—Tramway general manager (£800, rising to £1,000), electrical engineer (£1,000, rising to £1,250) for the Cardiff Corporation; mains engineer (£340) for the Sunderland Corporation electricity department; engine-driver (72s.) for the County Asylum, Rainhill; switchboard attendant (98s. 6d.) for the Stockport Borough Council electricity works; charge hand for the Gellygaer Urban District Council electricity department; commercial assistant to the borough electrical engineer and chief clerk (£306) for the Stoke-on-Trent Corporation electricity department; assistant engineer (£350) for the Willesden Urban District Council electricity department. See our advertisement pages to-day.

Wireless Telephone Receivers.—A comprehensive study of the telephone receivers used in wireless telegraphy and telephony is in progress at the Bureau of Standards, Washington, D.C. The tests include measurements to determine the loudness of response given by different types of telephones, as well as the electrical characteristics which determine how satisfactorily they fit the electrical apparatus in which they are used. Accurate methods are being devised for these measurements. It is expected that observations will be made by a large number of persons, so as to express results in terms of the avearage ear, and also to use an electrical artificial ear, and determine the relation of the average ear to this device which will then serve as a standard. The results should make it possible to determine which type of receiver is required in a given wireless apparatus in order to obtain the loudest signals. The methods developed will be of value in making measurements of the strength or signals received, and will be utilised in connection with a study of the properties of electrical waves.

Electric Ship Welding.—The report of Lloyd's Register of Shipping for 1918-1919 states that arrangements have been made for experiments and tests to be carried out by Dr. Marchant, Professor of Electrical Engineering at the University of Liverpool, in connection with electric welding, in order to ascertain the best electrical conditions to be employed in the process of arc welding, and also to determine whether the variations in the current and voltage across the arc during welding can be used as a criterion of the satisfactory nature of a weld after it has been completed. In 1917 Lloyd's Register arranged for an exhaustive series of tests to be carried out under the direction of the society's chief ship surveyor, to determine, as far as possible, the general trustworthiness of structional connections effected by electric welding, and their capacity to withstand the strains to which they would be subjected. The results of the experiments made were considered by the Technical Committee of the society, and on its recommendation, as a tentative measure, provisional rules for the classification in Lloyd's Register book of vessels electrically welded, subject to the notations "Experimental" and "Electrically welded," were adopted. The committee also formulated its requirements regarding the tests to be complied with by all systems of electric welding for which approval was desired, and a notice was issued stating that the committee was prepared to consider applications from any electric welding companies for their processes to be recognised by the society for use in ship construction, and for their names to be inserted in a list of companies whose processes have been approved as fulfilling the society's conditions. (We described the first electrically-welded ship built in this country in our issue of August 9th, 1918.)

Plans for the first vessel in which the butts, seams and other connections are to be electrically welded have been submitted, and approved by the committee. This vessel, about 150 ft. in length, in which the use of rivets will be entirely dispensed with, is now nearly ready for launching.

Armstrong-Whitworth's New Locomomotive Works.—One of the most interesting instances of reconstruction work on Tyneside is the conversion of the Scotswood munition works into a locomotive works. When the armistice was signed the works, which formed an important part of the great Elswick Arsenal, and covered an area of 35 acres, were occupied by some 4,000 machines for the production of shells, but the moment military operations ceased, the removal of the whole of these machines was begun, and others requisite for locomotive engine-construction were installed. It was a great undertaking, but so promptly was it done that within a year the first locomotive was built, tested, and ready for delivery.

The point of outstanding interest to electrical engineers, however, is the very extensive use that has been made of electrical energy, the installation having been reconstructed in the last nine months. The energy is obtained from the Newcastle-upon-Tyne Electric Supply Co., in bulk, off its 6,000-volt system, and this is led into four sub-stations at various parts of the works. These sub-stations have duplicate feeders laid between them, forming a ring main on the works supply. The E.H.T. cables are connected to "Reyrolle" ironclad wall-operated type switchgear, so arranged that half of the installation can be isolated for overhaul. Transformers, each of 1,000 K.V.A. capacity are arranged in banks at three of the sub-stations, reducing the pressure to 440 volts. The energy is distributed by three-core L.C. and A. cables to the various shops, being controleld by medium-pressure ironclad switchgear of the same make as the high-pressure switchboard. Alternating current is used throughout for heavy power requirements, driving compressors, hydraulic pumps, cranes, shafting, &c. For lighting, separate transformers reduce the pressure to 110 volts. High-candle-power half-watt lamps are used throughout for general lighting, a standard of 4-ft. candles being maintained, while local lighting for inspection purposes is provided for all machines requiring it.

A fourth sub-station is used for converting the supply of alternating current to direct current, by means of Westinghouse rotary-converter sets, each of 750 KW. capacity. The D.C. is distributed to the machine shops at a pressure of 480 volts, and is principally used for driving motors where variable speeds are required, including Lancashire drive combinations for planing machines, frame-slotting machines, slab milling machines, triplex and duplex drilling machines, boring and turning mills, plate and angle-bar straightening and bending machines, cold saws, and wheel turning machines, electro-hydraulic wheel presses, "Tasca" angle-face grinding machines, axle grinding machines, magnetic chucks and tables, portable drills and grinders, &c. The starting gear and control mechanism is invariably of the cast-iron pillar type with remote control, push-button operation on the larger machines to facilitate handling. Metering of the energy used on the various operations is provided for, so that costing of each stage of the work can be obtained.

Two novelties introduced are a rivet-heating machine made by the firm, and a machine of Messrs. Armstrong Whitworth's own invention for horizontal grinding, in which the articles are held in position by means of magnetism.

The whole of the electrical work involved in the change over of the works was carried out by the firm's own electrical department, with the exception of connecting the high-pressure mains to the switchboard, which was carried out by the supply company.

The first locomotive completed was a 0-8-0 super-heated engine for the North-Eastern Railway Co., built from the designs of Sir Vincent L. Raven, chief mechanical engineer of the railway. Fifty of these engines are to be constructed. When the works are in full swing, between 6,000 and 7,000 men will be employed, and the erecting shop has a capacity which will permit 70 engines to be built at one time, of which 36 could be of the main-line type.

Electrical Detection of Subterranean Oil.—It is stated that crude petroleum has been located electrically in the shallow oilfield near Corsicana (Texas), and that further tests are being made around Burkburnett. A series of batteries is used for the test, the negative terminal being connected to a wire which is dropped into a dry waterhole, valley, or indentation, and the positive terminal is connected to a "land wire," which is used to make contact at various points on the surface of the field investigated. It is stated that the higher electrical resistance of oil, compared with other constituents of the earth, permits it to be located by the reduced deflection of a sensitive instrument in the circuit.—*Electrical Review*, Chicago.

Society of Technical Engineers.—A mass meeting of members, at Manchester, on December 19th, was addressed by Mr. E. Murray-Wrong, who took as his subject "The Value and Purpose of Organisation." He explained to the meeting that he was speaking from the point of view of one outside the society, and he did not possess any special knowledge of the society's objects. The speaker then gave his views of trade unions and similar organisations, and pointed out that contrary to earlier social doctrines these did not restrict individual liberty, but provided a speaking medium through which the individual might express his ideals. It had been considered that trade unions necessarily involved class warfare and unrest, but this was chiefly due to ignorance of the functions of such bodies. Their main object was negotiation, and the strike was only resorted to when negotiations failed.

Mr. Murray-Wrong considered that the society had many difficulties to contend with. At one end of the scale it graded almost imperceptibly into Labour, and at the other into Capital. The society had therefore to guard against two possibilities. There might be an attempt to use it as a "balance of power" between Capital and Labour—a policy which meant failure. Again, the organisation might tend to become an appendage of Capital, thereby alienating labour and limiting the society's sphere of action. In the speaker's opinion, the best course to pursue would be for the society to associate itself with the labour movement generally, sending representatives to conferences and other similar gatherings. This would secure a public hearing, and make it possible to influence public opinion, which was the main purpose of such an organisation.

Upon the conclusion of the address a number of members took part in a discussion of the subject.

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The Electric Smelting of Tin.—In No. 99 of the *Revue d'Electrochemie et d'Electrometallurgie* an account is given by Prof. Jean Escard of the treatment of tin ores in the electric furnace. The author states that an electrical efficiency of 55 per cent. or more can be attained, and the electric furnace produces pure tin with continuous operation, which is not possible with the reverberatory furnace. The former, moreover, requires only 14 per cent. of carbon for reduction, as compared with 20 to 25 per cent., employs less labour (only three men per furnace), and consumes the electrodes so slowly that their cost is negligible. Where waterfalls exist in the neighbourhood of tin mines, and coal is dear, the electrical process presents marked advantages. Charcoal can be used for reduction. The energy consumption per ton of tin is about 1,140 KW.-hours. The furnace is of the "shaft" type, with three electrodes. Similarly, the electric furnace (of the resistance type) can be applied to the recovery of tin from scrap metal with a high commercial efficiency.

Inquiry.—The name and address of the glass shade manufacturers or factors known as "W. F. Co., Ltd.," is wanted.

Diesel Engine Users' Association.—At the December meeting of the Diesel Engine Users' Association, Mr. Chas. Gould, A.M.I.E.E., electrical engineer to the First Garden City, Ltd., Letchworth, was elected president for the ensuing year, and Mr. Percy Still, M.I.E.E., M.I.Pet.Tech., chief engineer and manager to the Chelsea Electricity Supply Co., Ltd., was re-elected hon. secretary. Messrs. Geoffrey Porter, A.M.I.nst.C.E., and A. W. A. Chivers were elected members of the General Committee, in place of the two members who retire. The present members of the Standing Committee on Insurance, which deals with any question arising in connection with the standard policy of insurance against breakdown at Lloyds which has been approved and adopted by the Association, were all re-elected for a further term of office. The Hon. Secretary made his annual statement, referring to the further growth in the membership of the Association, and the subjects dealt with and work carried out during the year.

Theatre Electricians.—As the result of a Conference with the Parliamentary Committee of the Trade Union Congress on December 30th an agreement was reached between the National Association of Theatrical Employés and the Electrical Trades Union in regard to a dispute between the two organisations. There had been trouble with the Electrical Trades Union over the attempt of that society to enrol theatrical electricians and kinema operators. The agreement signed by representatives of both Unions and the Parliamentary Committee runs thus :—

"That the N.A.T.E. and the E.T.U. agree to recognise each other's membership card in the entertainment industry. That each Union undertakes not to induce a member of the other Union to leave one Union for the other. That when any question arises affecting the conditions of employment of members of either Union employed in the entertainment industry both Unions agree that the section so affected shall have the support of all other sections belonging to either Union.

"That, with regard to members of either Union, employed in the entertainment industry, joint action be taken to promote a joint programme for all membars of either Union so employed, in any area. That immediate steps be taken to promote a joint programme for those employed in picture theatres."

Educational.—The Electricity Committee of the Willesden Urban District Council has had under consideration a scheme submitted by the electrical engineer for providing a graduated course of training in electrical engineering for boys residing in the district. This scheme is the outcome of many applications which have been received for the training of lads in this manner, and the Committee is of the opinion that it would be advantageous to the Council and to the inhabitants of the district if it were brought into operation. It, therefore, recommends that the scheme as drafted be approved in principle.

The Patent Office Library.—The library is now open daily, from 10 a.m. to 8 p.m., except Sundays, Good Fridays, Christmas Day, and Bank Holidays. On Christmas Eve, Easter Eve, and Whitsun Eve the library will close at 4 o'clock. As announced in our "Correspondence" columns on December 12th, Mr. C. Salter, of 33, Park Hall Road, London, N. 2, is promoting a petition to the President of the Board of Trade with a view to extending the hours to 10 p.m., and will be glad to hear from readers who will support the movement.

INSTITUTION NOTES.

Institution of Electrical Engineers.—The December issue of the *Journal* announces the following arrangements for January, 1920 :—

Ordinary Meetings of the Institution.—(To be held at the Institution of Civil Engineers, Great George Street, Westminster, at 6 p.m.)

January 8th. "Failures of Turbo-Generators and Suggestions for Improvements," by J. Shepherd.

January 22nd. "Transformers for Electric Furnaces," by J. L. Thompson, M.Sc.

Meetings of Territorial Centres.—January 6th, Preston. "Electric Traction," by H. E. O'Brien, D.S.O.

January 12th, Newcastle. "Scientific Management," by J. M. Scott-Maxwell.

January 13th, Edinburgh. (To be announced later.)

January 13th, Leeds. "Large Power Transformers," by A. G. Ellis and J. L. Thompson.

January 13th, Manchester. (To be announced later.)

January 14th, Birmingham. "Eddy Current Losses in Stator Windings," by H. W. Taylor.

January 15th, Birmingham. Joint meeting with Midland Junior Gas Association.

January 19th, Liverpool. Address by Prof. E. W. Marchant, D.Sc. (Inaugural Meeting of Liverpool Sub-Centre.)

January 26th, Newcastle. "Failures of Turbo-Generators and Suggestions for Improvements," by J. Shepherd.

January 27th, Manchester. (To be announced later.)

January 28th, Birmingham. "Failures of Turbo-Generators and Suggestions for Improvements," by J. Shepherd.

January 30th, Newcastle. Annual dinner of North-Eastern Centre.

STUDENTS' SECTION.—January 16th. City and Guilds Engineering College, South Kensington, S.W. (7 p.m.), "The Development of Automatic Telephony," by J. H. Reyner.

IRISH CENTRE (BELFAST).—The following have been appointed to form a Preliminary Committee to take the necessary steps to inaugurate this Centre :—Messrs. T. W. Bloxam, E. S. Dashwood, R. V. Macrory, F. W. Parkinson, H. D. Wight, and Prof. R. Stanley (acting hon. secretary).

SCHOLARSHIPS.—The Council has awarded the following Scholarships for 1919-20 :—

Salvesen Scholarships (value £50 each).—To Mr. J. C. Read, of Bristol University ; and to Mr. H. J. Barriscale, of the Engineering School, University College, Cork.

David Hughes Scholarships (value £50 each).—To Mr. D. S. Anderson, of the Royal Technical College, Glasgow ; and to Mr. B. A. Cronin, of the University College of South Wales and Monmouthshire.

Paul Scholarship (value £25).—To Mr. F. E. Price, of the Finsbury Technical College.

THE INSTITUTION OF ENGINEERS (INDIA).—The I.E.E. Council has awarded for the next five years, an annual prize of £20 for the best paper on an electrical subject read before the above Institution.

The *Journal* also gives a complete list of the Committees appointed by the Council for 1919-20, and the names of the Institution's representatives on other bodies.

The SCOTTISH CENTRE is holding a conversazione on February 4th, 1920, at St. Andrew's Hall, Granville Street, Glasgow.

Society of Technical Engineers (North-Eastern District).—The following meetings will be held during the current month, commencing at 7 p.m. :—

Sunderland.—Wednesday, January 14th, at the Subscription Library, Fawcett Street.

Middlesbrough.—Friday, January 16th, at the Corporation Hotel.

Newcastle-on-Tyne.—Wednesday, January 21st, at the City Hotel.

Belfast Association of Engineers.—"Wireless Communication in the War" was the title of a lecture given by Major Rupert Stanley, at Belfast, on December 18th. The lecturer, in the course of his address, which was illustrated by lantern views, dealt with the transmission and reception of wireless messages, wireless equipment for military purposes in the earlier phases of the war, the evolution of the hard valve and its advantages in wireless communication, the complete system of wireless communication employed in France in 1918, and the latest achievements in wireless signalling, telephony, and long-range work. Major Stanley was an instructor and experimental adviser to the British Expeditionary Force in France. In acknowledging the vote of thanks, Major Stanley said that the Allied triumph over the Germans in wireless work was largely due to the achievements of the French wireless experts.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Mr. E. JORDAN, of Northampton, has been appointed shift engineer at Rawtenstall Electricity Works.

Mr. A. W. COOPER, of the Electricity Works, Walthamstow, has been appointed meter charge engineer at the electricity works, London Road, Southend-on-Sea.

Captain and Adjutant D. A. WILLIAMSON, Tyne Electrical Engineers, has vacated the appointment of adjutant on ceasing to be employed.

Lieutenant W. G. C. HARDY, City of Edinburgh Electrical Engineers, has vacated the acting rank of captain on ceasing to be employed.

Commander J. P. SCHOFIELD, M.B.E., Principal of the Cardiff Wireless College, has been presented by the students with a silver cruet set. The college turned out 1,000 wireless operators during the war.

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At a smoking concert held at the Manchester Hotel, Hull, on December 19th, Mr. J. WILKINSON, who recently retired from the position of Corporation tramways electrical engineer, after nearly 20 years' service, was presented by Mr. J. W. A. Renton, supervising engineer, on behalf of the tramways department employés, with an Underwood typewriter and an umbrella. It is stated that Mr. Wilkinson is now introducing electrically propelled battery vehicles into Hull.

Mr. F. H. RUDD, electrical engineer to the Rochdale Corporation, has not yet recovered from a nervous breakdown, and on the advice of his doctor, is taking a further rest and change of surroundings. The Gas and Electricity Committee last week expressed their sympathy with him, and granted him a further two months' leave of absence. The committee feel that the breakdown of Mr. Rudd's health is due to the trying time he has had since he took control of the undertaking nearly three years ago. He has been faced with a great many difficulties, often being at the works for 48 hours at a stretch.

On the occasion of his leaving the Aberdeen Corporation Electricity Department to take up duty as shift engineer with the Falkirk Corporation, Mr. H. TROWSDALE, on December 26th, was made the recipient of a watch and chain as a parting gift from his fellow employés. Mr. Bullman, station engineer, in the absence of Mr. Bell, made the presentation.

The *Birmingham Post* states that the services rendered to Birmingham and the district by Sir Oliver Lodge and Lady Lodge were to be recognised by the presentation of an address and a memento to them at a meeting of the subscribers to be held at the Council House on January 1st. The list of contributors was closed on December 31st.

On the occasion of his leaving the Surbiton Electricity Supply system to take up another appointment, Mr. A. W. CRICK, who has been a member of the staff for the past 16 years, was presented with a suit case.

Alderman G. PEARSON, chairman of the Bristol Corporation Electricity Committee, who has for the past 14 years acted as honorary solicitor to the Incorporated Municipal Electrical Association, has recently, much to the regret of the Association, been compelled to resign owing to indifferent health. The Council of the I.M.E.A. have pleasure in announcing that Mr. P. M. Heath, deputy town clerk of Manchester, has consented to accept this position.

Acting Captain J. A. SLEE, C.B.E., R.N., has been appointed technical superintendent and adviser on the staff of the Marconi International Marine Communication Co., Ltd.

Obituary.—MR. CLAUD HAMILTON.—The death took place at Sidmouth, Devon, where he was on holiday, of Mr. Claud Hamilton, of Claud Hamilton, Ltd., electrical engineers, Glasgow and Aberdeen. Mr. Hamilton, who came of an old engineering family, took up that profession and served his apprenticeship with Messrs. A. & J. Inglis, Glasgow, and Messrs. J. & W. Abernethy, Aberdeen. When the latter business was incorporated as a limited company, he became a director. In the late '80's he founded the business of Claud Hamilton, which, under his direction, became one of the most extensive concerns of its kind in Scotland.

MR. W. HOPEKIRK.—The death is announced, at the age of 74 years, of Mr. W. Hopekirk, electrical engineer, of Hawick.

NEW COMPANIES REGISTERED.

Perna Engineering Works (Blackpool), Ltd. (161,690).—Private company. Registered December 15th. Capital, £3,000 in £1 shares. Objects: To take over the business carried on at Castlegate, South Shore, Blackpool, as the "Perna Engineering Works," and to carry on the business of general and electrical engineers, manufacturers of Perna electric-dynamo lighting sets and other Perna specialities, builders and makers of motor bodies, chassis, &c. The subscribers (each with one share) are: G. H. Morris, 59, Central Drive, Blackpool, contractor; W. S. Pyrah, 3, Alexandra Road, South Shore, Blackpool, engineer; R. H. Mann, 20, Osborne Road, South Shore, Blackpool, engineer. The first directors are: G. H. Morris, W. S. Pyrah, and R. H. Mann. Registered office: Castlegate, South Shore, Blackpool.

British Brass Fittings, Ltd. (161,968).—Registered December 22nd. Capital, £350,000 in £1 shares. Objects: To take over the businesses of Sperryn & Co., Ltd., Chas. Joyner & Co., Ltd., Ingram & Kemp, Ltd., and Player & Mitchell, Ltd., with certain of the assets thereof (the purchase considerations being respectively £95,644, £43,305, £28,164 and £23,872), and to carry on the business of brass and iron founders, water, gas, oil and electric fittings manufacturers, &c. The first directors are: G. Sperryn, Hampton Grange, Solihull, director of Ingram & Kemp, Ltd., and Sperryn & Co., Ltd.; G. M. Sperryn, 25, Wycliffe Road, Handsworth, director of same companies; H. B. Butler, Meadow View, Stratford-on-Avon, director of Butlers, Ltd.; D. B. Grubb, High Croft, Alvechurch, director of Kiore Sheep Farming Co., Ltd.; W. J. G. Sperryn, 45, Frederick Road, Wylde Green, Birmingham, director of Ingram & Kemp, Ltd.; W. Dampier, Park Mount, Strencham Hill, Moseley, Birmingham, director of Player & Mitchell, Ltd. Acting secretary: H. B. Butler. Solicitors: Brooks, Monk and Hargreave, 37, Waterloo Street, Birmingham.

C. H. Davies & Co., Ltd. (161,802):—Private company. Registered December 18th. Capital, £12,000 in £1 shares (2,000 6 per cent. cumulative preference). To take over the business of an electrical accessories manufacturer carried on by C. H. Davies at 153, Bracebridge Street, Birmingham. The subscribers (each with one share) are: C. H. Davies, 153, Bracebridge Street, Birmingham, electrical engineer; T. Gladdy, 155, Bracebridge Street, Birmingham, electrical engineer; T. Reynolds, 155, Bracebridge Street, Birmingham, mechanical engineer. The first directors are: C. H. Davies, T. Gladdy and T. Reynolds. Solicitor: E. F. Freeland, Birmingham.

British Electrical Repairs, Ltd. (161,905).—Registered December 20th. Capital, £50,000 in £10 shares. Objects: To carry on business as indicated by the title. The first directors are: J. J. Atkinson, 1, North John Street, Liverpool; H. C. Evans, 18, Exchange Street, Manchester; N. Fletcher, Eden Browe, Armathwaite; L. V. Gerrard, 24, Fennel Street, Manchester; H. M. Longridge, 24, Fennel Street, Manchester; N. H. Maxwell, 1, North John Street, Liverpool; H. F. Taylor, 56, Kingsway, W.C.2. Registered office: 24, Fennel Street, Manchester.

Sutton-in-Ashfield Motor and Electrical Engineering Co., Ltd. (161,841).—Private company. Registered December 18th. Capital, £20,000 in 19,950 preferred ordinary shares of £1 each and 1,000 deferred ordinary shares of 1s. each. To carry on the business indicated by the title, and to adopt an agreement with R. Fenna. The subscribers (each with one preferred ordinary share) are: J. B. Hole, Redbank, Mansfield, Notts, gentleman; B. Walton, jun., 74, Kirkby Road, Sutton-in-Ashfield, Notts, hosiery manufacturer. The first directors are: J. B. Hole and B. Walton, jun. (both permanent, subject to holding 100 deferred ordinary shares each). Qualification of ordinary directors, £500. Registered office: Bank Chambers, Sutton-in-Ashfield.

British Aris Sparking Plug Co., Ltd. (161,966).—Private company. Registered December 22nd. Capital, £5,000 in £1 shares. Objects: To carry on the business of manufacturers and importers of and dealers in sparking plugs and all kinds of mechanical or electrical machinery, engineers, turbines, dynamos, &c., and to enter into an agreement with Société Aris of 33, Rue de l'Abondance, Lyons, France. The subscribers (each with one share) are: J. P. Edmunds, White Lodge, Whitchurch, Glam., director and shipowner; H. H. Deacon, "Coedmor," Penarth, colliery agent. Permanent directors are: J. P. Edmunds, H. H. Deacon, F. H. Bridge, A. S. Shedden, H. J. Edmunds and A. L. Rhys-Evans. Qualification, £100. Secretary: A. L. Rhys-Evans. Registered office: 65-8, Merchants' Exchange, Bute Docks, Cardiff.

Appareil Magnetique Co., Ltd. (161,796).—Private company. Registered December 18th. Capital, £4,000 in £1 shares. To take over the business of a company of similar name, and to carry on the business of medical electricians and magneticians, manufacturers of electrical, surgical and calisthenic appliances, sports goods, &c. The subscribers (each with one share) are: H. F. Perry, 8, Park Grove Road, E.11, cashier; G. C. Baldock, 54, Strowe Road, E.7, solicitor's clerk. Managing director: G. Petterson. Registered office: 2, Charterhouse Street, E.C.

B. K. E. Electric Motors, Ltd. (161,749).—Private company. Registered December 17th. Capital, £20,000 in £1 shares. To carry on the business of buyers and sellers of and dealers in all kinds of vehicles, ships and vessels (whether propelled or moved by electricity, steam or other power) and all electric or other motors, &c. The subscribers (each with one share) are: C. E. W. Ogilvie, 32, Essex Street, Strand, W.C., solicitor; W. R. Bradshaw, 32, Essex Street, Strand, W.C., clerk. The subscribers are to appoint the first directors. Qualification, £500. Solicitor: C. E. W. Ogilvie, 32, Essex Street, Strand, W.C.2.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Power Engineering Co., Ltd.—Debentures for £500 registered November 14th, 1919, part of £11,500, charged on the company's undertaking and property, present and future, including uncalled capital.

Rushmores, Ltd. (formerly Rushmore Lamp Works, Ltd.)—Satisfaction registered November 12th, 1919, (a) to the extent of £27,500, of charge for £30,000 registered December, 1917, and (b) in full, of charge for £1,002, and other moneys registered August, 1919.

English Electric Co., Ltd.—Debentures for £1,000,000 (secure by trust deed dated September 15th, 1919) charged on interests in various shares and in certain freehold works at Preston and Bradford, and the company's undertaking and property, present and future, including uncalled capital.

CITY NOTES.

Eastern Extension, Australasia and China Telegraph Co., Ltd.

At the meeting held on December 17th, Sir J. Denison Pender first referred to the death of Mr. F. A. Bevan, who had been a director since 1873. Turning to the accounts, he said that these were very satisfactory as the gross receipts for 1918 showed an increase of £562,000, due to the enormous increase of traffic all over the company's system. The working and other expenses showed an increase of £68,000, mainly accounted for by additions to the staff salaries and war payments. A revaluation of their securities showed that the provision made in past years on account of investment fluctuations was found to be practically sufficient to meet the depreciation of the reserve fund securities on December 31st, 1918, when the accounts were made up. At the meeting of the Eastern Co. he had gone very fully into the causes of delays on traffic. He would not go over the ground again, and they would receive a full report of that meeting. As an illustration of the enormous growth of traffic since the outbreak of war he mentioned that the trans-Indian and this company's local traffics between India and the Far East, &c., showed an increase in 1918 of roundly 327 per cent. over the pre-war year 1913. Consequently, additional carrying capacity was urgently required to deal with this large volume of traffic, and they were making arrangements for the manufacture and laying of a new cable between Madras and Singapore at the earliest possible moment. The Eastern and other cable companies also urgently needed more cables to meet their traffic requirements, and it would, therefore, take some little time before this could be effected. The money required for the Madras-Singapore cable would be taken from the general reserve fund.

Ward and Goldstone, Ltd.

At the statutory meeting, held at Manchester on December 18th, Mr. M. H. Goldstone, who presided, said that the state of the order book was very healthy; in fact, they were booked up at profitable rates in most departments for a long time ahead. The demand for wires, cables, and flexible cords, continued in excess of the supply. Not only was there a continued increasing demand for cables for lighting, heating, power, telephone and bell service, but

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the automobile industry requirements were very substantial, and the directors were making provision in the new works for increasing the output. In the departments relating to switch and fuse gear, owing to the heavy stocks of castings they usually carried, they had as yet not been seriously handicapped by the moulders' strike, but unless this trouble was soon settled, they feared that this department was likely to suffer. Almost every branch of the engineering industry was dependent upon obtaining supplies of castings. The demand for their electrical plants for lighting country houses, bungalows, cinemas, &c., was growing, and they looked to this department to supplement their profits to a considerable extent. Referring to the competition of American and other makers, he said that they had little fear of fair competition in lighting sets. They were anxious to remove to the new works, particularly as the congested state of the present stores and warehouse was restricting turnover. They hoped to start moving in April of 1920, and as it was intended, as far as possible, not to stop production during removal, they were duplicating a portion of the machinery. It was anticipated that by a year hence they would be finally installed in the new works, when they would be able to cope more successfully with the large amount of business offered. The turnover of the company continued to increase satisfactorily. The directors were optimistic as to the future prospects of the company, providing that they could steer clear, as they had done in the past, of labour trouble.

Eastern Telegraph Co., Ltd.

Presiding at the annual meeting, held at Electra House, E.C., on December 17th, Sir J. Denison Pender made some comparisons to illustrate the growth of business during the war and since the signing of the armistice. The gross revenue for the year 1913 was £1,462,844. For 1917 it was £2,901,579, an increase of £1,438,735, or 100 per cent. For 1918 the gross revenue was £463,470 in excess even of 1917, and £1,902,205 above the pre-war figure. On the other hand, the total expenses had correspondingly increased, and large payments had accrued to the Government for excess profits duty and income tax, the result being that, notwithstanding the increase in the gross revenue over 1917 of £463,470, the amount available for reserve and dividend on the ordinary stock was roughly £20,000 less than in 1917. The amount charged in the accounts under review for income tax and excess profits duty payable in England was £861,300, and the amounts paid and due to the Government from this and their associated companies for the last five years totalled no less than six million pounds. Special attention should be drawn to the expenses attending maintenance of cables, £364,807. This work now involved great expense owing to additional cost of cable and materials, higher labour charges, and all the other items relating to the upkeep and running expenses of ships. The average annual cost of this item for the five years prior to the war was £107,021. Although their men had necessarily to run risks in repairing cables during the war, they did not lose a ship, although the whole fleet was at work practically night and day. The naval authorities realised the vital importance of maintaining telegraphic communication throughout the Empire, and it was a great satisfaction to the company to render important service to both the naval and military authorities by laying, maintaining, and working many strategic sections, as well as maintaining a satisfactory service for Government correspondence. The combined interests of this country and the Allies were their first consideration, and, although regular customers were subjected to many restrictions and their commercial service was hampered, they did everything possible to provide the best service obtainable during the war. Unfortunately, the commercial service still fell short of the high state of efficiency which existed before the outbreak of war, and public telegrams were subject to serious delay. They were doing everything possible to improve matters. That they would succeed in again attaining their pre-war standard there was no doubt whatever, but it must necessarily take time. Prior to August, 1914, the routes owned by the Indo-European and by the Great Northern Telegraph Companies, which passed through Germany and Russia, dealt with approximately 40 per cent. and 30 per cent. of the Indian and Far East traffic respectively, and since that date this company had had to deal with practically the whole of this work in addition to their own traffics. Before the war their system of duplicate, triplicate, and in some cases quadruplicate cables, and alternative routes, which provided security against the temporary breakdown from natural causes of one or more sections, always gave a good margin of capacity over and above a likelihood of any abnormal volume of traffic which might arise from any special event of national or international interest. When the unprecedented increase of traffic with which they had to cope was suddenly thrust upon them, the whole of their previous margin of safety disappeared, and it was impossible to manufacture and lay additional cables to meet this emergency. Not only was this impossible, but it was with the greatest difficulty that they were able to maintain the cables already laid. Another factor which should not be overlooked was shortage of staff. The demand for youth to maintain the fighting forces had, naturally, the effect of cutting off the supply of suitable young men, and as it took some years of training and experience to make an efficient telegraph operator, the burden during the war was thrown upon the shoulders of those who, from age or by the wise decision of the naval and military authorities, were prevented from taking an active part in the land and sea defences of their country. The supply of suitable young men was now more satisfactory, and the strengthening of the staff was now only a question of time, but it must be remembered that some years' training had been lost. The Government telegrams exchanged with and through the United Kingdom contained on an average over 30,000 words a day, whereas in 1913 the daily average was only about 3,000 words. The total number of paid words dealt with by the companies in 1918 was about 180 millions, in addition to which they had carried during the war three million words free of charge in connection with wounded, Red Cross, &c. In 1913 the total number of words was only about 64 millions. They had hoped that with the removal of the censorship restrictions and the reintroduction of private codes, the volume of traffic would appreciably diminish. The reverse had taken place, the number of messages had increased, and their length was only slightly reduced. Not long ago two of their main line cables were accidently broken by ships' anchors, and although these were speedily restored, the accumulation due to these interruptions created serious delay, because there was no margin of capacity to deal with the congestion resulting from the interruptions. No permanent improvement could be relied upon if the traffic was maintained at its present level, until they could improve the capacity of the system by laying additional cables and introducing new apparatus, which would increase the speed of working. Neither of these means was possible during the war, as all the cable and electrical apparatus manufacturers practically devoted the whole of their energies to the output of war materials, and it would be some time yet before their requirements could be met. They had long since placed orders for both cable and apparatus, and the manufacturers were doing all they could to assist, but the unavoidable delay in delivery hampered their initiative. They made arrangements with the Ministry of Shipping to charter the *Stephan*, one of the largest cable-laying vessels in the world, which was taken over from the Germans, and she had just completed the laying of another fast speed cable between Porthcurnow, in Cornwall, and Gibraltar, about 1,200 miles in length, which would form the first section of a new main line between Great Britain and the Far East through the Mediterranean, and on *via* Bombay and Madras, then taken on by their associated company, the Eastern Extension, &c., Co., to Singapore, involving an expenditure of about 7,000 miles of cable. Provisional orders were placed immediately there was a likelihood of the cable being manufactured, and as soon as each section was delivered it would be laid and worked. In the meantime partial renewals had been and were being carried out, and other means had been devised to improve the speed of some of the existing cables. The manufacturers were also being pressed by other administrations to carry out extensive orders for cable to improve telegraphic communication in other parts of the world where there was also heavy delay. After referring to the vexed question of triple-rate urgent telegrams, the chairman said that the company was one of the few public concerns which had not raised their charges during the war. On the contrary, they had, in fact, reduced their rates since 1914 with British West Africa, New Zealand, the Dutch East Indies, Japan, South Africa, and East Africa, while reductions with China, Hong-Kong, and the Philippines would come into operation on January 1st next. Although they were always ready to reduce rates whenever circumstances warranted it, they must point out that the Governments of Great Britain and India had considered it necessary to increase their pre-war charges for local internal telegrams, and the rentals charged for pneumatic tubes and underground wires had also recently been raised, which had had the effect of considerably increasing their outpayments in Great Britain. The general reserve fund had reached £3,076,000, due to the conditions ruling during the last five years, which made it impossible to undertake necessary renewals and the laying of cables—even those which in the ordinary course would have been necessary to provide additional capacity to enable them to deal properly with the normal growth of business. Therefore, the moneys which would have been expended on this work had there been no war were invested for the time being in War Loans. When it became possible to get delivery of a part of their requirements, they laid the first link, the new Porthcurnow-Gibraltar section already mentioned. This company alone must have at least another 4,000 miles of cable as soon as they could be manufactured and laid, the cost of which would be chargeable against the general reserve fund, and as the price of cables to-day was so greatly in excess of pre-war prices the reserve fund would be materially reduced. Their reserve fund was not a "free reserve" in the sense of the reserves of other trading concerns, and could not be looked upon as available for capital distribution. It was set aside for the specific purpose of providing renewals and additional cables, &c., as required; and the withdrawals in future would be very heavy. They had ordered a new cable repairing ship capable of consuming either coal or oil fuel, and fitted with all the latest cable repairing machinery and equipment. She would be a very useful addition to their fleet. Had it not been for the moulders' strike she would have been delivered in May next, but this date could not now be adhered to. Her cost would be more than double the pre-war price.

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Bullers, Ltd.—The report for the four years ended July 31st, 1919, states that during the period in which the company was a controlled establishment the directors were unable to issue reports and statements of account owing to the difficulty of arriving at accurate figures relating to munitions levy and excess profits duty. A settlement with the Government has been reached enabling balance sheets for the four years to be submitted. In order to deal with the great increase in the volume of business, new works at Milton are being erected and are nearly complete. The accounts for the years 1916, 1917, and 1918 have been adjusted and a final balance of £9,443 has been brought forward to be dealt with. For the year ended July 31st, 1916, 7½ per cent. dividend on the ordinary shares has been paid, and for 1917 and 1918 10 per cent. The reserve fund has been increased, and now stands at £90,000. The accounts, after payment of the directors' fees, salaries, &c., and after providing for excess profits duty, show a profit of £32,653. This amount, together with £9,443 brought forward, makes a total of £42,096. The directors recommend a further dividend of 7½ per cent., making 12½ per cent. for the year, on the ordinary shares; that £10,000 be placed to reserve, bringing that amount up to £100,000; a further allocation of £5,000 against contingencies at Hanley, and the balance of £846 to be carried forward.—*Financial Times.*

Companies Struck off the Register.—The following companies have been struck off the register, and are accordingly dissolved:—

British Empire Lighting and Construction Co., Ltd.
Carbo Welding Syndicate, Ltd.
Coal Carbonising Patent Syndicate, Ltd.
Electra Rubber and Vulcanite Syndicate, Ltd.
Oil Fuel Gas Generator, Ltd.
Ostro Light Co., Ltd.
Shipston Electrical Co., Ltd.

Barbados Electric Supply Corporation, Ltd.—For the year ended June 30th, 1919, the trading profit was £3,600, as against £3,197 for the previous year. £1,303 has been charged against trading for repairs and renewals, as against £484, the increase being due chiefly to the cost of renewals to Diesel engines necessitated by a breakdown which occurred subsequent to the issue of the last report

	Consumers connected June 30th.	25 c.p. equiv. connected June 30th.
1918	1,541	22,208
1919	1,646	23,034

In view of the breakdown and of the difficulty of obtaining materials of all kinds, the progress is considered satisfactory. Capital expended during the year £1,854, chiefly upon further house connections and mains additions. A 225-KW. set is being installed to meet the growing demand and to provide sufficient spare plant to admit of the systematic overhaul.

Stock Exchange Notices.—Application has been made to the committee to allow the following to be officially quoted:—

British Electric Transformer Co., Ltd.—62,500 6 per cent. cumulative preference shares of £1 each, fully-paid (Nos. 200,001 to 262,500).

Aluminium Corporation, Ltd.—£206,323 ordinary stock, and £219,512 preference stock.

The Rumanian Lahmeyer Co.—The annual report for 1918 of the Electrica Societate Romana Jost Lahmeyer, of Bucharest, states that the company was placed under Rumanian compulsory administration in December of that year. The net profits earned amounted to 237,000 lei in 1917, and 437,000 lei in 1918, dividends at the rate of 4 and 6 per cent. respectively having been declared. It is stated, however, that the dividends have not been paid, nor has the coupon due on July 1st, 1919, on the bonds, which were issued in Swiss francs, been met, the rate of exchange being unfavourable to the company.

Crompton & Co., Ltd.—Interim dividend at the rate of 7 per cent. per annum on the preference shares for the half-year ended September 30th, 1919.

Burmah Electric Tramways & Lighting Co., Ltd.—Dividend of 10 per cent., less tax, on the preference shares for the period ended July 31st, 1919; £8,000 is placed to depreciation reserve, making it £35,894; £750 to depreciation of investments, and £492 is carried forward.—*Financial Times.*

International Light & Power Co.—Dividend of 1½ per cent., less British tax, on preference for quarter ended December 31st.

STOCKS AND SHARES.

NEW YEAR'S EVE, 1919.

HARKING back for a couple of years, it may be recalled that at the end of 1917 the interim report of the Coal Conservation Sub-committee on the supply of electric power in Great Britain was presented to the nation. That report contained drastic suggestions which had for their object the conservation of coal by amalgamation of authorities. The sub-committee estimated to save a million pounds cash and 55 million tons of coal. The scheme was regarded at that time in the Stock Exchange as being of too wide and sweeping a nature for it to become practical politics, excepting, perhaps, after the lapse of many years. Some of its suggestions found their way into the Government's Electricity Supply Bill, 1919, and, as it is scarcely necessary to recall, this Bill the House of Lords has recently put its foot upon and trodden out of shape, so far as the objectionable features were concerned. Objectionable, that is to say, from the point of view of holders of shares in electricity supply companies. Throughout the whole of the year now ending, this Bill has laid a weight upon electricity investment of every kind. It has seemed to be the fate of the industry to be dogged for the past two decades by uncertainties. Now, however, the sky, although far from clear, is rendered the less obscure by the House of Lords' action, which, however, has failed to do much in the way of reviving the drooping spirits and the drooping prices that have prevailed amongst the shares in this section throughout the past twelve months. In presenting the usual tables, we give the closing quotations which prevailed at the end of 1918 and 1919. It may be devoutly hoped that when we come to give a column to the quotations for Leap Year, proprietors will derive more refreshment from the review than they are able to draw from the present prices.

The Home Railway market is another which has been dogged by troubles throughout the period. Nationalisation, when first predicted by Mr. Winston Churchill, was hailed as a lever for raising prices, but it very soon became apparent that from the point of view of the investor, there was nothing to it, as the soldiers say, and prices again started on the slippery slope which has taken them down lower than ever. Within the past few weeks something of a rally occurred on the expectation of the railway business being substantially benefited by the rise in freights that is to come into operation a fortnight hence, so that the final quotations for the year are well above the lowest. Even so, however, there is left a string of falls, though here again the prospect in respect of 1920 is a little more cheerful.

The steady upward march of cable securities continued through the greater part of the past twelve months. With taxation likely to press yet more heavily in the spring, investors, looking ahead, again favoured securities upon which dividends are paid free of tax, and for this reason such issues as Eastern Extensions, Globe Ordinary, Western Ordinary, and Eastern Telegraph stocks with several others, are decidedly better. Great Northerns are amongst the few to show a material fall on the year, an illustration of the way in which stocks with an inter-bourse market have been affected by the dislocation of the French rate of exchange. Marconis are better than they appear, inasmuch as the present quotation is ex the value of the rights recently deducted. Various Anglo-American stocks and bonds in companies domiciled in the United States and Canada have improved, this also being due to the rate-of-exchange factor, which has worked to the advancement of such prices as those into which the value of the dollar enters as an element. Mexicans have gone back again sharply after the big rises which occurred in 1918. To take Mexico Tramways First Mortgage Bonds as an example, the price last year gained 39½ points, whereas this year it has gone back 24½. A good deal of attention has been paid to British Columbia Electric Railway stocks, and the prices, after acute falls, recovered rapidly on the much more hopeful outlook which now opens up for the company. Anglo-Argentine tramway stocks are somewhat reactionary, in spite of the expectation that it may not be long before the company is able to pay off arrears of interest on the first preference shares.

The changes amongst manufacturing shares are somewhat mixed, but, on the whole, this market has been helped not a little by the idea that if the Government's Electricity Supply Bill went through, it would benefit the undertakings to a considerable extent, and notwithstanding the House of Lords attitude, the improvements secured by manufacturing issues have been well held. The loss of the Anti-Dumping Bill in the House of Commons caused some little speculation as to how far this may be likely to affect companies that were most likely to be helped by a policy of active protection. The lists of prices make an interesting study:—

HOME ELECTRICITY COMPANIES.

Stocks or Shares.	Dec. 31st, 1918.	Dec. 31st, 1919.	Rise or fall.		Dec. 31st, 1918.	Dec. 31st, 1919.	Rise or fall.
Brompton ..	7¼	5⅞	— 1⅜	London	1⅜	1⅛	— ¼
Charing Cross ..	3⅜	2⅞	— ½	Metropolitan ..	3	3	—
Chelsea	4	3	— 1	St. James' ..	7⅛	6	— 1⅛
City of London ..	13	12	— 1	South London ..	3	2⅛	— ⅛
County of London	11¼	9½	— 1¾	Westminster ..	7½	5½	— 2
Kensington ..	5⅝	4½	— 1⅛				

TELEGRAPHS AND TELEPHONES.

Ang.-Am. Pref. ..	99	90¼	— 8¾	Indo-European ..	58¼	48½	—10
Cuba Submarine	10¼	10¼	—	Marconi	4½	4⅛	+ ⅜
E. Extension ..	15⅞	16½	+ ⅝	United R. Plate..	7⅞	7⅜	— ½
E. Telegraph ..	157½	168¾	+11	W. India & Pan.	1⅞	1⅛	— ¾
Globe Tel. Ord. ..	14¼	16⅛	+ 1⅞	Western Teleg. ..	16½	17½	+ ½
Great Northern ..	38	23½	— 9½				

HOME RAILS.

Cen. Lon. Assen.	65½	58½	— 7	Under. Ord. ..	3⅜	2½	— ⅞
Metropolitan ..	31½	25½	— 6	do. "A" ..	8/9	6/6	—2/3
Met. District ..	26	21	— 5	do. Income .	92½	81	— 6½

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FOREIGN TRAMS., &c.

Stocks or Shares.	Dec. 31st, 1918.	Dec. 31st, 1919.	Rise or fall.	Stocks or Shares.	Dec. 31st, 1918.	Dec. 31st, 1919.	Rise or fall.
A. Arg. Tr. 1st Prf.	4 1/16	3 3/8	— 11/16	Mex. Trams. 1st	67	42 3/8	—24 3/8
Brazil Traction..	57	60 3/8	+ 3 3/8	Mex. Light Com.	38	17	—21
B. Col. Elec. Prf.	67 1/2	61 3/8	— 6	do. Pref. ..	49	25	—24
do. Preferred..	50	54 3/4	+ 4 3/4	do. 1st.. ..	70	52 1/2	—27 1/2

MANUFACTURING.

Babcock & Wilcox	3 11/16	3 5/16	— 3/8	Elec. Construct...	1 1/4	1 1/16	— 3/16
Brit. Aluminium	1 1/16	1 3/4	— 5/16	Gen. Electric ..	17 3/8	2	+2 3/8*
B. West. Pref. ..	2 3/4	2 1/16	+ 5/16	Henleys	2 1/4	2 1/2	—
Callenders ..	10 1/2	8 1/4	—2 1/4	India-Rubber ..	17	18 1/4	+1 1/2
Castner-Kellner..	3 3/8	3 5/16	+ 1/16	Telegraph Con. ..	48	26 1/2	+5*

* On undivided shares.

One of the features of the past few weeks has been an enormous outpouring of new issues. The electrical industry has taken its part, though a comparatively small one, in the demand for money. The general effect has been to reduce, a little, the quotations of the existing securities, and for obvious reasons. Newcomers must offer terms more tempting than those available from present stocks, and the diversion of public money into the former means that there is so much the less left for investment in the latter. The public have taken willingly, not to say greedily, the greater part of the new issues which have been so liberally presented, and that there is still plenty of money available for employment in stocks and shares is evident from the way in which company promoters are actively employed in the preparation of new prospectuses to be issued early in the New Year. The first year of peace has proved in some respects disappointing to those who looked for immediate resumption of normality, but the conviction that the anticipation of its fulfilment is only postponed for a while, lends sincerity to the hope that this may prove to all who are interested in electrical matters a Prosperous New Year.

SHARE LIST OF ELECTRICAL COMPANIES.

HOME ELECTRICITY COMPANIES.

	Dividend 1917.	Dividend 1918.	Price Dec. 30, 1919.	Rise or fall.	Yield p.c.
Brompton Ordinary..	10	8	5 1/4	+ 1/4	£6 16 2
Charing Cross Ordinary	4	4	2 1/4	—	7 1 7
do. do. do 4½ Pref. ..	4 1/2	4 1/2	3	+ 1/4	8 8 8
Chelsea..	5	5	5	—	5 0 0
City of London	8	8	12	+ 3/4	6 13 4
do. do. 6 per cent. Pref. ..	6	6	9 3/4	+ 1/4	6 8 0
County of London	7	7	9 1/4	—	7 11 4
do do. 6 per cent. Pref.	6	6	9 1/4	—	6 9 9
Kensington Ordinary	7	6	4 1/2	—	6 6 4
London Electric	Nil	Nil	1 1/2	+ 1/4	
do. do. 6 per cent. Pref...	5	6	8 1/2	+ 1/4	8 17 10
Metropolitan..	4	5	8	—	8 6 8
do. 4½ per cent. Pref. ..	4 1/2	4 1/2	8	—	7 10 0
St. James' and Pall Mall	9	10	6	—	8 6 8
South London	5	5	2 1/4	—	7 8 6
South Metropolitan Pref... ..	7	7	1	—	7 0 0
Westminster Ordinary	9	8	5 1/2	—	7 12 5

TELEGRAPHS AND TELEPHONES.

Anglo-Am. Tel. Pref.	6	6	90 1/2	—	6 12 8
do. Def.	1 1/2	88/6	22 1/2	+ 1/2	7 10 0
Chile Telephone	8	8	6 3/4	—	6 3 1
Cuba Sub. Ord.	7	7	10 1/2	—	*6 18 4
Eastern Extension	8	8	16 1/2	—	*4 18 7
Eastern Tel. Ord.	8	8	168 1/2	—	*4 15 0
Globe Tel. and T. Ord.	7	8	16 1/2	—	*4 19 3
do. do. Pref.	6	6	9 1/4	—	6 1 6
Great Northern Tel.	22	22	23 1/2	—	9 7 2
Indo-European	18	18	48 1/2	—	6 18 4
Marconi	20	25	4 3/8	+ 3/16	6 1 4
Oriental Telephone Ord.	15	10	2 1/2	—	4 14 1
United R. Plate Tel.	8	8	7 3/8	—	*5 5 0
West India and Panama	1/8	1/8	1/8	—	Nil
Western Telegraph..	8	8	17 1/2	—	*4 12 9

HOME RAILS.

Central London Ord. Assented ..	4	4	58 1/2	—	6 16 9
Metropolitan	1	1 1/2	2 1/2	+1/2	4 18 0
do. District ..	Nil	Nil	21	+1	Nil
Underground Electric Ordinary..	Nil	Nil	2 1/2	+ 1/4	Nil
do. do. "A" ..	Nil	Nil	6/6	+6d.	Nil
do. do. Income ..	4	5	87	+5	*5 15 0

FOREIGN TRAMS, &c.

Adelaide Sup. 6 per cent. Pref. ..	6	6	8 3/4	—	7 14 10
Anglo-Arg. Trams. First Pref. ..	6 1/2	Nil	3 3/8	—	—
do. do. 2nd Pref. ..	—	—	3 1/4	+ 1/4	—
do. do. 5 Deb. ..	5	5	61 1/4	—	8 2 8
Brazil Tractions	—	—	60 1/2	—1	—
Bombay Electric Pref.	6	6	13 1/2	—	4 9 0
British Columbia Elec. Rly. Pfce.	5	5	61 1/2	+2	8 2 8
do. do. Preferrred	Nil	2 1/2	54 1/2	+5	4 11 9
do. do. Deferred	Nil	Nil	52 1/2	+1	Nil
do. do. Deb. ..	4 1/2	4 1/2	61	—	6 19 4
Mexico Trams 5 per cent. Bonds..	Nil	Nil	42 1/2	—	Nil
do. 6 per cent. Bonds..	Nil	Nil	29	—1	Nil
Mexican Light Common	Nil	Nil	17 1/2	—7 1/2	Nil
do. Pref.	Nil	Nil	25	—	Nil
do. 1st Bonds	Nil	Nil	52 1/2	—2	—

MANUFACTURING COMPANIES.

Babcock & Wilcox	15	15	3 5/16	+ 1/16	*4 14 2
British Aluminium Ord.	10	10	1 3/4	—	5 14 3
British Insulated Ord.	25	12 1/2	2	—	6 5 0
Callenders	25	25	8 1/4	—	7 11 6
,, 6½ Pref.	5	6 1/2	4 1/4	—	6 11 6
Castner Kellner	25	20	3 7/16 xd	—	3 15 7
Crompton Ord.	7	10	21/6	—6d.	9 6 0
Edison-Swan, "A"	—	10	1 3/16	— 3/16	8 8 0
do. do. 5 per cent. Deb. ..	4	5	81 1/2	—	6 2 9
Electric Construction	10	10	1 5/16	— 1/16	9 8 2
Gen. Elec. Pref.	6	6 1/2	19/6	—6d.	6 12 6
do. Ord.	10	10	40/-	—	*5 0 0
Henley	25	25	2 1/4	—	5 11 1
do. 4½ Pref..	4 1/2	4 1/2	3 3/8	—	6 4 2
India-Rubber..	10	10	18 1/2	— 1/2	*5 9 7
Met.-Vickers Pref.	—	—	2 1/2	—	5 14 0
Siemens Ord...	—	10	27/-	+1/-	*7 8 2
Telegraph Con.	20	20	26 1/2	+ 1/4	*4 10 6

* Dividends paid free of Income Tax.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Tuesday, December 30th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Oxalic	per lb.	1/6	..
a Ammoniac Sal	per ton	£95	..
a Ammonia, Muriate (large crystal)	,,	£75	..
a Bisulphide of Carbon	,,	..	..
a Borax	,,	£89	..
a Copper Sulphate	,,	£41	..
a Potash, Chlorate	per lb.	1/1	..
a ,, Perchlorate	,,	1/8	..
a Shellac	per cwt.	£88	..
a Sulphate of Magnesia	per ton	£15	..
a Sulphur, Sublimed Flowers ..	,,	£28	..
a ,, Lump	,,	£25	..
a Soda, Chlorate	per lb.	6d.	..
a ,, Crystals	per ton	£70/-	..
a Sodium Bichromate, casks ..	per lb.	..	..
METALS, &c.			
g Babbitt's Metal Ingots	per ton	£88 to £292	..
c Brass (rolled metal at 80 basis)	per lb.	1/3 7/8	½d. inc.
c ,, Tubes (solid drawn) ..	,,	1/6 1/2	..
c ,, Wire, basis	,,	1/3	..
c Copper Tubes (solid drawn) ..	,,	1/8 1/2	..
g ,, Bars (best selected) ..	per ton	£157	£6 inc.
g ,, Sheet	,,	£157	£6 inc.
g ,, Rod	,,	£157	£6 inc.
d ,, (Electrolytic) Bars ..	,,	£128	£11 inc.
d ,, ,, Sheets ..	,,	£156	..
d ,, ,, Wire Rods ..	,,	£148	£11 inc.
d ,, ,, H.C. Wire	per lb.	1/5 1/2	1½d. inc.
f Ebonite Rod	,,	3/-	..
f ,, Sheet	,,	2/6	..
a German Silver Wire	,,	2/5	..
h Gutta-percha, fine	,,	10/- to 11/-	..
h India-rubber, Para fine	,,	2/6 1/2	..
i Iron Pig (Cleveland warrants) ..	per ton	Nom.	..
l ,, Wire, galv. No. 8, P.O. qual.	,,	£44	£2 inc.
g Lead, English Pig	,,	£46 10	£6 inc.
g Mercury	per bot.	£21	£1 dec.
e Mica (in original cases) small ..	per lb.	6d. to 4/6	..
e ,, ,, ,, medium ..	,,	5/- to 10/-	..
e ,, ,, ,, large ..	,,	12/6 to 25-/ & up.	..
g Phosphor Bronze, plain castings	,,	1/6½ to 1/10	½d. told. inc.
g ,, ,, rolled bars & rods	,,	2/3 to 2/6	..
g ,, ,, rolled strip & sheet	,,	2/3 to 2/9	..
d Silicium Bronze Wire	per lb.	1/10½	1½d. inc.
r Steel, Magnet, in bars	per ton	..	..
g Tin, Block (English)	,,	£310	£27 inc.
a ,, Wire, Nos. 1 to 16 ..	per lb.	4/6	3d. inc.
White Anti-friction Metals ..	per ton	£60 to £386	..

Quotations supplied by—

a G. Boor & Co.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
m P. Ormiston & Sons.
r W. F. Dennis & Co.

The Proper Position of an Engineer in Industrial and Political Circles.—In a paper read by Mr. E. C. de Segundo before the Woolwich Branch of the Society of Technical Engineers, on December 12th last, the lecturer said: Before considering the question of an engineer's position in industrial and political circles, it is necessary to define the term "engineer." There are many who usurp the title and it is, therefore, a difficult matter to distinguish between the false and the true. One American definition is that an engineer is "a man who can do for one dollar what any fool can do for two." At the first glance, an engineer would appear to be a man who works at a disadvantage to himself. In spite of this the description is an apt one, implying the possession of the ability to execute a task at the lowest expense in a minimum of time, and yet with the greatest efficiency. An engineer, then, must necessarily have energy, skill, and initiative. These attributes must have been developed by special education—he must therefore be a trained man. In addition to these mental and manual qualifications, however, an engineer must be a man of honesty and integrity, able to distinguish between questionable and true methods. Much of the present-day labour unrest is engendered by the lack of these virtues in both employers and employés—classes to either of which an engineer may belong. The former, in many cases, consider it their sole duty to get as much as possible out of their employés while paying them as little as they possibly can. On the other hand, employés often make it their ambition to obtain the highest possible rates, and at the same time to do a minimum of work. This is nothing short of civil war, and its effect upon the nation is disastrous, breeding mutual mistrust, discontent, and retarded production. The position of an engineer will depend entirely upon his qualifications, although, of course, there are bound to be a few exceptions. Nevertheless positions obtained by means of influence or favour cannot fail to work harm to the community if the occupants are not qualified to fill them. The position of a true engineer, therefore, is that of a leader carving out new paths of progress for the advancement of civilisation, bringing to bear the brains, the will, and the means of turning them to account.

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THE HIGH-FREQUENCY RESISTANCE OF WIRES AND COILS.

By Prof. G. W. O. HOWE, D.Sc., M.I.E.E.

(Abstract of paper read before the WIRELESS SECTION OF THE INSTITUTION OF ELECTRICAL ENGINEERS.)

THE last five years have seen a remarkable development of the application of high-frequency currents to telegraphy and telephony. In almost every such application coils through which high-frequency currents flow form an essential part of the apparatus. In some cases they contain an ounce or less of the finest wire, in others many hundredweights of massive copper strip or tubing. In all cases, however, it is a matter of importance to be able to calculate or, at least, to predict the losses occurring in these coils when carrying high-frequency currents. Without this knowledge it is impossible for the designer to utilise his material and space to the best advantage.

In this paper an explanation is given of the principles involved, and it is shown how these principles can be applied to the calculation of the resistance of wires and coils. A method of measuring the resistance is described and the results obtained are compared with the calculated values. The use of multiply insulated stranded wire is discussed. The paper is to be regarded as an opening contribution to a discussion on the subject.

Straight Conductors.—In a previous paper the author has shown how the well-known telephone transmission formulæ may be used to calculate the skin effect in many cases. It is there shown that in a solid round copper wire carrying a current of such a high frequency that the penetration is small, the ratio of the high-frequency resistance R_f to the steady current resistance R_o is given by the formula—

$$R_f/R_o = 0{\cdot}038\ d\sqrt{f} + 0{\cdot}25$$

where d is the diameter of the wire, and f the frequency.

For values of $d\sqrt{f}$ less than 32, or values of R_f/R_o less than 1·5, the penetration into the wire is so great that the assumptions made in establishing the formula are no longer tenable. Even in this case, however, the problem can be solved by applying the graphical method so frequently employed in studying telephonic transmission problems. The line is divided into a number of sections by assuming its leakage and capacity to be concentrated at a number of equidistant points. The current and potential difference at the receiving end are assumed and those at any point of the line determined by constructing a vector diagram section by section, commencing at the receiving end and gradually working back along the line. This method was applied to the determination of skin effect in the paper already referred to.

The vector diagram is instructive in showing how the magnitude and phase of the current vary with increasing depth. This is shown in fig. 1 for $d\sqrt{f} = 79$. It is seen that at the moment of maximum current the central portion of the wire is carrying current in the reverse direction.

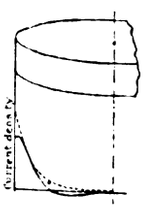

FIG. 1.

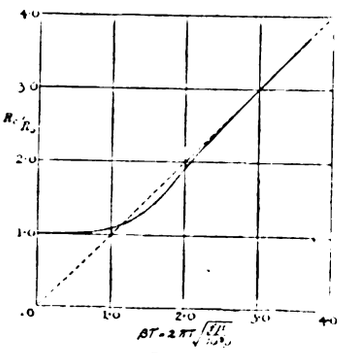

FIG. 2.

FIG. 1.—CURVES SHOWING MAXIMUM VALUE (DOTTED) AND VALUE AT MOMENT OF MAXIMUM TOTAL CURRENT (FULL LINE).

When it is desired to keep the inductance of a circuit as low as possible, parallel strips placed close together are frequently employed. The current is concentrated towards the inner faces. If the frequency is so high that the current density at the back of the strips is practically zero, this is the simplest of all skin-effect calculations. The resistance and losses are the same as if the total current were distributed uniformly over a layer of depth t where—

$$t = \tfrac{1}{2}\pi\sqrt{10^9\rho/f\mu}.$$

For copper the permeability $\mu = 1$, and the specific resistance $\rho = 1{\cdot}7 \times 10^{-6}$ ohm per cm. cube, at a frequency of a million, $t = 0{\cdot}066$ mm. If the frequency and the thickness of the strips are such that the current penetrates appreciably throughout the whole cross-section—

$R_f/R_o = \beta\tau/\gamma$, where $\beta = 2\pi\sqrt{f\mu/10^9\rho}$, τ = the thickness of the strip, and $\gamma = (\cosh 2\beta\tau - \cos 2\beta\tau)/(\sinh 2\beta\tau + \sin 2\beta\tau)$.

For small values of $2\beta\tau$, that is, for low frequencies or very thin strips, this reduces to—

$$R_f/R_o = 1 + 2/3\ (2\beta\tau)^4/5!$$

which for copper may be written

$$R_f/R_o = 1 + 47{\cdot}5\ (\tau\sqrt{f})^4\ 10^{-6}.$$

The value of R_f/R_o for any value of $\beta\tau$ can be read directly off the curve in fig. 2.

When the frequency is such that the current is confined to the outer skin of a round conductor, material can be saved by using a tube. If the thickness of the wall is such that the current density at the inner surface is negligible, the resistance will be the same as if the conductor were solid; if, however, the wall is so thin that the current density is appreciable throughout, the above formula for the strips can be applied. τ is then the radial thickness of the wall, which should not exceed one-third of the radius.

Single-layer Cylindrical Coils.— In the previous paper the author has shown that the resistance of a long coil closely wound with a single layer of square or rectangular wire is given accurately by the same formula as that already found for the parallel strips, viz.:—

$$R_c = R_o\ \beta\tau/\gamma$$

where τ is the radial thickness of the wire. The values of R_c/R_o are plotted in fig. 2 against values of $\beta\tau$.

If the wire has a square section of side τ cm. and if s is the number of turns per cm., $s\tau$ is the fraction of the axial length occupied by the conductor, the remainder being occupied by insulation or air space. The penetration would be the same if the turns were close together, but the permeability of the material reduced from 1 to $s\tau$. Assuming the conductor to have unit permeability, β would be reduced to—

$$2\pi\sqrt{s\tau f/10^9\rho}.$$

It will be seen from fig. 2 that the values of the ratio R_c/R_o are practically independent of $\beta\tau$ for values of the latter up to 0·6, but directly proportional to $\beta\tau$ if it exceeds 2·5. Hence, when the frequency is so low that the skin effect is only slight, the pitch of the turns has little effect, but at very high frequencies where the skin effect is very pronounced, the ratio R_c/R_o is proportional to $\sqrt{(s\tau)}$. This is only strictly true when $s\tau$ differs but little from unity.

For many purposes it is convenient to consider the ratio of the high-frequency resistance R_c of the coil to the high-frequency resistance R_f of the same wire when straight.

A round wire equal in diameter to the side of a square wire has $4/\pi$ times its resistance both at very low and at very high frequencies. It may be assumed, therefore, as an approximation, that this ratio is constant at all frequencies. The inscribed-circle method gives results in good agreement with observations: the biggest difference between the calculated and observed results is about 4 per cent. for values of $\tau\sqrt{f}$ ranging from 0 to 42.

The values of R_c/R_o and R_c/R_f have been calculated for a solenoid of square wire with $s\tau = 1{\cdot}0$, 0·8, 0·5, and 0·25 respectively.

TABLE I (*Abridged*).

Calculated Values of R_c/R_f for Coils Wound with Square Wire.

$\tau\sqrt{f}$.	R_f/R_o.	$s\tau = 1$. R_c/R_f.	$s\tau = 0{\cdot}8$. R_c/R_f.	$s\tau = 0{\cdot}5$. R_c/R_f.
2	1	1	1	1
4	1	1·012	1·006	1
6	1·001	1·06	1·039	1·015
8	1·003	1·175	1·115	1·035
10	1·007	1·38	1·26	1·1
12	1·015	1·667	1·47	1·2
14	1·027	2·006	1·735	1·335
16	1·045	2·3	2·01	1·5
18	1·071	2·54	2·24	1·69
20	1·104	2·745	2·44	1·885
24	1·200	3·033	2·72	2·125
30	1·399	3·26	2·92	2·31
40	1·774	3·43	3·06	2·48
60	2·569	3·56	3·18	2·52
120	4·888	3·74	3·34	2·64
200	7·98	3·81	3·41	2·69

The results are given in Table I (abridged). It has been assumed that the coils are long and that the diameter is large compared with the pitch.

If the author's formula for square wires is assumed to hold approximately for round wires of equal cross-section, we have—

$$R_c/R_o = 1 + 23 \times 10^{-6}\ (d\sqrt{f})^4\ (s\ d)^2,$$

in exact agreement with Wien and Sommerfeld. This formula is only applicable to low frequencies ($d\sqrt{f}$ less than 10).

None of these formulæ take into account the effect of the diameter of the coil, which may be an important factor for small values of $s\ d$; the formulæ assume the coils to be very long in comparison with their diameters, and they would obviously be very inaccurate if applied to narrow coils of large diameter.

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A number of measurements of the high-frequency resistance of coils have been made at the Imperial College of Science and Technology during the last three or four years by the author and by several research students, especially Mr. Smith-Rose, B.Sc., and Mr. W. Greenwood, B.Sc.

In the case of a coil of 92 turns of 0·264 cm. wire, the total length of the coil being 26·9 cm. and its external diameter 2·86 cm., the calculated values for the equivalent square wire are about 11 per cent. greater than the measured values of R_c/R_o. Another coil consisted of 62 turns of wire 0·163 cm. diameter with a total length of 20·4 cm. and a pitch of 0·33 cm. The calculated values of R_c/R_o are 26 per cent. higher than the measured values.

Exigencies of space sometimes compel the designer of radio apparatus to employ coils with more than a single layer of wire. The inductance increases as the square of the number of turns in a given length, whereas the resistance to steady currents is directly proportional to the turns. At high frequencies, however, the resistance may be greatly increased by the addition of a second or third layer.

If the size of wire and the frequency are such that the skin effect is very pronounced, the effective resistance increases much more rapidly than the inductance as the number of layers is increased. When, however, the penetration into the wires is considerable, the calculation of the effective resistance is much more complicated.

TABLE II.—VALUES OF R_c/R_o.

$\beta\tau$.	First layer.	Second layer.	Two-layer coil.	Third layer.	Three-layer coil.
0·5	1·000	1·05	1·02	1·13	1·06
1·0	1·086	1·73	1·41	3·01	1·94
1·5	1·376	4·17	2·77	9·76	5·10
2·0	1·897	8·36	5·13	21·25	10·50
2·5	2·475	12·70	7·59	33·15	16·11
3·0	2·988	16·08	9·53	42·12	20·40

Table II gives the values of R_c/R_o for coils with various numbers of layers. These values refer to long coils closely wound with square or rectangular wire, and corrections must be applied for the spaces between adjacent turns, and for the coil not being very long compared with its diameter. The results are not affected, however, by the space between adjacent layers. With round wire an approximate result can be obtained by assuming it to be replaced by square wire of equal sectional area.

It is a common practice to make wires intended for high-frequency currents of a large number of small wires, each separately insulated, and the whole so stranded that every individual wire occupies in turn the same relative position in the composite wire. In this way the current is forced to distribute itself uniformly between the individual wires. It must not be assumed, however, that because these wires are of so small a diameter that when used alone they exhibit but little skin effect, the composite wire will, therefore, have the same resistance to high-frequency currents as to direct currents. The author discussed this subject in detail in a paper read before the Royal Society in 1917. The ratios R_c/R_o and R_f/R_o are in many cases so great, that better results would be obtained by using a solid wire even of the same copper section. The solid wire can, however, have a much larger cross-section of copper and still occupy the same space in a coil. Not only is the solid wire much cheaper, but the making of end connections and tappings does not introduce the difficulties met with in dealing with stranded conductors. In many cases in which the stranded wire has a theoretical advantage, this is so small as to make it doubtful whether the use of stranded wire, with its attendant disadvantages, is justified. The cause of the high effective resistance of the stranded wire is the eddy-current loss in the individual wires, due to the magnetic field produced by all the other wires.

Another interesting fact which was shown in the paper referred to was that the minimum high-frequency resistance was not obtained by putting as many individual wires as possible into the available space, but that there is an optimum space-factor beyond which the addition of more wires increases the resistance.

TABLE III.—CORRECTION FACTORS FOR SHORT COILS.

l/D.	B′/B.	$\sqrt{(B'/B)}$
0·25	0·61	0·78
0·5	0·70	0·84
1·0	0·82	0·91
2·0	0·92	0·96
4·0	0·97	0·985

The calculated formulæ for the high-frequency resistance of coils are all based on the assumption that the coils are very long in comparison with the diameter. In a short coil the density of the magnetic flux at the inner side of the wire is less than in a long coil with the same number of ampere-turns per centimetre. The value of R_c/R_f for a short coil can be read off the curve for a closely-wound infinitely long coil if instead of $\beta\tau$ one takes the value—

$$\beta\tau\sqrt{(8\tau)}\sqrt{(B'/B)}$$

where B is the flux density in a long solenoid and B′ that in the short coil, the values being determined at the inner side of the wire. The author has calculated the ratio B′/B for various values of l/D and the results are shown in Table III.

THE INSTITUTION OF ELECTRICAL ENGINEERS.

WESTERN CENTRE.

AT Bristol, on December 1st, Mr. W. A. Chamen addressed the Western Centre on the financial side of electricity supply. He said: All engineers must be profoundly sorry that considerations of finance have to enter into any of the wonderful schemes, not to mention castles in the air, which emanate from the deep recesses of their minds from time to time. And yet, without the necessity for considering the financial side of any scheme, our usefulness would be largely, if not entirely, gone, and the need for our services would probably almost entirely disappear. For it is economy in the expenditure of money, both in the first cost of the schemes which are propounded and in the maintenance of them, which governs the whole matter. What is the use of them all, unless they serve some purpose of economy? People sometimes talk about "private" money and "public" money and "Government" money, but, after all, there is nowhere for the money to come from except, in some way or other, from individuals. If the Government finds money it issues a loan on the security of its power to tax the people, *i.e.*, the individual. The money itself comes from the public in one way or another; in the first instance from the pockets of individuals. And so it must surely follow that in seeking money for the carrying out of any scheme, the scheme must be propounded and explained in such a way as to tempt the individual to put his money into it. This root fact is exactly the same, no matter by whom an undertaking is run. In all these alternatives, the money comes from the same source, and the individual is really responsible for deciding as to what enterprise he will place his money in. Now there is a difference between Government or municipal concerns and company concerns. In the case of a Government or municipality, money is borrowed from individuals. It is secured by being made a charge upon the taxes of the country or the rates of the municipality or other local authority as the case may be. If the concern does not prove a financial success, the deficit is made up by increasing the taxation or the rating, as the case may be, of the people, that is, of the individual. For this reason, the rate of interest on money lent to a Government or municipality is low. There is no risk directly attaching to the loan of money by the individual. But with a company the case is different; the element of enterprise enters in. The individual lends his money in the hope of receiving a dividend. He has no security like the investor in Government or municipal stocks, but is willing to risk his money in the hope of getting a higher rate of interest. It is not difficult to see, therefore, that unless there is a possibility of a shareholder in a company getting a larger rate of interest than he can do from Government or municipal investment, not a penny piece will be invested in companies. Possibly this fact is seized upon sometimes to argue that all schemes ought to be carried out by means of loans issued by Government or municipalities, so as to borrow money at a low rate of interest and prevent the temptation to what, in these days, may be called profiteering, by taking higher rates of interest when they can be got, and thus raising the price of electricity above what it need be. This line of argument, however, loses sight of some facts which have a most important bearing on the question. One of these is that the Government or municipality has to repay the loan and, consequently, the price charged for electricity must be sufficient to cover annual payments into a sinking fund, of such an amount as shall accumulate the total amount of capital to be repaid by the time the term of years for which the loan was granted has expired; while, on the other hand, there is no obligation on a company to put by a sinking fund for repayment of capital subscribed for ordinary shares, or even for preference shares. Again, there is no obligation on the part of a company to increase the price of electricity to such a figure as will ensure payment of a certain dividend on the shares of the company if for a period the development of the undertaking does not allow of a dividend being earned when reasonable prices are charged for the energy supplied. The shareholder knows this full well, and often makes his investment knowing that for some years he will get no dividend, but he believes that he will get a dividend in the end as will recoup him for the lean years. This fact stimulates the rate of development by company enterprise, because good dividends can only be earned when the concern reaches a stage of considerable development and, assuming that prices realisable for the sale of electricity are sufficient to provide a reasonable margin when the concern is more or less fully developed, the capitalist is willing to risk money, although for the time being no dividend can be paid. It not infrequently happens that all the capital subscribed for ordinary shares is spent before a stage of development is reached sufficient to pay any dividend. If this continues, people do not care to continue subscribing money, but are willing to do

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so upon an issue of preference shares. Beyond this, it is sometimes necessary for the concern to borrow money specially at fixed rates of interest, on debentures or debenture stock, the interest on which *must* be paid year by year; otherwise the holders may appoint a receiver. There is, therefore, a considerable risk in proceeding by means of company enterprise, which obviously must be compensated for by the prospect of reasonably good dividends. There are, however, no electricity undertakings run by companies which are free to make whatever profit they may like. All of them are limited in some way or another, and the public is always protected by a limitation of price in the Act or Provisional Order under which the concern is worked; so that there is but small chance of profiteering at the public expense in the electricity supply industry. It may be that there are advantages in some ways in the Government or municipal method of procedure, but on the whole, the advantage, even from the public point of view, lies with a properly guarded and properly managed company undertaking. If such a limitation were imposed upon the rate of dividend or interest which a company might pay, as to reduce it to the level of a Government or municipal loan, no money would be found for any company enterprise, and it is difficult to see how it could be found for Government or municipal enterprise either, for a very large number of individuals are not satisfied to lend their money at very low rates of interest, in spite of the absolute security of rates and taxes, and there would come a time when, in order to get money, the rate of interest would have to go up. It is surely wiser to allow reasonable and proper freedom for the earning of interest on capital employed in public utility undertakings, and so encourage the finding of capital, than it is to hamper it by limitations which take away all the spirit of enterprise and hamper energetic development. It is remarkable that the Electricity Bill does nothing to encourage the idea that Government will readily find money for the development of electricity supply, though it provides for that being done more or less as a last resort. Elaborate provisions are set out for the financing of District Boards, if such boards are formed, but they all seem to do away with the element of enterprise, and take the form of powers, granted to the District Boards and to the Electricity Commissioners, to borrow money by the issue of stock bearing interest at some fixed rate, and redeemable at such time as the Electricity Commissioners may decide. It would seem very doubtful if individuals will be willing to invest their money in this way unless the rate of interest is considerably higher than it has been on municipal or Government loans hitherto. And this interest as well as the repayment of the loan must all come out of the consumer, *i.e.*, the price charged for electricity must be sufficient to cover all these charges. The prospect of getting a cheap supply of electricity under a District Board does not seem very promising, but the Bill as amended and now passed by the House of Commons does not make the formation of District Boards compulsory. Under clause 5 (2) associations or bodies within the district are given an opportunity to submit schemes for improving the existing organisation, if it needs improvement, in the views of the commissioners. It may not be easy to suggest, in detail, how this can be done, but the first thing to do is to create the desire for such a scheme, and, having done that it is wonderful how difficulties seem to dissolve. The desire must be unanimous; it may be that some degree of self sacrifice will be required, but do not let us allow what may be an entirely imaginary bugbear to hinder us from putting our heads together with the real desire to improve the whole existing organisation of electricity supply. The problem *might* possibly be dealt with by the giving and taking of bulk supplies between the parties, but that would probably entail keeping up certain walls of separation between them, and it would probably be far better to amalgamate the different concerns. This involves the difficult question of finding a way to unite the different orders of capital, municipal and company. There cannot, however, be any insuperable difficulty about this matter, and it must be remembered that the alternative is the District Board with its purchase of all power stations and its practically unavoidable waste of money both in first cost and in maintenance. If taken advantage of in this way the Electricity (Supply) Bill opens up an avenue of progress such as has not been possible before, but if we allow the formation of District Boards, as alternatively provided for, we shall be taking a retrograde step, and causing at once a strong feeling of want of confidence among those who have their own generating plant. They will be afraid to place themselves in the hands of District Boards on the score of economy. Human nature cannot be reformed by coercion. We must look to something quite different from District Boards to bring about that unity of aim and interest which alone can give us prosperity and peace.

DISCUSSION AT BRISTOL.

Mr. H. FARADAY PROCTOR said he was particularly interested in the address because he did not see eye to eye with the author. He advocated a District Board for his locality. The interest which the Government or a local authority paid was less than that which companies paid because they could get money at that cheap rate. Was not the fact that the money was cheap sufficient evidence that the supply was sufficient? Plenty of money could be got at that comparatively cheap rate of interest provided the security was good. He did not understand the protests against what was considered to be the elaborate system proposed in the Bill for the financing of District Boards. There were two sums of money mentioned, 20 millions and 25 millions. Neither of these sums was intended for the systematic financing of District Boards. The financing of the District Boards would be done by the various component parts of those Boards guaranteeing the sums required. Money would be raised only by the issue of stock—the Boards were empowered to issue stock, and such must be guaranteed, to give the investor that security which would ensure his capital being forthcoming when necessary. Some areas might be so sparsely populated as not to be able to provide a sufficient guarantee for a large scheme which it might be desirable to inaugurate, in which case the 25 millions which the Commissioners were to have placed at their disposal would come into use. They would lend some of that money to the District Board.

The joint electricity authority had to be representative of authorised undertakers within the district *either with or without* the additional representatives of any county, other local authorities (not being authorised undertakers), large consumers, and other interests. A District Board should incorporate the local authorities, companies and persons who were authorised undertakers, but it should also include the representatives of railway companies who used or proposed to use electricity for traction purposes, of large consumers, and of labour, and where there were other local authorities and County Councils not being authorised undertakers, who provided financial assistance, they also got representation. What reason was there for the suggestion that the incorporation of these other people—the consumers, for they had to come into the District Board—would lead to extravagance? As regards the incorporation of other local authorities, who were not at the moment authorised undertakers, why should they be tempted to extravagance? It was not compulsory to have labour represented on the joint electricity authorities; on the District Board it was compulsory. His experience with labour had not been so very bad when one got in close contact with labour as a rule; there were exceptions, there was nothing bad or unreasonable. At any rate let them see behind the scenes. Referring to the objection that all the money for the repayment of interest and dividends had to come out of the consumers' pockets, it was a very poor company that did not take its dividends out of the consumers' pockets. Surely, the representation of the large consumers, who were the persons most keenly interested in the production of cheap electricity, was the very best form of representation one could have on District Boards.

Mr. J. H. EDWARDS thought that finance was the chief thing to consider in connection with electric supply, but finance went a little further than actual money. For instance, they had to consider the saving in coal as much as the saving in money. He suggested that in this proposal of the Government they were aiming at conserving the coal resources of the country, and that the Government had at last realised that the vital thing for the life of this country was electricity supply. It was hoped by giving a cheap supply of electricity to proceed a good distance towards the solution of the housing problem. If they were ever to have peace between the capital classes and the workers they must attempt to solve the problem of the slums. He was not a believer in nationalisation, but he suggested that none would think to-day of handing over the water supplies of this country to private enterprise. In connection with the Electricity Bill how far were they to go? Was it a reasonable suggestion that the actual generation of electricity and the provision of trunk mains could be efficiently nationalised, whereas the more intricate section of the work required a more elaborate scheme of organisation, that was best left to private enterprise?

Mr. W. HARDY was interested in the Electricity Bill from the consumers' point of view, and did not know whether under the Government scheme they were, as consumers, going to benefit in the price of electricity supply. At the same time a scheme which unified electricity supply should in itself supply the consumer at a cheaper rate, provided, of course, the cost of transmission did not overcome the cost of production by the consumer himself. He understood the scheme had not been formulated from a financial point of view, but purely to give a cheap supply to the country. He had always felt that they, as electrical engineers, did not produce the best value from coal, and it seemed that a scheme of that size was being run into very quickly without due consideration of that fact. An endeavour should be made to use the heat of exhaust steam; that heat should be used for heating for domestic and industrial purposes, and for that reason an electricity scheme with a tremendous distributing area would not be the right thing.

Mr. H. H. THOMPSON said that one must congratulate Mr. Chamen on the splendid imagination shown in the latter part of his address; if he was serious in his main conclusions, however, one was inclined to agree entirely with Mr. Proctor. Personally, he believed in the present and its possibilities, especially as new conditions, commercial and financial, and extremely interesting possibilities had arisen out of the war. The appeals to the public in connection with new issues at low rates of interest was evidence that a large section of the

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community was generally satisfied with small returns on money invested consistent with small risk. As to the financial success of electricity supply under the proposed conditions, he was optimistic; it was not always sound to estimate future success by past results. Now the state of things was quite different; electricity supply had become a prime necessity of industrial growth and economic life. If the new loans for the proposed developments were raised by private subscription, that would be a good feature. Direct public interest in the new schemes as proposed should tend towards closer scrutiny and consequent reduced expenditure. He was scarcely in agreement with the feared effects of Government control, or the bad effects of what was termed nationalisation. State management by expert business-like officials had still to be tried and tested.

Mr. A. L. STANTON doubted "the belief" in *cheap* electric power supply, as expressed through the medium of the daily Press. He disagreed with the view generally held which asserted the Bill to be mainly based upon a desire to conserve the national coal supplies. It was yet to be laid down that coal exports would definitely cease; steam raising coals such as were at present used by generating stations represented but a fraction of the total grades of coal annually produced; by the time the national coal resources reached the limit line, the scientific developments of that age would have far superior methods in operation to those now employed; finally, the war was largely won as a result of the part played by engineering and allied production on a scale hitherto undreamt of. How was the result achieved? Largely as a result of the enormous flexibility and other advantages which electricity supply as already available presented in the shape of an industrial power utility. The prosperity of the country depended upon its industrial expansion which implied a capability to produce commercially with economy, rapidity and continuity of output. The Electricity (Supply) Bill represented a recognition of the part played by this form of energy during the war, and aimed to utilise it to a far greater extent as an element of the highest importance during peace. Resting upon such foundations and realising the all-importance of the "financial aspect" as an element of success, one could not doubt but that the necessary capital required for promoting essential schemes would surely be produced. Granted that Government control of utilities had proved itself inefficient and wasteful in the past, he could not see that such judgment constituted any justification for allowing matters to remain so. They had the power to raise the standard and should use it. He was in accord with Mr. Proctor's references to "the labour element." His experience was that the surest way to obtain progressive effort from the so-called "labour element" was to prove by one's individual actions that its place in the universe was recognised, and that no monopoly of intelligence existed anywhere. Respect was thus gained and confidence was held.

Mr. W. A. CHAMEN, in reply, said that his objection was that a District Board had got to purchase or acquire generating stations. The scheme which he favoured was the joint electricity undertaking. That there was no hardship in waiting for dividends so long as the burden of the loss fell upon the community which benefited, he was in absolute agreement. The water supplying London was now excellent, but the cost of it had gone up so much that the Board had had to apply for powers to increase the charges; the statutory local authority had to make up deficits out of the rates. One might get an excellent engineering proposal, but it might not be an economic one; that was the lesson to be learnt from the London Water Board. The utilisation of exhaust steam was provided for under the Bill. It seemed to him more satisfactory to arrange that in conjunction with a unified scheme, in which the big consumers took their part, but they had to negotiate with District Boards. Power companies had a lot of "water" in their capital; there were, however, two ways of looking at that. Contractors were enterprising; they wanted to stimulate a demand for their production, and they thought that power companies could be of assistance in that direction. The idea was good, and there was a spirit of enterprise in what they did, and they owed a debt to the contractor that power companies had gone so far as they had. They had suffered very severely from lawyers' government. He did not agree that human nature was unalterable.

INDUSTRIAL ELECTRIC HEATING.

CONSIDERABLE attention has recently been directed to the application of electric heating for industrial and commercial purposes, and some notable developments have taken place in Switzerland in this direction, where, according to an article in *Le Génie Civil*, of August 30th, 1919, by F. Rutgers, electrical energy is being largely utilised for heating in laundries, textile mills, and foundries, as well as for central heating systems in offices, workrooms, &c., with a marked economy over the use of coal or coke.

The special conditions obtaining in Switzerland with its abundant water power, and consequent cheap supply of energy, have in no small measure contributed to the results obtained. Nevertheless, even in countries not so favourably circumstanced it should not be impossible for electric heating

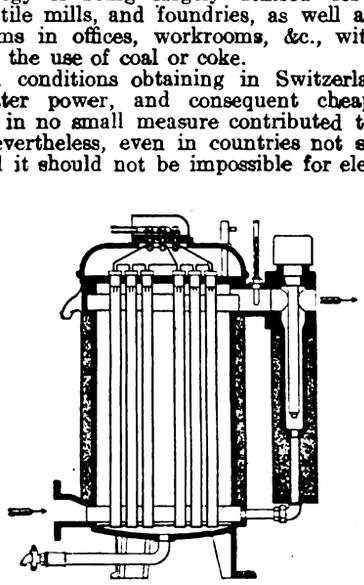
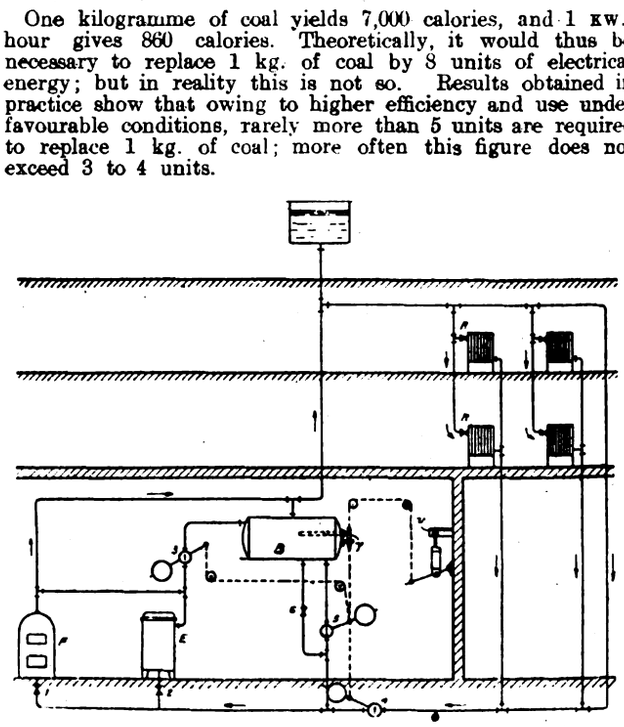


FIG. 1.—SECTION OF ELECTRIC WATER HEATER.

to find far more extensive application in the industries in competition with the existing methods than is at present the case, more especially when the manifold advantages of this form of heating are properly realised. The heat required can be produced exactly at the time and place desired, it can be efficiently and simply controlled, and when the heating appliance is out of service losses can be reduced to a minimum. In many cases the heating can be performed entirely at night, when it should be possible for energy to be supplied at a specially low rate for this purpose, considering the ideal nature of such a load, and its importance in materially raising the load factor of the supply station. Moreover, the economy of electric heating does not solely depend upon the relative cost of coal and electricity as is so often supposed.

One kilogramme of coal yields 7,000 calories, and 1 KW.-hour gives 860 calories. Theoretically, it would thus be necessary to replace 1 kg. of coal by 8 units of electrical energy; but in reality this is not so. Results obtained in practice show that owing to higher efficiency and use under favourable conditions, rarely more than 5 units are required to replace 1 kg. of coal; more often this figure does not exceed 3 to 4 units.



B, Storage vessel; R, Radiators; F, Ordinary boiler; E, Electric boiler; T, Thermostat; U, Retarder.

FIG. 2.—DIAGRAM OF CENTRAL ELECTRIC HEATING SYSTEM WITH DELAYED DISTRIBUTION.

The special electric heating apparatus described and illustrated in the article referred to above are manufactured by the Swiss Oerlikon Works, and cover a variety of types for heating water, generating steam, producing hot air, &c.

The type of heater generally used for hot water is the tubular circulating boiler depicted in fig. 1. The one illustrated is for 100 KW., has a height of 1.5 m. (4.92 ft.), and a diameter of about 0.5 m. (19.7 in.). These boilers are also made for a capacity up to 300 KW. For still higher powers several boilers are used. The tubes enclose the electric heating elements and are mounted on a special base, and they

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can be readily removed for cleaning and scraping. When automatic control of the temperature is required a thermostat can be fitted to interrupt the supply current when a predetermined temperature is exceeded. For small installations, provision can also be made for automatically closing the circuit as soon as the temperature falls below a certain value.

The boilers of this system are mainly used for heating water in breweries, dye-works, chemical works, hotels, &c. In conjunction with a tank they can also be used for hot-water storage, and are frequently employed in central heating systems in factories, dwellings, offices, &c. Fig. 2 shows an electric boiler operating in parallel with a coke-fired boiler for central heating.

A central heating system which has given special proof of its value is one in which the electric boiler and storage vessel are heated during the first part of the night, *i.e.*, up to about 4 o'clock in the morning, when the cost of the electrical energy is low. As soon as the storage vessel reaches the maximum admissible temperature the hot water is automatically caused to circulate through the heating system, and the rooms are heated. During the day the supply of heat is derived from the heat accumulated in the storage vessel. When the weather is cold, the necessary heating during the day can be obtained either by means of an electric boiler of small power or by burning wood or turf in the existing boiler. This central electric heating system with delayed heat distribution has the advantage that smaller storage vessels can be employed than would otherwise be neecssary for the thermal storage obtained by utilising the whole energy available during the night. The rooms are heated before work is started; no attendance is required during the night; the circulation is automatically effected. In fig. 2 is shown a diagrammatic representation of this central heating with "delayed heat distribution."

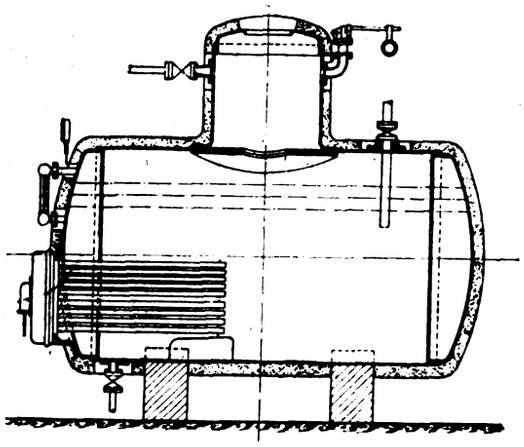

FIG. 3.—SECTION OF ELECTRIC STEAM BOILER FOR 500 KW.

Very often the tubular radiators, or immersed radiators as they are termed, are placed directly inside the thermal storage tanks, and are also used in a similar manner inside vats in breweries, inside coppers in laundries, &c.

For the generation of steam electrically similar radiators, but of larger capacity and heavier construction, are used, and the arrangement employed is that shown in fig. 3, which is a sectional elevation of a 500-KW. electric steam boiler.

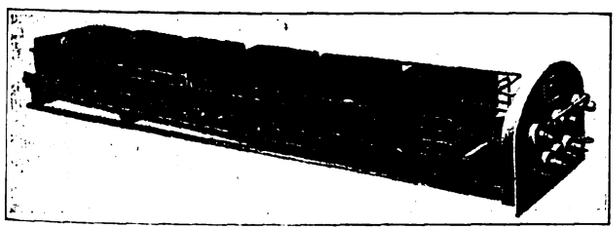

FIG. 4.—REMOVABLE GRATE RADIATOR FOR COAL-FIRED BOILERS.

These electric boilers can be installed direct in workshops without fear of trouble, provided they are of sufficiently robust construction, as the current can be instantly shut off, and the production of steam stopped momentarily, which is impossible with coal-fired boilers. In Switzerland the authorities stipulate that the boiler must be built for a pressure equal to 1½ times the normal working pressure. As an example, if the working pressure is 88.2 lb. per sq. in. (6 atmospheres) according to these rules it must be designed for a working pressure of 132.3 lb. per sq. in. (9 atmospheres) and a test pressure of 205.8 lb. per sq. in. (14 atmospheres). It is a simple matter to provide for the automatic interruption of the supply when the pressure rises above a certain value or when the water level drops.

Electric steam boilers have a large field of application in chemical factories, textile mills, dye-works, chocolate factories, &c. Specially good results have been obtained with them in installations in which in the summer steam is only required in small amounts for certain purposes, when the ordinary steam boiler would be working under uneconomical conditions.

An interesting application of the electric steam boiler is made in a spinning mill in which it is used in combination with an ordinary boiler. In the mill a large quantity of energy is available during the night, which is utilised in the electric boiler for heating the main boiler, which in this way acts as a heat accumulator. At times of heavy load the steam produced can be used directly by means of automatic reducing valves and an overflow valve. The electric boiler used takes 500 KW., and generates steam at a pressure of 117.6 lb. per sq. in. (8 atmospheres).

Another special application of electric heating is the use of removable radiators (fig. 4), which are placed on the grate of an ordinary steam boiler to keep it under pressure during the night.

The production of hot air electrically is also of growing importance. The air is blown upon the radiator by means of a fan. For small powers in drying installations spiral radiators are employed. For larger powers the radiators are built up of special cast resistances such as those shown in fig. 4. The temperature of the radiator is from 400 deg. C. to 500 deg. C. They are employed for heating houses, in drying plants, &c. A portable type for 300 KW. is illustrated in fig. 5.

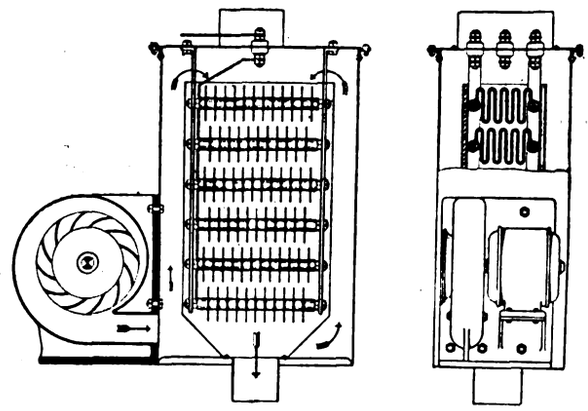

FIG. 5.—SECTION OF ELECTRIC HOT AIR FURNACE FOR 300 KW.

These electric hot-air furnaces are very extensively employed in foundries, where they are displacing the small portable coke furnaces hitherto in vogue for heating moulds. The numerous disadvantages of coke furnaces, such as the vitiation of the air of the foundry, frequent attendance, liability to burn, dirty moulds through flying cinders, &c., disappear with the hot air electric furnace.

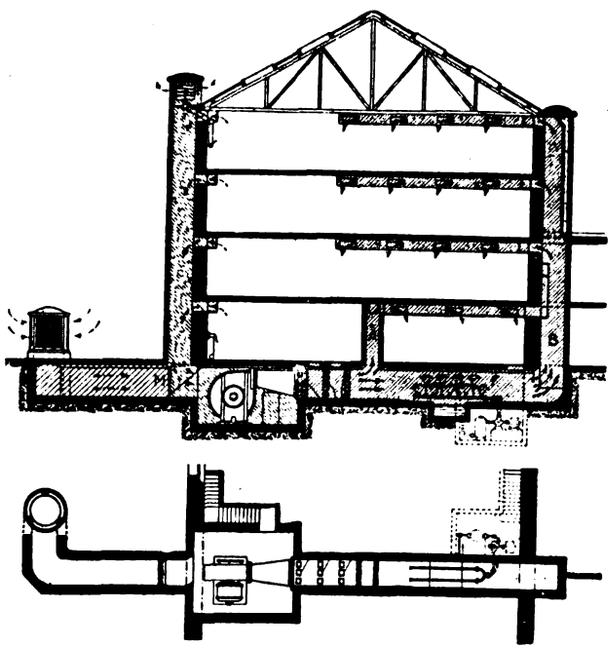

FIG. 6.—ELECTRIC HEATING SYSTEM IN A TEXTILE MILL.

In most of the Swiss foundries these electric furnaces are used in place of coke furnaces, and the moulds are dried during the night. In many foundries even stationary electric furnaces are used, and the cores and small moulds are then

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dried inside them. The cold air is first heated by being passed through a double spiral; heat losses are thus minimized.

For localised heating in machines the electric heating system is specially advantageous, and either the spiral type of radiator is used or a radiator similar to those already described made up of special resistances in various shapes. The simplicity of regulation and the desired localisation of the heat required make it superior to all other methods.

In addition to the central electric heating system with water, steam, or hot air, radiators with or without heat storage can be used for heating rooms, &c.

An interesting innovation in connection with heating rooms consists in arranging simple tubes analogous to those used with low-pressure steam systems around the walls. The electric heating elements are contained in these pipes, and a large development of heat is obtained with a low energy consumption. This arrangement is of special use in textile mills, more particularly in carding rooms, owing to the reduced superficial temperature of the pipes. Fig. 6 shows an electric heating and ventilating installation in a spinning mill combined with a plant for humidifying the air.

The energy required for various heating purposes can in many cases be simply calculated when, for example, the quantity of water or air to be heated and the temperature are given. The energy necessary to produce a determinate amount of steam is known, and the heat losses can be kept within well-defined limits by appropriate heat insulating means. Also the quantity of coal previously used can serve as a basis for comparison with the results obtained in similar installations.

From 4 to 5 units replace 1 kg. of coal in the case of central heating. With drying furnaces for foundries the ratio is 4.5 to 1, and in certain manufacturing methods 2 KW.-hours are used, as compared with 1 kg. of coal.

In connection with heat storage, good results have been achieved with thermal storage by water or steam extending over several decades. Thermal storage by means of electrically heated stone slabs has also been realised.

As regards the electrical pressure of electric heating apparatus for small portable heaters voltages above 250 volts should not be employed. In the case of large installations 500 volts has given good results. Higher pressures are not to be recommended owing to the possibility of danger in handling. For steam generation electrically in addition to the electric tubular type of boiler, electrode apparatus are used which can be easily designed for several thousand volts. Pressures exceeding 5,000 volts are, however, but little suitable. At present the best solution is the tubular type of steam boiler for a maximum pressure of 500 volts.

As an example of the economy to be obtained in certain cases by using electricity instead of steam for heating a wool mill may be cited, in which 400 kg. of coal were consumed daily for the exclusive heating of the dressing machines in the summer. With electric heating only 575 units were required per day, showing a considerable saving, as theoretically about 2,400 units correspond to 400 kg. of coal. The equipment of the mill which was carried out by the Oerlikon Works, comprises, in addition, an electric steam boiler and an electric hot-air heating system for the winter, as well as other electric heating apparatus.

A further example is given in the original article in connection with the drying of foundry moulds. In the foundry in question the sand of the mounds to be dried has a volume of 2.5 cubic metres, and the operation is conducted in a drying room having a cubical content of 25 cubic metres. The coke consumption amounted to 280 kg. in 12 hours, and at a price of 0.24 fr. per kg. at the factory, cost 67 fr., so that including for firewood (8.3 fr.), labour and attendance (4 fr.), cleaning, blowing, and blackening the moulds (4.8 fr.), the total cost for the 12 hours was 84.10 fr.

On the other hand, the electrical consumption of the radiator and fan in the same time was 1,200 units, and with energy costing at night 0.05 fr. per unit, the cost of energy was 60 fr., which represented the total cost, as no attendance was necessary, and no outlay was incurred in connection with the moulds, as they were removed from the drying room in a clean condition.

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

The Filbar Electric Boiler.

One of the exhibits at the recent exhibition in Glasgow, and at the Science and Key Industries Exhibition which was held in that city, was the electric water boiler introduced by MESSRS. FILBAR ELECTRIC HEATER, LTD., of 46, Berwick Street, London, W. 1. This is a new device, capable of providing up to a quart of boiling water within one minute, and smaller quantities in a correspondingly shorter time. The boiler is 6 in. in diameter and 16 in. high. When hot water is desired, a valve rod is pressed until a gauge indicates that the required quantity of cold water has been admitted, when it is released; and in due course—after 30 to 60 seconds—the boiling water is automatically ejected. The current cannot be switched on unless water is admitted, and the water cannot be ejected until it is actually boiling.

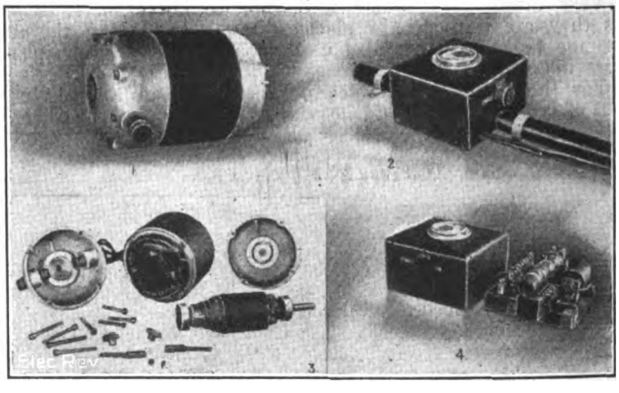
Other exhibits were the Filbar patent steriliser and a small electric heater of the geyser type, which is attached to a water tap; the geyser measures 8 in. high × 2¾ in. in diameter, and when the water is turned on the current is automatically switched on, a continuous flow of water at 120 to 160 deg. F. being obtained.

Electric Salt-bath Furnaces.

MESSRS. AUTOMATIC & ELECTRIC FURNACES, LTD., of 281, Gray's Inn Road, London, W.C. 1, inform us that as a result of lengthy experiments in their laboratory, extending over two years, they have succeeded in obtaining a perfectly non-porous metal container for their electric salt-bath furnaces, which permits the current to be switched "on" and "off" as and when required. The new metal furnace pots are easily replaced by simply lifting the furnace up and removing the pot. With energy at one penny per unit, a ton of tools can be hardened for the small cost of £2 4s. The use of these metal pots is an entirely new departure, and is the subject of provisional protection.

The Perna Motor Cycle Lighting Set.

Judging by the recent exhibition at Olympia, a feature of motor-cycle development is the increasing adoption of electric lighting. To meet the demand a number of new dynamo lighting sets specially designed for use on motor cycles have already made their appearance. Among these is the Perna, made by the PERNA ENGINEERING WORKS, of Castlegate, South Shore, Blackpool. The set, which has been undergoing private tests since 1914, and is stated to have proved entirely reliable in use, comprises the dynamo, switchbox, accumulators, and the usual set of three lamps. Dealing first with the generator, the windings are arranged to give a continuous output of 40 watts at 8 volts; the makers state that it will supply a constant current of one ampere above that taken by two 32-C.P. half-watt lamps and one 4-C.P. tail lamp, when running at a normal speed of 3,000 R.P.M. The armature shaft runs on large double-row, self-aligning bearings, and is arranged to be driven by a Whittle belt or by a chain as required.



FIGS. 1, 2, 3 AND 4.—THE PERNA MOTOR-CYCLE LIGHTING SET.

The overall dimensions of the dynamo are 4 1/16 in. outside diameter, by 5¾ in. over the bearings; the weight is under 10 lb. Fuller block accumulators are employed in connection with the set, and the wiring passes through a switchbox so arranged that it can be mounted on the top tube of the frame of the motor cycle. The switchbox has an ammeter in the top easily visible when driving by night, as when the lamps are switched on a small bulb beneath the ammeter dial in circuit with the tail light acts as a tell-tale for the back lamp. Inside the switchbox is an electromagnetic cut-out which automatically breaks the circuit when the generator speed drops below 800 R.P.M., thus preventing the batteries discharging themselves through the dynamo. Another feature of the set is a half-voltage device whereby the lamps can be run on half-pressure, and the lamps dimmed when the machine is stationary or when riding through fog. One advantage of this arrangement is that only a small current is

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consumed, enabling a smaller battery than usual to be employed. Referring to the illustrations, fig. 1 shows the generator, and fig. 2 its component parts; fig. 3 shows the switchbox in position mounted on the top bar of the cycle. Fig. 4 is a view of the switchbox with the cover removed.

The Lesco Lampholder.

In designing the "Lesco" lampholder, Messrs. LESCO, LTD., of Lloyd's Bank Buildings, King Street, Manchester, have struck out a new line. They have abandoned the internal-screwed carrier ring and the spring plunger contacts, both of which have given trouble enough in the past, and have substituted an external ring and solid contacts. The latter are mounted in a block of porcelain, and the leads are directly attached to them, so that there are no sliding contacts; the block carrying the contacts is pressed down upon the lamp cap by a substantial spring, which of course carries no current. The cord grip is also a new departure, consisting of two moulded plates of insulating composition; the leads are passed through separate holes cut at an angle in the upper piece, and then through a single hole in the centre of the lower piece, the slight bend imposed on the wire in doing this forming a perfect lock on the flexible when the holder is assembled. This cord grip requires no cutting away to accommodate the flexible, and will withstand a direct pull of 60 lb. The holder is very easily wired. The shade ring is *outside* the shade, which is secured by one half turn of the locking ring, which is provided on every holder, of which in fact it is an integral part even when no shade is used, locking the two portions of the holder together. To put on the shade, the lower portion of the holder is taken off and the shade is placed in position; the holder is then put together with a bayonet joint, and the locking ring fixed in position, the whole operation taking only a few seconds. The "Lesco" holder is made only in one quality (heavy gauge), and is suitable for ordinary or workshop flexible; it can be had with cord grip or screwed. Being able to carry more current than the ordinary lampholder, it is useful on low-voltage systems.

Siemens Dry Cells.

MESSRS. SIEMENS BROS. & CO., LTD., of Palace Place Mansions, Kensington Court, W. 8, have carried on the manufacture of dry cells at Woolwich for over 25 years, and have therefore accumulated a store of experience in this difficult art. During the war their battery department was extended to cope with the Government demands, and they are now in a position to produce large quantities. They have taken up the

FIGS. 5 AND 6.—SIEMENS REFILLS.

FIG. 7.—SIEMENS DRY CELL.

manufacture of pocket lamps, including the cases, some of which are fitted with a neat "cam" switch, the subject of a patent, and are made in a variety of patterns. Fig. 5 shows one of the three-cell refills for a pocket case, and fig. 6 a two-cell refill for the "baby torch" type. It is interesting to note that in order to prevent deterioration in storage, the firm have applied to these small cells their "Inert" patent method of manufacture, which has proved so successful with the larger sizes. Fig. 7 shows one of their ordinary square cells, six N, for large output and strong current, as in the case of small glow lamps, induction coils, telephones, &c.

Roger's Magneto.

A magneto for aero-engines having 12 to 16 cylinders has been developed by the Vita Manufacturing Co., of 730, Williamson Buildings, Cleveland, Ohio, U.S.A. It is described in the *Technical Review* as having no moving wires or revolving armature, puncture-proof condenser, and a hotter spark because of the manner in which the voltage and amperage are built up in the magneto field. The process of impregnating the coils renders them waterproof. They were found to be perfectly dry after submersion in water for a week. The two-pole type for 12 to 16 cylinders gives four sparks per revolution of the rotor, the two-spark type gives eight sparks per revolution, while the Liberty motor types give twelve sparks. In recent Government tests attempts were made to short-circuit the condenser by driving nails into it. The magneto continued to function properly, as it also did after portions had been cut out from the condenser.

LEGAL.

A MUNITIONS TRIBUNAL CASE AT WOLVERHAMPTON.

AT the Munitions Tribunal at Wolverhampton, last week, Mr. Flavell, representing the Workers' Union, called attention to an arrangement made between the union and a Wolverhampton firm of manufacturing electrical engineers, whereby, in settlement of claims made for the payment of arrears of pay under an award applicable to the trade, the firm had agreed to pay the sum of £1,200 for distribution among 168 girls in their employ. The claim was for the payment of arrears of 50 weeks, amounting to 3s. per week for girls over 18 years of age, and 2s. per week for girls under 18 years of age. Mr. Flavell said that his members were quite satisfied with the settlement, and added that the firm had agreed to pay the rates under the award in the future. A representative of the firm stated that they had not been defaulters willingly, as it was only after the case had been referred to the Interim Court of Arbitration that the award in respect of their workers was made.

The CHAIRMAN said that the firm had rendered themselves liable not only to pay the money, but, in respect of every girl, to a penalty of £5 for every day that they had neglected to pay. It was evident that the defendants had committed a series of offences since November 11th, 1918, though he would not deny that they had been placed in a very difficult position owing to the difficulty of interpreting the Act, and the fact that the case had been sent to the Court of Arbitration. It was evident there was no deliberate intention to evade the Act, especially as the Ministry of Labour had given them an answer on the subject which obviously was wrong at the time it was given. In the circumstances, they would inflict a merely nominal penalty of £10.

Electrical Trades Benevolent Institution. — NORTH EASTERN SOCIAL.—On Friday, December 12th, a social evening was held at Tilley's Rooms, Newcastle-on-Tyne, by many ladies and gentlemen interested in the North-East Coast electrical industries. The occasion was organised with a view to helping the funds of the Electrical Trades' Benevolent Institution. Some 300 guests were received by Mr. and Mrs. R. P. Sloan, who acted as host and hostess. The Lord Mayor and Lady Mayoress were present. The reception was followed by a conversazione. Supper was served in the smaller reception room, and dancing commenced at 10 p.m.

Mr. H. W. Clothier, in proposing a vote of thanks to Mr. and Mrs. Sloan, stated that the object of the Electrical Trades' Benevolent Institution was to grant pensions and temporary relief in case of distress to persons who were or had been engaged in the electrical trade as employers, managers, teachers, or on the engineering designs, drawing, sales, or office staff, or in other similar capacities, or to their dependents, in these times of uncertainty. Although the institution had been in operation since 1905, this was the first local event organised for the purpose of collective effort in the North-East Coast District, but it was hoped by the committee that it marked an epoch of local sympathy and activity. It was announced that the occasion had already been the means of introducing seven life members at £10 each, who together with 25 other subscribers and new members would immediately augment the fund by over £100, and it was hoped that new members would come forward to double this achievement; in any case, Mr. R. Robson and Mr. W. Fletcher were to be congratulated for their initiative and work which had brought about such a useful and enjoyable event, and Mr. and Mrs. Sloan had added another token of kindness to their invaluable service to the electrical industry. The funds will further benefit by about £25, the profit left after paying all expenses.

Electrical Heating of Acids. — The heating of acids requires special precautions. The direct immersion of electric heaters in the acid is precluded owing to the fact that there are no suitable materials that will withstand the action of boiling acid. The special heaters described consist of a spiral of wire enclosed in quartz tubes. For high temperatures the spirals are wound of tungsten, while for lower temperatures nickel or nichrome may be used. The spiral touches the inner surface of the quartz tube. The tube is filled with an inert gas, such as hydrogen. Tubes of 1 KW. capacity have an external diameter of 15 mm. and a length of 400 mm. They may be used for all electric heating purposes, and will stand being suddenly immersed in water or liquified gas.—*Revue générale de l'Electricité.*

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NEW PATENTS APPLIED FOR, 1919.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by MESSRS. SEFTON-JONES, O'DELL AND STEPHENS (successors to W. P. Thompson & Co., of London), Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

31,268. "Telephones." R. L. MURRAY and TELEPHONE MANUFACTURING CO. December 13th.

31,269. "Electrical cable connector boxes." M. H. GOLDSTONE. December 13th.

31,300. "Acoustic alarms operated by alternating electric current." M. P. FAYRE-BULLE and M. J. LAVET. December 13th.

31,304. "Electrical signalling apparatus for mines, &c." C. HUNTER and F. E. IMESON. December 13th.

31,329. "Sparking plug." F. J. NICHOLLS. December 15th.

31,338. "Electrical terminals of sparking plugs, &c." C. B. BROWNE. December 15th

31,345/6. "Radio-navigational apparatus, &c." H. L. CROWTHER, J. ERSKINE-MURRAY and J. ROBINSON. December 15th.

31,384. "Electrically-driven sewing machines." F. W. LE TALL. (Westinghouse Electric and Manufacturing Co.) December 15th.

31,390. "Electric lighting systems for automobiles, &c." J. S. WITHERS. (Renault.) December 15th.

31,403. "Sparking plugs." B. HOPPS and A. M. LODGE. December 15th.

31,452. "Methods of distribution on alternating-current systems." A. M. TAYLOR. December 16th.

31,472. "Mounting of rotary shafts for electric motors, dynamos, and rotary converters." L. KING. December 16th.

31,478. "Sparking plugs." C. H. BINGHAM. December 16th.

31,500. "Electric relays for signalling." J. J. V. CONNAUGHTON and M. J. RAILING. December 16th.

31,501. "Electric signalling apparatus." J. J. V. CONNAUGHTON and M. J. RAILING. December 16th.

31,511. "Apparatus for use in telegraphy and telephony and control of electrically-actuated apparatus at a distance." A. H. BRANTON and E. A. HINTON. December 16th.

31,519. "Spotlight electric lamps." EDISON SWAN ELECTRIC CO. and P. FREEDMAN. December 16th.

31,534. "Electric lamp holders." A. G. OLIVER. December 16th.

31,561. "Dynamo-electric machines." BRITISH THOMSON-HOUSTON CO. (General Electric Co.) December 16th.

31,569. "Electric switches." R. W. HILLS. December 16th.

31,572. "Telegraphic and telephonic apparatus." H. ST. J. DE A. DONISTHORPE, R. M. RADIO, LTD., and A. WILLIAMS. December 16th.

31,575. "Magneto-electric transformers." P. RABBIDGE. December 16th. (Australia, December 19th, 1918.)

31,578. "Process of welding." WILSON WELDER METALS CO. December 16th. (U.S., October 31st, 1917.)

31,579. "Welded joints." WILSON WELDER METALS CO. December 16th. (U.S., September 14th, 1918.)

31,580. "Manufacture of arc-welding electrodes." WILSON WELDER METALS CO. December 16th. (U.S., July 21st.)

31,617. "Electric welding." O. A. KENYON. December 17th.

31,626. "Means of casting bridge pieces on lugs of accumulator plates, &c." H. DUTTON. December 17th.

31,627. "Insulators for electrolytic systems." A. S. GUSH. December 17th.

31,642. "Apparatus for purification of liquids by electrolytic treatment." A. S. GUSH. December 17th.

31,651. "Electrical signalling and indicating devices for ships, &c." R. S. O'NEIL. December 17th.

31,665. "Dynamo-electric machines." BRITISH THOMSON-HOUSTON CO. and F. P. WHITAKER. December 17th.

31,674. "Wireless reception apparatus." H. L. CROWTHER and J. ROBINSON. December 17th, 1919.

31,695. "Apparatus for issuing receipts from electricity meters, gas meters, &c." C. A. GUSTAFSSON. December 17th.

31,710. "Starting, lighting, and ignition apparatus of internal-combustion engines for motor vehicles." N. STELL. December 18th.

31,711. "Electric heat-producing element." C. H. RODDIS. December 18th.

31,712. "Sparking plugs." W. AKED and J. TAPLEY. December 18th.

31,775. "Coin collecting devices for telephone services." A. J. H. HADDAN. (Hall.) December 18th.

31,776. "Meter registers and control devices for telephone services." A. J. H. HADDAN. (Hall.) December 18th.

31,783. "Sparking plugs." A. J. HUDSON and W. H. PEATE. December 18th.

31,786. "Dynamo-electric machines." BRITISH THOMSON-HOUSTON CO. and F. P. WHITAKER. December 18th.

31,788. "Mixed electric drive for vehicles equipped with steam turbines, polyphase generators, and asychronous motors." MASCHINENFABRIK OERLIKON. December 18th. (Switzerland, October 30th.)

31,789. "Method of controlling polyphase motors on vehicles." MASCHINENFABRIK OERLIKON. December 18th. (Switzerland, November 3rd.)

31,806. "Refillable electric fuses." PERFECT REFILLABLE FUSE INC. December 18th. (U.S., December 18th, 1918.)

31,814. "Treating weakly magnetic iron ore containing sulphides as a secondary constituent." R. JOHANSON. December 18th.

31,815. "Incandescent electric lamps." L. A. DE BECKER. December 18th.

31,832. "Signal lamp." P. PHILPOT. December 18th.

31,834. "Apparatus for electric traction systems." S. MCLEAN and A. MUIR. December 18th.

31,856. "Device for testing sparking plugs." A. V. TERRY and TERRY & SONS. December 19th.

31,876. "Electrically-controlled valves for steam, hot water, gas, &c." G. WILKINSON. December 19th.

31,880. "Telegraph and telephone systems." I. HORTIX. December 19th.

31,891. "Contact breakers for ignition magnetos, &c." F. H. FARRER, F. POUNTNEY, and VILLIERS ENGINEERING CO. December 19th.

31,895. "Medical electrical light and heat treatment couch." H. J. MOUSON. December 19th.

31,898. "Dynamo-electric machines." BRITISH THOMSON-HOUSTON CO. and C. A. MARTIN. December 19th.

31,899. "Electric furnaces." BRITISH THOMSON-HOUSTON CO. and H. C. HASTINGS and N. LAYCOCK. December 19th.

31,920. "Electric switchboards." A. J. MIDGLEY and C. A. VANDERVELL & CO. December 19th.

31,927. "Enabling movable objects to pursue an electrically staked-out route." A. W. LOTH. December 19th.

31,940. "Telephones." C. KEARTON and G. B. RILEY. December 19th.

31,942. "Electric lamps." EDISON SWAN ELECTRIC CO., P. FREEDMAN and G. A. PERCIVAL. December 19th.

31,948. "Ignition devices for internal-combustion engines." F. A. SMITH. December 19th.

31,953. "Switches for electric lamps, &c." J. B. PORTWAY. December 20th.

31,966. "Sparking plugs." G. WILSON. December 20th.

31,975. "Spot welding machines." F. A. CRAMER and H. MARRYAT. December 20th.

31,976. "Seam welding machines." F. A. CRAMER and H. MARRYAT. December 20th.

32,013. "Sparking plugs." E. CHASSERAUX. December 20th. (France, January 14th.)

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1917.

11,785. VARIABLE ELECTRIC RESISTANCES. W. E. Baker. January 18th, 1918. (135,523.)

1918.

6,856. HIGH-TENSION ELECTRIC TRANSFORMERS. F. Dessauer. April 23rd, 1918. (135,528.)

12,968. MAGNETO-ELECTRIC MACHINES. B. Wolkoff. August 9th, 1917. (118,620.)

13,752. ALTERNATING CURRENT DYNAMO-ELECTRIC MACHINES. British Thomson-Houston Co., H. W. Taylor, F. H. Clough and F. P. Whitaker. August 23rd, 1918. (135,533.)

14,315. DYNAMO-ELECTRIC MACHINES. British Thomson-Houston Co. and A. A. Pollock. September 3rd, 1918. (135,534.)

15,529. ELECTRICAL IGNITION APPARATUS FOR INTERNAL-COMBUSTION ENGINES. Remy Electric Co. September 19th, 1917. (120,203.)

15,769. X-RAY APPARATUS. M. B. Rodriguez. September 27th, 1918. (135,540.)

19,326. UTILISATION OF WIND POWER FOR THE GENERATION OF ELECTRICITY. H. J. Read. November 23rd, 1918. (135,573.)

19,595. FILAMENTS FOR ELECTRIC LAMPS. Westinghouse Lamp Co. February 19th, 1917. (121,396.)

20,279. CIRCUIT ARRANGEMENTS FOR REDUCING STATIC INTERFERENCE IN RADIO-RECEIVING STATIONS. Western Electric Co. (Western Electric Co.) December 6th, 1918. (135,635.)

20,289. ELECTRIC SELECTORS FOR TELEPHONE SYSTEMS. C. A. W. Hultman. December 11th, 1917. (121,474.)

20,378. ELECTRIC METALLURGICAL FURNACES. W. E. Moore. December 7th, 1918. (135,639.)

20,828. SPARKING PLUGS. T. Antoine. December 13th, 1918. (135,661.)

21,052. HIGH-TENSION INSULATORS FOR USE IN ELECTRIC SUPPLY SYSTEMS. J. E. Pollak. (Fabbrica Isolatori Livorno.) December 17th, 1918. (135,667.)

21,307. INSULATORS FOR HIGH-TENSION ELECTRIC CABLES. H. Wade. Fabbrica Isolatori Livorno.) December 19th, 1918. (135,669.)

21,562. ELECTRIC TIME SWITCHES. E. A. Fagerlund. December 23rd, 1918. (135,672.)

21,644. ELECTRIC SWITCHES. L. Benvenuti and G. Cigolini. December 24th, 1918. (135,673.)

21,863. ELECTRIC FURNACES. E. Waring and W. Waring. December 31st, 1918. (135,674.)

1919.

1,737. ELECTRIC STARTING MECHANISM FOR INTERNAL-COMBUSTION ENGINES. H. Lucas, C. L. Breeden and H. W. F. Ireland. January 23rd, 1919. (135,695.)

2,742. HIGH-TENSION DISTRIBUTORS FOR ELECTRIC IGNITION APPARATUS. Akt. Ges Brown, Boveri et Cie. February 4th, 1918. (Addition to 114,825.) (123,086.)

5,621. ELECTRIC LIGHT FITTINGS. F. Rawcliffe. March 6th, 1919. (135,734.)

8,560. ROTORS FOR DYNAMO-ELECTRIC MACHINES. P. F. Brittain. April 4th, 1919. (135,747.)

10,932. APPARATUS FOR LAMP SIGNALLING IN OVERHEAD WIRE SYSTEMS OF ELECTRIC TRACTION. Brecknell, Munro & Rogers and A. M. Willis. May 2nd, 1919. (135,764.)

13,201. ELECTRIC FIRES. H. H. Berry. May 26th, 1919. (135,779.)

14,427. ELECTRIC RAILWAY SYSTEMS. Metropolitan-Vickers Electric Co. July 10th, 1918. (129,628.)

14,934. CONSTRUCTION AND DESIGN OF BASES, CONTACTS, AND SOCKETS OF WIRELESS VALVES OR VACUUM TUBES. J. W. Polybank. June 13th, 1919. (135,792.)

16,916. ELECTRICAL MEASURING INSTRUMENTS OF THE MOVING COIL TYPE. G. T. Garwood. July 5th, 1919. (135,801.)

17,622. SPARKING PLUGS FOR INTERNAL-COMBUSTION ENGINES. C. M. E. L. Monnier. July 13th, 1918. (129,985.)

18,678. ELECTRIC LIGHTING OF MACHINES DRIVEN BY ELECTRIC MOTORS. V. Hope. March 21st, 1918. (Divided application on 4,990/18.) (135,150.)

21,025. TELEPHONE SWITCHBOARD AND PLUG FITTINGS. Naamlooze Venootschap de Nederlandsche Thermo-Telephone Mattschappij. August 27th, 1918. (131,895.)

21,866. SPARKING PLUGS. F. A. L. Johnson. September 5th, 1919. (135,154.)

23,540. APPARATUS EMPLOYING VARIABLE ELECTRIC RESISTANCES. S. G. Brown. August 13th, 1918. (Divided application on 13,167/18.) (135,157.)

Water Power.—Mr. Lloyd George, on December 30th, visited Dolgarrog Aluminium Works, near Bettwsycoed, and the North Wales Power Co.'s Works. The Prime Minister was accompanied by Mrs. Lloyd George, Sir George Riddell, and Mr. and Mrs. Richard Lloyd George, and was entertained at luncheon by Mr. Jack, managing director of the companies, and the heads of the various departments. Replying to the toast of his health, Mr. Lloyd George said that he had long intended to visit those works, as he was specially interested in the regeneration of country life. For hundreds of years millions of gallons of water had been running to waste. We were the most backward nation in the utilisation of water-power. In Germany water-power had long been made use of for factories, agriculture, and other purposes, with the result that remote communities had been established which were rendering valuable service to the community at large. He hailed the advent of similar enterprises in this country. The secret of the future lay in the adequate exploitation of our great natural resources—coal and water. In other words, cheap power was the great necessity of our manufacturing life.

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THE

ELECTRICAL REVIEW.

VOL. LXXXVI. JANUARY 9, 1920. No. 2,198.

ELECCAL REVIEW.

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THE PR OF THE "ELECTRICAL REVIEW."

During the ar, almost exceptionally among technical publications and periodicals of the character of the ELECTRICAL REVIEW, we have refrained from increasing the price. Owing, however, to the constant increase in cost of paper, printing, engraving and production charges generally, we have reluctantly decided that the price from the beginning of th year must be raised to 6d. per copy. The change will not apply to unexpired subscriptions.

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THE FUTURE OF ELECTRICITY SUPPLY.

Now that the Electricity Supply Bill has become an Act, it is to be hoped that we shall soon see tangible results. In a number of undertakings extensions of the generating plant are urgently needed, but the whole matter has been hung up pending a settlement of the national policy embodied in the Bill. Now at last there is a chance of making progress. Moreover, at present the matter is, to a great extent, in the hands of the undertakers themselves. We say at present, since a further Bill (to provide for the establishment of district boards and compulsory expropriation) is threatened (or promised, according to one's point of view) for next session. But in the meantime undertakings have a free hand to form joint electricity authorities by voluntary action, subject to the approval of the Electricity Commissioners—when they are appointed. The chances of the supplementary Bill being passed appear, to a great degree, to be contingent on what has been done to form joint authorities up to the time when the Bill is brought forward. If joint authorities are actually in existence in all the principal districts when the new Bill is put before Parliament, the Bill will obviously have little justification. But if the undertakings are backward in taking action, or if mutual jealousies or animosities are allowed to delay the formation of joint authorities, the most powerful arguments will be put in the hands of the supporters of the Bill.

As a matter of fact, a good deal of spade-work has already been accomplished in this direction. South Lancashire, which has been in the van of progress ever since the subject was broached, as the valuable reports which we have published bear witness, was on the verge of forming a joint authority in 1917, but the scheme broke down owing to the refusal of the local authorities to consider the purchase of existing stations and the erection of new ones, and progress was confined to the linking-up of a number of power stations. However, the scheme was so far developed that there should be no difficulty in picking up the threads, and this time, we imagine, the municipal authorities will approach the subject in a very different frame of mind; it would be something of an anti-climax if they, of all people, should prove to be the stumbling-blocks!

Again, considerable progress has been made in other areas, such as the West of Scotland, South Wales and Monmouthshire, Dublin and district, and elsewhere with linking-up proposals, which should be of great assistance in connection with the more comprehensive projects now called for, and movements have been set on foot in the Midlands, at Dundee, Stalybridge, Bradford, Sheffield, and other centres towards the formation of joint authorities. The latest development comes from the West of England, where, for Gloucestershire and the surrounding counties, a joint electricity authority has already been provisionally arranged. Due largely, we surmise, to the "push" of Mr. Faraday Proctor, representatives of the undertakers in the area, and certain local authorities that were interested, were brought together last Friday in Bristol Town Hall, with the result that a joint authority was agreed upon, and resolutions were passed, which, if confirmed by the companies, councils, and others there represented will settle the preliminaries at least as far as the principle is concerned, a by no means mean achievement at one meeting, and within a fortnight after the Bill became law. If succeeding steps are taken at the same rate, we ought soon to see

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the first joint electricity authority in being. We hope, however, that this will not be an isolated phenomenon, but that in speed the Gloucestershire area will be only *primus inter pares*.

Small undertakings all over the country await, with considerable impatience, the setting-up of joint authorities, trusting that these may provide some way out from their difficulties in providing additional generating plant. Big undertakings are also holding their hands. It is to the interest of everyone, therefore, that the Act shall be put into operation immediately for all it is worth. When shall we have the names of Sir John Snell's four colleagues?

Relativity.

IT is generally assumed, or taken for granted, that the special province of philosophical physicists is to *explain* the order of physical occurrences, which means to express it in terms of common-sense. Judging by what has transpired between them during the last two months, their efforts in this direction have been meeting with less than a moderate measure of success. There has always been some difficulty in explaining action at a distance, since it prompts the question: How can a body act where it is not? In the case of light, after the corpuscular theory had proved inadequate, the luminiferous ether was introduced to explain it. In the case of gravitation, we were settling down simply to accept action at a distance as a fact: indeed, most people were content to leave it at that; but this did not satisfy Dr. Einstein, who, armed with a new mathematics of transcendental power, set out to show it was a property of space. The spectacular success he achieved in predicting the deflection of light from the stars by the gravitational field (we must no longer say the attraction) of the sun, will be in the minds of all our readers; but, although we cannot withhold our admiration of the result achieved, it does not prove that the mathematical conceptions he formed in reaching it have actual counterpart in reality. His general line of reasoning is set out very fairly in the contribution he made to *The Times* of November 28th.

He points out that the mechanical laws as enunciated by Galileo and Newton hold good, not only for a system of co-ordinates at rest, but for every other system of co-ordinates that moves in respect to it with uniform rectilinear motion. He then inquires why the validity of these laws should be confined in this arbitrary way. Why should not these laws hold good, though the system of reference be subject to acceleration, and, or, rotation? Such a development would, of course, introduce forces indistinguishable, by any means known to us, from forces of gravity; for a gravitational field of force is exactly equivalent to a field of force introduced by a transformation of the co-ordinates of reference, so that by no possible experiment can we distinguish between them. The objection which at once occurs to everyone is: if what I am accustomed to think of as my weight is due to a perpetual acceleration of my body away from the centre of the earth, how is it that I remain always at the same distance from it?

The surmounting of this difficulty is the essence of his theory, and if, so far, all the great men of science have excused themselves from the task of making clear how that is done, it is unlikely that we shall succeed in doing so. Suppose, however, you are in flat land. Since there is no third dimension of height or depth, we shall not know gravity as on this earth. Now, suppose flat land to undergo rotation about a horizontal axis situated behind you. Then all things, including yourself, would be subject to a force of the kind called centrifugal, but indistinguishable from gravity acting throughout flat land. You would tend always to slide forward, and would exercise pressure on all that restrained you. To apply this analogy to things as they are, you must invoke what is called non-homaloidal space-time, which is a curved surface in five dimensions. This, of course, is absolutely inconceivable, indeed, it is of the order of inconceivability squared, and if Dr. Einstein esteems it his business to explain gravitation, he has singularly failed, for an explanation that revolts common-sense is not an explan at all. The fact remains, however, that he has achie correct results in at least two problems which have pr irreducible by any other means.

That the instruments of reasoning have therefore objective reality is a conclu it would be unwise to draw, for do we not frequentl ive at correct results by the agency of instruments tha inconceivable, in the sense of being meaningless as his Suppose we are given the area of the face of a cu nd invited to find its contents. The area is, let us, 100 sq. in. We had best proceed by taking the squar ot of this, which will give us 10 in., a quantity we ca alise and verify with a foot-rule if we like. Then cubin s we have 1,000 cu. in. for the contents required. But ay proceed in another way. We may begin by cubing 100 sq. in., which will give us 1,000,000—but a million t? Nothing on earth, or elsewhere. These are, indeed, its which we cannot imagine or conceive, much less fy physically with a foot-rule. Nevertheless, taking t square root of this number, we get 1,000 just as before the contents required in cu. in. Now this result does n rove the existence of space in six dimensions. In the sa way the correctness of Dr. Einstein's calculations do not guarantee the objective reality of any conceptions may have framed for the purpose of carrying them . Moreover, these same conceptions, being of the pure mathematical kind, may be capable of entirely different terpretations. Sir Joseph Larmor made a communicatio a meeting of the Royal Society, held on November 20 which proposed a re-arrangement of essential features in Einstein's theory, whereby it becomes a theory of cor ondence between different modes of specifying the activity physical systems, and not directly a theory of relativity at l.

The Need for Engineering Goodwill.

THE note of optism which we adopted last week in r brief forecast of the electrical indus is also struck by Sir John McLaren, airman of the Leeds Engineering Employers' Federation, a New Year message regarding the whole of the engin ing industries. There are boundless opportunities for e ineering, and, therefore, for engineers, and Sir John is pbably perfectly correct when he promises unlimited emplo ent and good wages for all who care to work. As we ha passed out of Peace celebration year, we may with some asure of confidence hope that there will be a greater disp tion to work —to do good work—and to increase produ con. But all our optimism and confidence are necessari moderated, because we know well enough that there wi not be prosperity for all, even when the demand for manu ctures is so overwhelming, unless there is peace. Most spropriately, and seasonably, Sir John calls for goodwill—godwill among both workers and employers. If we have t at we shall prevent "paltry grievances" on the part of a handful of men holding up large sections of industry, and e shall also be able to secure such a large output that, while he demand is so great, the present wages will be justified. Whether or not, or for how long, wages will remain at their present level, must depend partly upon the cost of living and partly upon whether we are able to secure a strong psition in the export field. High production and efficien methods should enable us to reduce costs, so that our overseas customers will find it possible to continue to purchase from us rather than from somebody else. Everybody ought to be brought to see—some are learning the lesson painfully—that mere high wages are not necessarily a sign of industrial prosperity, nor with the cost of living high are they a sign that the employé is any better off than he used to be. It is only in the atmosphere of a genuine goodwill that such aspects of our industrial problems can be calmly and sanely considered. If hot-heads and extremists are in the saddle, we can hardly expect goodwill. They may find it congenial to flare up at the mere mention of lower wages ever becoming necessary in the engineering trades. But Sir John, in a New Year plea for goodwill and industrial peace, is not living in so unreal a world that he can be induced to forget the possibility that such a necessity may

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arise sooner or later. He was speaking as an engineering employer, and presumably, therefore, his allusion to the possible necessity of wages coming down "in some trades, or even all'round," was intended to relate to even the, at present, very active engineering industry. He repudiates any suggestion that he is an advocate of low wages, but foreshadows that a reduction may become a pure economic necessity "so as to bring the cost of manufacturing to a figure which will enable foreign customers to purchase from us." We may be permitted to hope that by such a time the cost of living will have reversed its present course, also that by means of scientific production and earnest effort, we shall have found it possible to decrease costs of manufacturing without decreasing wages. We hope that the belief that the extremist is growing in disfavour, will be justified by the course of events in the engineering and electrical trades. It rests with the large body of serious-minded men in these activities persistently to bring the weight of their influence to bear in conversation with their comrades, so as to ensure that British chances of successful employment shall not be jeopardised by reckless policy, or even be rendered unstable by inflammatory talk. It equally rests with all employers, whether big concerns with many millions of capital or small firms with a few "hands," to act generously toward and to study reasonably, without objectionable coddling, the well-being of those who, in earning their livelihood, are securing the return upon capital. It is only by all parties working together in harmony that we can secure the maximum benefit for all.

Fools and Their Money—

THE wild-cat scheme to which we referred last week, for the generation of electric power by converting the public roads into treadmills, is being put forward as a bait to catch the unwary investor; one-third of the world rights of the "patent" (save the mark) is being offered by advertisement for £20,000. To explain that, even if such a scheme were practicable, the energy would be supplied by the owners of the vehicles that traversed the roadways, who would not tolerate any such robbery, would be to insult the intelligence of our engineering readers; it is conceivable, however, that some person with more money than wits might be induced by the foolish editorial notices in the lay Press to part with the former, and in the hope of saving possible victims from disaster, we invite our readers to help us in disseminating a warning as to the futility of the proposal.

Making Both Ends Meet.

THE new and unforeseen conditions with which electricity supply undertakings are faced, will demand certain revisions of the terms under which they have hitherto been working. Some method must be devised so that supply undertakings may make both ends meet. In many undertakings the continuously-increasing working expenses are bringing them perilously near having to shut up shop. The seriousness of the situation is very well illustrated by a Bill which is now being promoted by a group of companies, the title of which is "Edmundson's Electricity Corporation, Limited, and other Electric Supply Companies (Increase of Charges) Bill." Particulars of the Bill are given elsewhere in this issue. As explained in the preamble, the capital of the undertakings included exceeds £1,300,000, and we see by the schedule that 30 Provisional Orders are covered.

The undertakings represented by these Orders are situated in widely different districts, so that the conditions which the promoters are trying to remedy may be taken as normal to most small-sized undertakings throughout the country.

The preamble to the Bill voices a crying necessity. It claims that owing to the great cost under existing conditions of carrying on the undertakings scheduled in the Bill, the revenue obtainable within the limits of the statutory maximum prices is in certain cases insufficient to meet the working expenses after making provision for depreciation, and in the remaining cases is barely sufficient for that purpose. Continuing, it explains that the remedy proposed in the Bill is necessary to enable the companies to fulfil their statutory obligations and to carry on efficiently, and to render possible the raising of further capital to meet the increasing requirements of consumers. This preamble would, of course, fit many more undertakings than those scheduled in the Bill. As to the remedy suggested, it is proposed that the maximum price should be raised to 1s. 2d. per unit (the highest maximum price, we believe, yet applied for), qualified by a kind of sliding scale adjustment of the actual price to be charged. If the company charges 1s. per unit, or over, the company shall only retain of the revenue a sum not greater than would pay 6 per cent. on the capital employed. If it charges less than 1s. per unit, the company shall retain, in addition, a sum equal to half of 1 per cent. on the capital employed for each halfpenny by which the charge is less than 1s. Whether this particular method is one which will find favour in the House, or with the Electricity Commissioners, is an open question. But that some such kind of wide revision of the present rigid system of maximum prices is, in many cases, absolutely necessary, is beyond doubt. The Bill, therefore, touches upon a matter of crucial importance to a very wide section of the electricity supply industry.

Electricity in Mines.

NEW YEAR'S DAY often has, in addition to its ordinary significance, a special connotation in relation to particular persons and things; and the first day of the year which is already growing old was noteworthy for its special meaning to colliery engineers—for the regulations for the use of electricity in mines which were put in force on July 10th, 1913, were not to apply to apparatus installed before June 1st, 1911, until January 1st, 1920. *Eheu fugaces labuntur anni!*—that date has come and gone; but who could have foreseen the world-shaking events which have intervened? or the utter impossibility, in those times of toil and stress, of carrying out the alterations necessary to comply with the Rule? Application is to be made to the Home Office to extend the time for a further period of two years, a proposal which certainly cannot be regarded as unreasonable: and as the Home Secretary has power to grant exemption in cases which he considers worthy of it, there should be no difficulty in complying with the request—more especially in view of the fact that the mines are under State control, in name at least (some say they are controlled by the miners, in fact). To what extent the electrical equipment of the coal mines has already been brought into conformity with the Rules, we have no information.

Electric Heating.

MUCH has been heard of late regarding the relative merits of gas and electricity for heating purposes. As we have often pointed out, the only sound criterion is the practical test, and we have pleasure in drawing attention to the description of the new heating system of the Lyric Theatre, Hammersmith, which appears elsewhere in this issue. Actual trial there shows that the cost of installation of electric heating apparatus throughout the theatre was only one-third of that of a hot-water system, and the running cost is only half that of the gas-heating system which has been displaced on account of its inefficiency, although the electrical energy is not supplied at a specially low price. Moreover, the results obtained from the electrical installation have been most satisfactory. The heating of a theatre is a difficult problem, and it is gratifying to know that, as usual, the electrical method provides an adequate solution. The facts that the whole of the electrical system is controlled from a central point, and requires no personal attendance, whereas the gas radiators had to be visited when starting and stopping, and that fire risk is reduced to a minimum, are other strong points in favour of electricity, which, moreover, can be installed with practically no disturbance to the decorations or inconvenience to the patrons of the theatre.

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THE ELECTRIFICATION OF THE MELBOURNE SUBURBAN RAILWAYS.

THE railway system of the State of Victoria, Australia, is operated by the State Government, the executive functions being exercised by three Railway Commissioners; at present there are only two, Mr. C. E. Norman, chairman, and Mr. W. M. Shannon. The electrification scheme owes much of its success to the late Mr. E. B. Jones, for some years a Commissioner, whose death before the completion of the work was a serious loss to the Victorian railways.

The total track mileage of the railways is some 4,300, of which over 300 miles are suburban lines serving the city of Melbourne. The importance of the Melbourne suburban traffic to the whole system is shown by the fact that it accounts for some two-fifths of the total train-mileage of the railways entering Melbourne. Not only are the suburban railways of greater importance to the system as a whole than in other countries, but they are of greater importance to the city itself than are the suburban systems of most other cities. Owing largely to the foresight of the authorities responsible for laying out the city, the density of population is only about one-fifth of that commonly found in this country. The result is that the suburban railways cover an unusually large area, in spite of there being an excellent cable tramway, and deal with a large amount of traffic which in other cities is catered for by electric tramways, interurban railways, or motor omnibuses.

The conversion of the Melbourne suburban lines to electric traction was first considered in 1907, when, at the request of the Hon. Sir Thomas Tait, K.C.M.G., chairman of the Commissioners, Mr. Charles H. Merz, of London, visited Melbourne and presented an exhaustive report (June, 1908) on the whole question, which showed that although there would be a considerable saving in operating expenses, an increase of traffic would be necessary to cover the capital charges. An increase in traffic more than sufficient for this purpose was anticipated, but it was decided not to proceed with the electrification at that time. By 1912, however, the traffic had increased very much more than had been estimated, and sufficiently to necessitate either expensive track widenings, or alternatively to justify the capital expenditure involved in electrification, even if this produced no additional traffic. At the request of the Hon. W. A. Watt, then Premier of the State of Victoria, a

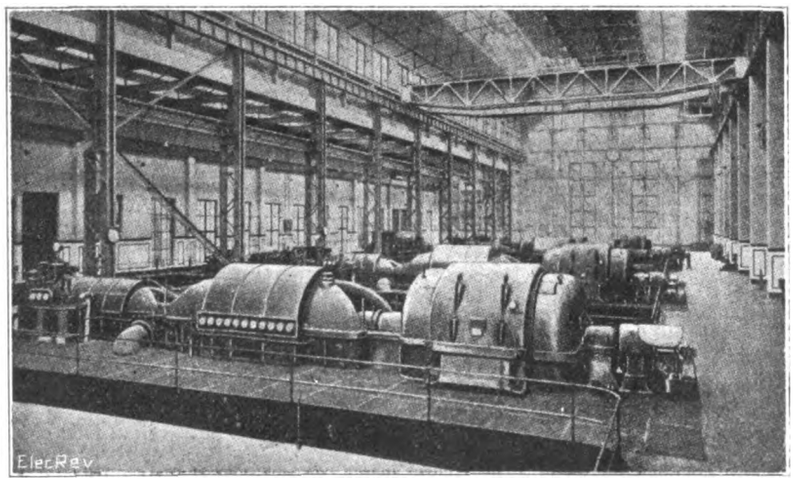

FIG. 1.—TURBINE ROOM AT NEWPORT POWER STATION, AUSTRALIA.

further report was presented by Messrs. Merz & McLellan, based upon actual tenders from manufacturers. Alternative prices were obtained for the single-phase and direct-current systems. The latter proved to be substantially cheaper both in capital expenditure and operation. Contracts were, therefore, placed providing for the conversion of the whole of the suburban lines on the high-pressure, direct-current system, the work to be carried out in three stages. With the exception of the coach equipments, all the contracts have been executed by British or Australian firms with the stipulation that manufacture of the British contracts was to be carried out in this country. The coach equipments were ordered in America with the special condition that some of the motors were to be made in England.

The scheme is one of the largest and most important railway electrification works as yet carried out. The leading engineering features are the production of electrical energy at 3,300 volts between phases, by means of three-phase, 25-cycle, turbine-driven alternators, raised to 20,000 volts by static transformers, its transmission to sub-stations where it is converted to 1,500-volt direct current, and its supply at this pressure to the trains by means of an over-

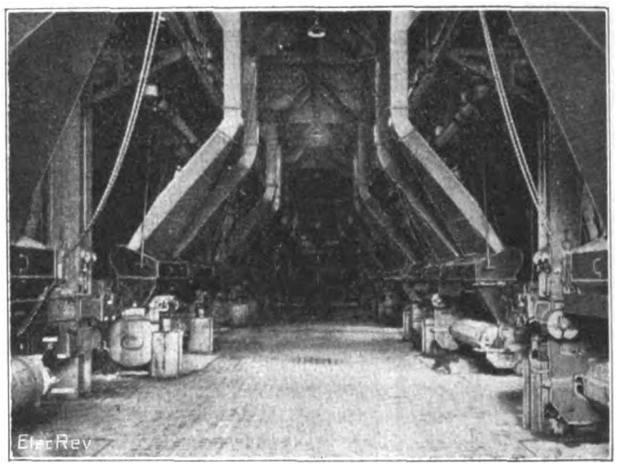

FIG. 2.—NO. 1 BOILER HOUSE—FIRING FLOOR.

head contact wire. The main contracts were placed in March, 1912, work was started in November, 1913, and the first train was run on May 29th, 1919. The work has, of course, been much delayed by the war.

Power Station.—The power station was originally to have been placed on the River Yarra at Yarraville, the nearest available site to Melbourne having a good supply of condensing water and reasonable access by rail. It was, however, decided to adopt a site at Newport which had certain advantages in connection with condensing water, sub-soil, &c., that compensated for the additional expenditure on transmission cables. Thus the existence of a stone breakwater enabled the intake and discharge to be separated in a manner which is not ordinarily obtainable without considerable expense. The site consists of some 36 acres of land adjoining the Williamstown Ferry, and is mostly situated on basaltic rock which, while providing a satisfactory foundation, involved considerable extra work, some 45,000 cb. yards having to be removed. The site has been laid out to contain two power stations side by side, the position of the future station being indicated by broken lines in fig. 5. In this way full advantage may be taken of any future developments in power-station design without interfering with the symmetry of the present station. The first station is laid out to contain six 10,000-KW. turbo-alternators, which suffice for present requirements, and include two spare sets for the purposes of stand-by and over-haul. The two boiler houses are at right angles to the engine room, and each is provided with its own coal store and coal-handling machinery. The elevation of the power station is shown in fig. 6. Between the two boiler houses is a space occupied by a general-purpose building containing stores, water-storage tanks, workmen's accommodation, laboratories, test tanks, &c. Placing these accessories in this position has proved efficient as regards administration

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and working, and the separation of the engine room from the boiler house by a lower pump room has a good effect.

Boiler Houses.—The equipment of each of the boiler houses, fig. 2, is as follows :—12 Babcock & Wilcox marine type water-tube boilers, 30,000 lb. normal evaporation, 210 lb. per sq. in. working pressure, 610° F. total temperature of steam, 6,725 sq. ft. heating surface, 168 sq. ft. grate area ; two chain-grate stokers per boiler ; 288-pipe Green economiser per boiler ; six Sirocco fans, one fan to two boilers ; two Weir impulse turbine-driven centrifugal feed pumps ; two Nichols vertical single-cylinder feed pumps, 30,000 lb. capacity water per hour, each type feed pump ; two sets ash-handling plant ; three coal conveyors, 40 tons per hour each ; one coal storage yard and crane.

The boilers are arranged six a side in pairs, each boiler having its own integral superheater and economiser. One steel chimney, 7 ft. in diameter and 58 ft. above economiser floor level, with an induced-draught fan, serves each pair of boilers. The furnaces are arranged at present to burn coal from the State mine at Wonthaggi or Newcastle (N.S.W.), but the arches could, doubtless, readily be adapted to burn brown coal if necessary.

Coal and Ash-Handling Plant.—The storage and handling of coal is provided for by means of railway sidings, the full and empty wagons being worked in a continuously forward direction. The 15-ton hopper wagons dump their coal into large hoppers below the track, between the boiler houses and the storage yard. From these hoppers the coal passes to the bucket conveyors below, which carry it over weigh-bridges, weighing four buckets at a time, to the coal bunkers above the boilers, or by the central conveyor to the coal storage yard. Motor-driven crushers are provided below the hoppers. The coal, on reaching the gantry over the coal storage yard, can be automatically dumped where required, just as in the coal bunkers. In addition, a grab, handled by an electric jib-crane of the luffing type, can be used to spread the coal over the storage area. To recover this coal for the boiler houses, the grab can be brought into use again, feeding the chutes to the travelling coal filler in the underground passage below the storage ground, which returns it to the other conveyors ; or the grab can deliver it direct into an auxiliary hopper on the end of the coal gantry, which, in turn, feeds the main hopper.

The ash-handling equipment consists of two sets of suction plant, each with an exhauster driven by a 60-B.H.P.

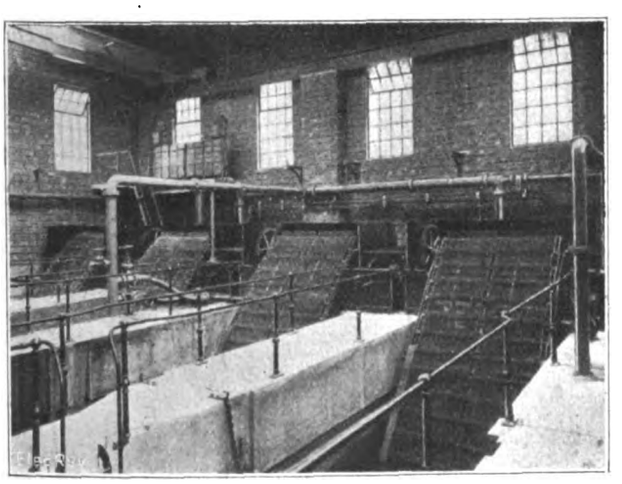

FIG. 3.—SCREENING PLANT.

motor, and a receiver, into which the ashes are drawn while being subjected to a fine spray of cooling water. The four ash bunkers are erected over the track on which ash wagons are worked in between the coal wagons. A few ½-ton trucks, running on narrow-gauge rails under the furnaces, are provided for ash handling in case of emergency. The suction ash plant also deals with the soot from the economisers.

Generating Plant.—The generating plant is so arranged that, provided any one boiler is in steam, any one turbo-alternator can be started up : but, as no atmospheric exhaust valve is fitted between the condenser and the turbines, these are not intended to run on atmosphere, and two small auxiliary turbines, each of 350-K.V.A. capacity, have been installed for starting up the power-house auxiliaries at any time when all the main turbines have been shut down. In addition, the breakdown of anything comprised in one generating set will not prevent the operation of the remaining sets.

Each prime mover is treated, as far as possible, as an independent unit ; thus each turbo-generator has its own oil-cooled transformer for stepping up to 20,000 volts, and a transformer stepping down to 440 volts for operating the circulating water, oil-cooler, and air-filter pumps, &c.

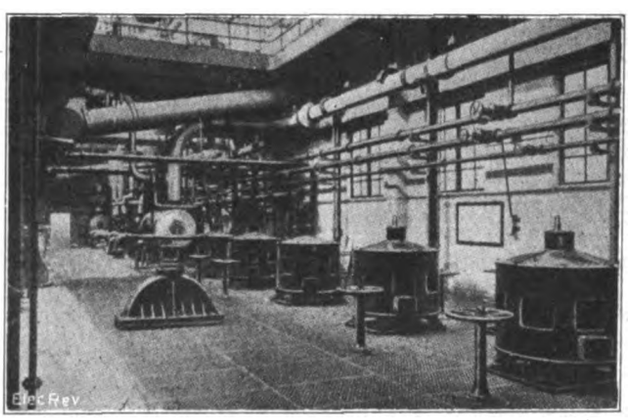

FIG. 4.—PUMP HOUSE : CIRCULATING PUMP MOTORS IN FOREGROUND.

Although experience seems to indicate that oil in transformers presents a negligible fire risk, it was thought wise to install the transformers belonging to each generator in a chamber outside the engine room ; this being out of reach of the engine-room crane, special provision is made for lifting the transformers off railway trucks. Between the transformer chambers are intervening chambers containing air-filters, neutral resistances, &c. The whole of the condenser, boiler feed, transformer, air cooler, turbine oil cooler, and air-filter auxiliaries are placed on the same level in the basement, and easily accessible, the basement being well lit and free from obstructions.

The turbine room, fig. 1, will ultimately contain six Parsons horizontal pure-reaction turbines, with divided cylinders, 1 h.p. and 2 (or one double-flow) l.p. cylinders. The normal working conditions are : Steam pressure, 200 lb. per sq. in. ; steam temperature, 600° F. ; vacuum, equal to an absolute pressure of 1·25 in. mercury ; speed, 1,500 R.P.M. Energy is generated at 3,300 volts, 25 cycles, three-phase, the economical output being for four sets 10,000-KW. each and for two sets 12,500-KW., at 0·95 lagging P.F. The maximum continuous capacity is four 12,500-KW. and two 14,000-KW., while the maximum output for short intervals is four 14,000-KW. and two 15,000-KW.

In addition, there are also provided six Weymouth twin-surface condensers of the "Contraflo" type, each twin condenser having a cooling surface of 22,000 sq. ft., and being capable of dealing with 120,000 lb. of steam at a vacuum of 28·8 in. when supplied with 14,000 gallons of circulating water per minute at a temperature of 60° F. ; six Michell-type Weymouth air-and-water-extraction pumps, working on the kinetic system, each combined set of air-and-water-extraction pumps being driven at a speed of 750 R.P.M. by an induction motor of 80 E.H.P. ; six circulating-water pumps, each of the vertical-turbine type, and capable of delivering 40,000 gallons of water per minute when driven at a speed of 500 R.P.M. by a vertical induction motor of 225 E.H.P. ; six bilge pumps of the vertical centrifugal type, capable of lifting 100 gallons of water per minute against a head of 35 ft. when driven by induction motors of the liberal rating of 6 E.H.P. at 750 R.P.M.

The are six Sirocco ventilating fans, each driven by a 30-B.H.P. Westinghouse induction motor ; six transformer oil circulating and wet-air filter pumps, each being driven by a Westinghouse induction motor of 15 B.H.P. ; six 350-K.V.A. auxiliary turbo-generators, non-condensing, generating three-phase energy at 440 volts, 25 cycles, for

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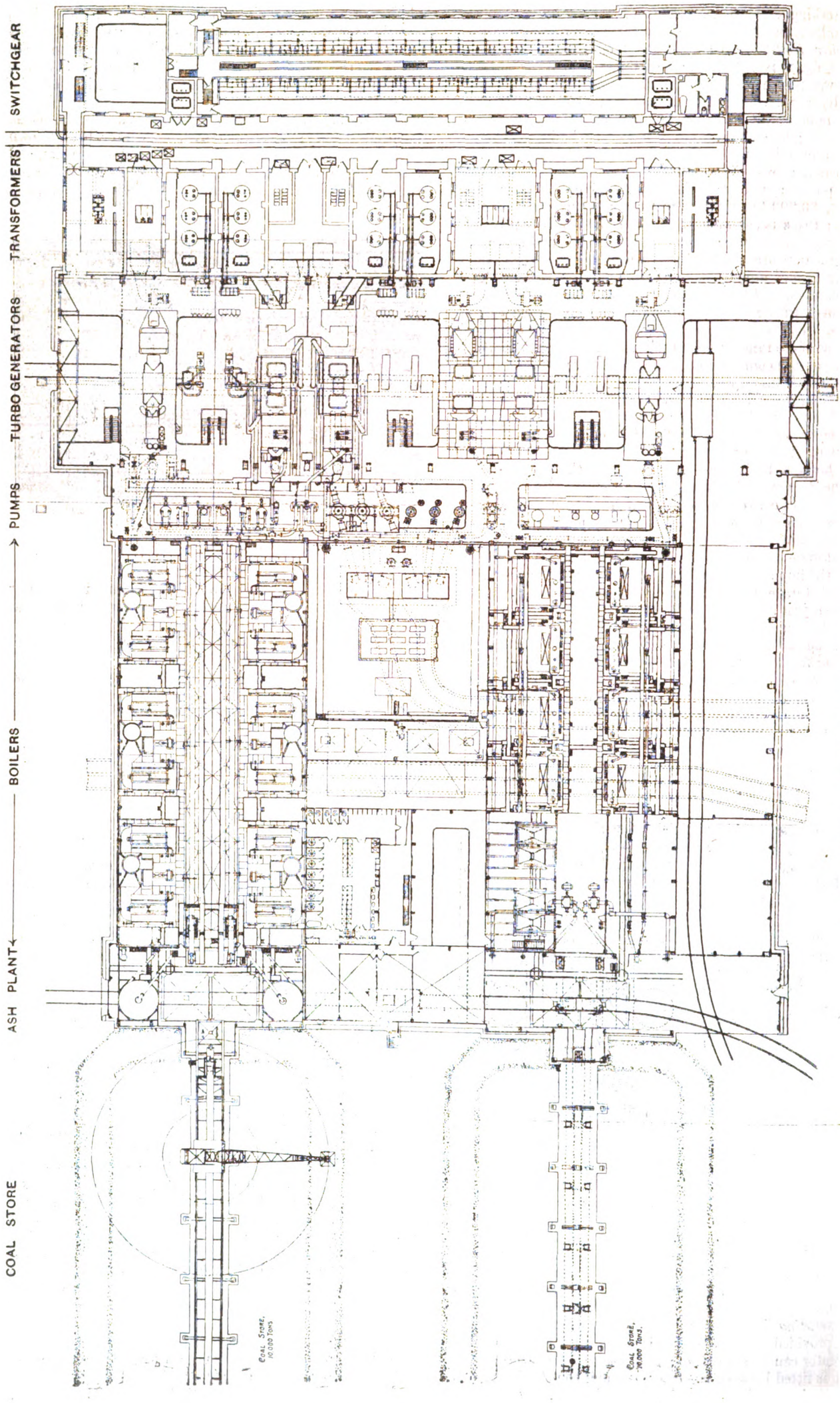

FIG. 5.—PLAN OF POWER STATION AT NEWPORT, AUSTRALIA.

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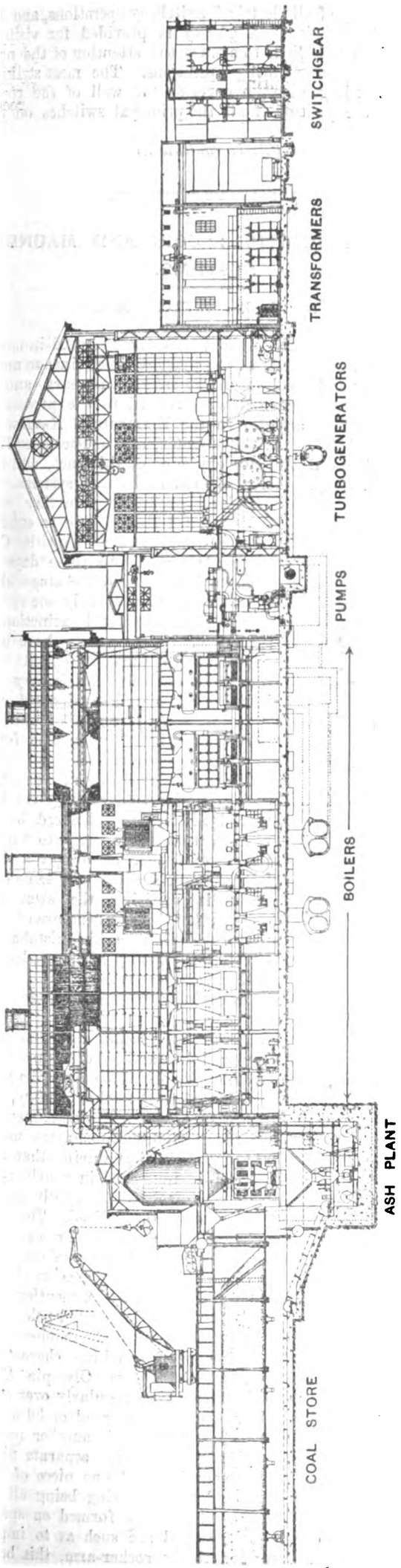

FIG. 6.—SECTIONAL ELEVATION OF POWER STATION AT NEWPORT, AUSTRALIA.

starting up; sundry motor-driven oil pumps, an air compressor and a vacuum cleaner. The Babcock & Wilcox turbine room crane has a capacity of 60 tons, with an auxiliary hoist capable of lifting 50 tons, the span being 75 ft. Fifteen-ton hand-operated cranes, by the same firm, are provided for the repair shop and pump house.

The high and low-pressure portions of the turbines are in separate cylinders, the high-pressure cylinder being of cast steel. The rotor shafts and disks are forged of solid steel. Each turbine is directly connected to the condenser below it, which is supported on large steel spiral springs. There is no exhaust valve between the turbine and the condenser, it being intended that these turbines shall not run on the atmosphere longer than is necessary to get a spare turbine into commission. In the case of the two turbo-alternators yet to be installed, the economical output of the turbine has been raised to 12,500 KW., and the maximum continuous output to 14,000 KW., the steam consumption being correspondingly reduced. The machines will be similar to the four already installed, the improved rating being obtained by "end-tightening" of the blading, and other modern improvements. The speed of the turbine can be controlled by a small electric motor from the control room switchboard. Oil is supplied continuously under pressure to the bearings by means of two gear pumps, a steam-driven pump being provided for starting up and shutting down.

The alternators are totally enclosed and ventilated by fans on the rotors, in addition to the forced ventilation by means of the separately driven Sirocco fans. The alternator is excited by an exciter mounted on an extension of the alternator shaft, the exciter being of the compound type, but without commutating poles. The construction of the stator windings of the alternator is interesting. Cotton-covered stranded wires are laid up into an oval conductor the full area of the slot; each conductor is soldered to a flat copper end-connection, thus simplifying the end connections, and facilitating rigid anchoring. The Michell type thrust bearing, an Australian invention, is used throughout.

Water Supply.—The situation of the circulating pumps is a novel and convenient feature of the design. The water supply to the pumps is in duplicate, with arrangements so that four pumps may be supplied from each half of the duplicate system. As this is sufficient for the full-load output of the station, overhaul operations in connection with the maintenance and upkeep of the water-supply system can be carried out at any time as a matter of routine. Condensing water is taken from the River Yarra, to which it is returned on the opposite side of the retaining wall after use. The two collecting channels terminate in screen pits, the water passing first through stationary screens, which remove only the heavy *débris*, and then through revolving screens consisting of link chains carrying galvanised iron-wire screens. Four screens are provided (fig. 3), each being driven by a Westinghouse 5-B.H.P. motor. The screens are washed by jets of water supplied at 50 to 60 lb. per sq. in. pressure by two pumps driven by Westinghouse 53-B.H.P. motors. The screens were supplied by Messrs. Babcock & Wilcox, and the pumps by Messrs. Gwynne, of London. The pumps are installed in a pit below the pump-house basement, so that they are flooded at all stages of tide. The induction motors (fig. 4) driving these pumps, which are mounted on the turbine floor level, are of the vertical type, equipped with Michell thrust bearings; separate thrusts are provided for the motor as distinct from those for the pump shaft, the drive being through a flexible coupling.

Power Station Switch House. — One of the most interesting features of the installation is the switch house. This is parallel to the engine room, but at some slight distance from it, there being no attempt to provide ready communication between the switch-house and the engine-room staff except by telephone and telegraph. All main switching is carried out at 20,000 volts. The power-station bus-bars are divided into two sections by means of a section switch, each sub-station being fed from both sections. So far as security of supply is concerned, therefore, the arrangement may be regarded as equivalent to duplicate bus-bars without the complication and expense of

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the latter. Another feature is the arrangement for preventing accidents, a system of mechanical interlocking being provided which prevents all possibility of an operator obtaining access to conductors while they are alive. This applies not only to the conductors of each switch panel, but to the sections of the bus-bars themselves; that is to say, access to each section of the bus-bars is entirely prevented until the whole of the isolating switches connected to it are open, thus ensuring that the bus-bars are dead. In addition, each oil switch is interlocked with its isolating switches, so that the latter cannot be opened or closed while the oil switch is closed. The oil switches are electrically operated with remote control, the operating mechanism having a wall separating it from the oil-switch chamber, so that it can be examined and cleaned without danger.

An interesting feature is the absence of windows in the switch house. One side of each switch cell is open to the outside air, in order immediately to release any excessive air pressure in the event of an unusually heavy short-circuit. Precautions are, of course, taken to prevent the entrance of birds, rain, &c.

Each phase of the main switches is a separate single-pole switch in its own oil tank, the parts working in air being isolated from the parts working in oil. Each S.P. switch has multiple breaks in series, arranged vertically close together in the middle of the tank, with insulating barriers between adjacent breaks, there being four breaks in the S.P. generator oil switches. These are so connected that upon the switch opening under load the mutual induction of the arcs produces a radial blow-out effect towards the insulated wall of the tank. Opening speeds up to an equivalent of 50 ft. per second can be obtained, aluminium being employed to ensure rapid acceleration. The gases produced are discharged to the outer passage way.

FIG. 7.—CONTROL ROOM.

The three-phase oil switch will safely open a short circuit on a system controlling power of a rated capacity of 240,000 K.V.A. The operating gear consists of a rotary type magnet actuating a countershaft through a toggle mechanism and tripping box, the magnet being excited from a 110-volt battery supply and contactor, operated from the control board. In addition to red and green indicating lamps, there is an alarm-bell device to give warning when the switch has opened.

The generator equipments are fitted with Merz-Price protective gear, while feeder equipments have split-conductor protective gear. Each generator has an emergency control pillar and load indicator fixed in the engine room.

Control Room.—This is situated at the end of the switch house (fig. 7). In it is centred not only the control of the main power-station switches of the generators and transmission feeders, but all electrical operations throughout the entire transmission and conversion system are directed from this point. On the control engineer rests the responsibility of all electrical switching operations, and his control is absolute. A gallery is provided for visitors, although there is little to attract the attention of the non-technical observer during operations. The most striking feature is a large diagram covering one wall of the room, showing the position of all the principal switches on the system.

(*To be continued.*)

ELECTRIC IGNITION: COIL AND MAGNETO SYSTEMS.

BY F. H. HUTTON, M.A.

THE subject of ignition for petrol engines used in motor cars is full of interest at the present time, since so many developments have been made in recent years, and so much has been learned with regard to the process of ignition. The articles in the ELECTRICAL REVIEW of November 7th by Mr. C. Sylvester, and of December 12th by Mr. A. C. Booth, are evidence of this fact, and testify to the appreciation of modern battery systems.

Before proceeding further with the subject I should like to enter a mild protest against the title, Coil *versus* Magneto. In these days we seem to have passed the stage when it was a question of only one system surviving to the total extinction of the other. Both systems have been developed to such an extent that they are entirely satisfactory for ignition when well carried out, and it is largely a question of which is most convenient or suitable for a particular purpose.

Mr. Sylvester belongs to the school of those who vote entirely for battery ignition, as evidenced by his remark that "the magneto will in the near future be almost a dead letter," and again, "the same company is utilising the same machinery for the manufacture of magnetos. This is a big mistake, because the majority of its production will never be required."

These are rather sweeping statements. Are they quite justified by the facts?

The high-tension magneto in pre-war days had been developed into a very reliable and efficient machine, which rarely gave trouble. Since those days the magneto industry has been transferred to this country, and has developed and grown in a most remarkable manner. Not only were there about 300,000 magnetos manufactured between 1914 and 1918, but during that time the design was being rapidly improved in nearly every important detail, until the machines as finally turned out were about as good as could be desired. The magnetos that are now being made for motor cars conform to this high standard, and the makers have the benefit of all their war-time experience on the design of complicated aeroplane types. To mention only a few points. The introduction of laminated pole pieces in place of the solid cast shoes formerly employed has greatly improved the low-speed sparking characteristics of the magneto. At the recent Olympia Show machines were to be seen sparking regularly over standard three-point 5.5 mm. gaps at a speed of 50 R.P.M. The new system of cam construction is another important point. Instead of the cams being separate pieces of steel they are now ground out of one piece of steel tubing, the two cams and the cam ring being all one integral part. The cam shapes are formed on special profile grinding machines, and are such as to impart a smooth regular motion to the rocker-arm, this being

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necessary at the high speeds at which modern magnetos operate. By this means the flinging and bouncing action of the arm is avoided. Again, the "jump-spark" distributor is generally considered a great improvement; and so on. Nearly every detail has been developed in this manner.

It has to be remembered that motor cars are made for the public, the great majority of whom are not engineers or electricians. What they require in the way of ignition apparatus for their cars is something of the "foolproof" and thoroughly reliable order. They have been accustomed to magnetos for many years, and have been very well satisfied with them on the whole, in spite of the fact that "swinging" the engine is necessary for starting with a magneto, and that this is not a pleasant occupation with a large engine when it is cold and stiff. Again, from the very fact of this swinging being necessary, back-fires, which the average motorist dreads more than anything, are of uncommon occurrence, especially with a fixed ignition point which cannot, therefore, be unduly advanced. Again the older motorist who had some experience of battery ignition in the old days of no dynamos and trembler coils has a holy horror of this kind of ignition, not having realised fully that modern battery systems are an entirely different proposition. Taking all this into consideration, and remembering that we are naturally of a conservative nature in our habits, it does not seem very likely that the average motorist will be in a hurry to throw away his magneto. And what the average motorist wants, the average manufacturer has to provide, if he wants to sell his cars in normal times. Moreover, there are almost innumerable instances where there seems little prospect of the magneto being displaced as a means of ignition, and this field appears to be a rapidly increasing one. To mention a few which come to mind at once: the farm tractor, which is just in its infancy; motor lorries and heavy vehicles of all descriptions; motor 'buses and taxicabs; stationary petrol engines for all purposes, and a host more, for all of which the magneto seems pre-eminently fitted as a means of ignition. From this it would appear that the magneto firms need not at once shut up shop and draw down their blinds.

On the other hand, we have the facts that practically all cars are now turned out fitted with electric lighting and starting sets; that the battery must always be kept in working order for these purposes; that this battery can be used just as well for ignition in connection with a modern closed-circuit system; that starting with battery ignition is very easy, only a very low speed of rotation being necessary; that this is an advantage not only for hand-cranking, but also where electric starters are used; that the spark is equally good over the whole timing range, and can be advanced or retarded as much as desired; that this gives a very useful additional control over the engine and adds a refinement to the performance of an engine which is much appreciated by those who know how to use it; that battery ignition is ideal for slow running, the spark being at its best at low speeds. Using battery ignition we have to remember to switch off the current when leaving the car, and to retard the timing lever before restarting. These items can be dealt with automatically by the introduction of thermostatic switches and ignition governors, but that means bringing in complications which it is desirable to avoid. Now, taking all these facts into consideration, and bearing in mind that battery ignition has for some years been the standard system in the U.S.A., it is difficult to believe that it will not be very largely used in this country also when its merits become better known. Certainly a little more care and attention are required than for magneto ignition, which can be practically neglected. The battery must be looked after, but as that forms an essential part of the lighting and starting systems it is not likely to be neglected for long, and knowledge about batteries will probably become much more general in this country as in America. The extra feeling of control given by the ability to use the timing of the ignition freely is delightful to anyone who has an appreciation of mechanical sense, and likes to feel that he is getting the best result from his engine under all circumstances of speed and load. The contact-breaker, distributor, and coil of a battery system, if properly designed and constructed, are simple, and can be made very accessible. The first two are generally combined and driven by gearing from the dynamo in many modern systems, making one unit with the latter, so that only one driving connection to the engine is required.

Mr. Sylvester in his article mentions how the Remy system was appreciated in the air services, both in this country and abroad, and also mentions the Delco as used on the Liberty engine which was installed on the seaplane N.C.4 when it crossed the Atlantic. Mr. Booth, who has had considerable personal experience of a Delco system, gives it a very good character, and indeed his record of 9,000 miles of running spread over five years without once using the starting handle is remarkable. One point must be remembered. Mr. Booth is himself a skilled electrician, and we must not take quite for granted that the same result would have been achieved if the system had been in unskilled hands. The skilled man may not imagine that he treats his car any differently to another, but all the same there is a difference. A few minutes with a screwdriver or file, a touch here, a clean connection there, the battery not neglected, &c., may not seem anything out of the way to an engineer, but the layman would leave them out, and in the long run they might make a considerable difference.

In case British manufacturers should seem to be neglected in these remarks, I should like to quote a paragraph from Mr. Booth's article with which I entirely agree. "I would prefer to see British industry in the forefront. On the other hand, I have no hesitation whatever in giving credit where credit is due, even though it be to those who are not Britishers, primarily in justice, secondarily with a view to encouraging our own people to do likewise, if they are unable to do better." That is exactly my feeling in the matter.

British manufacturers have not yet had sufficient time to develop battery ignition systems fully, as evidenced by the comparatively small display of them at Olympia, but there is no reason why they should not excel in this line as in the case of magnetos.

The Remy system must be admitted to be a very good example by all who have had experience of it, and was to be seen at Olympia fitted to some high-class cars, from the magnificent Lanchester to the little 3-cylinder Cosmos, on which, by the way, a particularly neat lay-out was provided. In this system simplicity in design has been combined with first-class workmanship.

Mr. Booth raises many interesting points in his timely article, but as these do not all strictly bear on the subject of ignition perhaps a discussion of them should not be included here. Much has been written in the motoring Press on magneto and coil ignition, but the opinions expressed are generally strongly prejudiced in favour of one system or the other, and it is difficult to find any well-informed and unbiased pronouncement. So far as the present article is concerned, whatever may be thought of the views expressed, they are at least straightforward impressions put forward without any partiality or preference for any particular firm or system.

Excess Profits Duty.—The Board of Referees has considered an application by the River Plate Electricity Co., Ltd., for an increase of the statutory percentage as respecting the business of supplying electric light and power in the Argentine Republic. The Board has made an order increasing the percentage in the case of any trade or business carried on or owned by a company or other body corporate to 9 per cent. with additional percentages in the case of other trade or business as specified in the order. A similar order made in respect of the Bogota Telephone Co., Ltd. (the business of supplying public telephone service in the Republic of Columbia), increases the percentage to 7½ per cent., with additions in specified cases.

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THE ELECTRICAL TRADE OF INDIA.

We have already dealt generally with the report by H.M. Trade Commissioner in India (Mr. T. M. Ainscough, O.B.E.). We desire to repeat our advice that the report should be carefully studied, and below we make a few extracts:—

American Competition. Competition from the United States is becoming particularly keen in electrical machinery, mining machinery, steelworks plant, oil-crushing and refining machinery, machine tools, and miscellaneous engineering supplies for industrial purposes. Before the war, British makers had such a hold on the trade, largely on account of the fact that purchases were usually made in London by the managing agents of Indian industrial concerns, and also because British engineering practice and standards were preferred, that foreign competition made little headway. During the past four years, however, orders have had to be placed in the United States for immediate requirements, and it is likely that the American connections, having once been made, will be retained, and we must regard this competition as being permanent. So far, very few American manufacturers have opened offices in India, but their representatives are very active, and buyers are being inundated with catalogues and literature of all kinds. Mention should also be made of the value to American industry of having American engineers at the head of some of the largest industrial ventures in India. (A number of instances are given in the Trade Commissioner's report.)

The effect of the break in the supply of the British product will probably extend for many years, inasmuch as the plea will be made that, in order to secure homogeneity of plant, future extensions should also be obtained from the makers of the original machines. The influence of engineers in responsible positions is also very great outside the sphere of their own works. There were in India, before and during the war, no firms of consulting engineers, as this work was almost entirely done in London. Consequently, the advice and opinion of the chief engineers of successful industrial undertakings is eagerly sought by the rulers of native States and the promoters of other ventures. The leading British industrial firms in Calcutta are also now engaging the services of trained British engineers on their staffs to advise them with regard to new plant, and it is to be hoped that more British engineers will come out to India in a consulting capacity. The openings are very great for specialists of all kinds, particularly for highly qualified mechanical and electrical engineers, with a thorough knowledge and experience of modern industrial practice and organisation.

How to Combat It. The leading groups of electrical machinery makers already possess strong local branches in the leading centres, and there is a thoroughly representative Indian Committee of the British Electrical and Allied Manufacturers' Association in Calcutta. One prominent firm is believed to be proposing to erect works in the country. In view of increasing American competition, particularly in hydro-electric enterprises, makers of suitable plant should take steps to strengthen their position, and manufacturers of the smaller allied products would be well advised to associate themselves for selling purposes with one or other of the principal groups, so that they may receive the advantages of the group's technical knowledge and selling organisation on the spot, and also to enable the group to quote for a complete installation. In view of the considerable developments which are taking place in India in the use of water power for industrial purposes, many of which are already either in progress or projected, it is essential that British makers of water turbines, generators, transformers, and all the lesser articles which make up a complete plant, should be strongly represented. Very severe competition will be experienced from the United States, and it must not be forgotten that the engineers of some of the largest hydro-electric schemes in India, who have great influence on the placing of orders, are Americans who were formerly in the employ of our principal American competitors.

Coming Industrial Development. Very large extensions are planned for iron and steel works plant, power plants of all kinds, particularly electrical, improved mining machinery, complete machine shop equipment, and complete installations of textile (cotton, woollen, jute, and possibly silk) mills, flour and paper mills, sugar refineries, oil pressing and refining mills, glass works, chemical works, oil-well equipment and pipelines, shipbuilding yards, tanneries and leather factories, soap works, paint works and cement plants, not to mention the repairs and renewals and considerable extension to public works, railways, and the postal, telegraph, and telephone services.

One point, in particular, should be borne in mind by the British manufacturer, and this is the necessity for quoting for the supply and erection of a *complete plant*.

Trend of Import Trade. In our issue of December 26th, 1919, detailed figures were given of India's import trade in electrical goods. The following remarks by Mr. Ainscough should be read in conjunction with those statistics.

Philips's Dutch-made lamps have obtained a firm hold, and Japanese lamps of all kinds have entered the market. The demand for electric ceiling fans, and to a lesser degree for desk fans, is increasing rapidly, and will continue to do so. American and Italian makes are the best known, best advertised, and most actively sold fans on the market. There is a great opportunity for the British maker in this direction if only he will make the goods in strict accordance with the wishes of his representatives on the spot. As regards heavy cables, British makers, owing to their reputation and excellent selling organisation in India, are able to hold their own; but, in the finer wires for house wiring, the Japanese maker has come to stay. As a rule, the Japanese productions are not equal to the British makes, but during the war India has been only too glad to accept any quality in order to satisfy her demands. There is little doubt that we shall regain the greater portion of this trade, but there will be keener competition than before, and Japan will probably retain a great portion of the bazaar trade. British standard marks should be carefully watched against infringements. A complete range of samples of Japanese electrical accessories in the Indian market, with a full report on them, may be seen by interested firms at the Department of Overseas Trade.

Local Electrical Manufacture. The manufacture of electrical machinery such as dynamos, motors, transformers, &c., has not yet been attempted in India on account of the difficulty of obtaining the requisite material. After experiment it would doubtless be possible to produce suitable cast iron, but there is no immediate prospect of producing from indigenous sources the thin iron core-plates, electrolytic copper wire and sections, cotton yarn and tape, and press-spahn. The cotton tape and yarn required must be made from fine counts, entailing the use of long-staple cotton, and the finished product must be entirely free from dressing and of uniform dimensions. This has not yet been produced in India.

A certain amount of switchgear for direct current has been manufactured in India during the war, and the results reflect great credit upon the firms concerned, the gear comparing very favourably with similar imported articles. The difficulties of manufacture have been great, as, with the exception of pig-iron for the castings, recourse has had to be made to imported copper sheets, brass bars, &c., and in almost every case it has been necessary to utilise such material as was obtainable rather than that which would normally have been used. All small pins, screws, nuts, springs, and washers have had to be manufactured, either by hand or upon unsuitable machinery, and this has resulted in increased cost of production and the sacrifice of interchangeability.

A notable achievement has been the successful production of electrical porcelain, the insulators now produced in India being in every way equal in quality to the usual imported types. None were made in India before the war, and if the existing factory is extended to supply insulators in large quantities the imports will be considerably affected. If electrical porcelain becomes readily available, factories could be established for the manufacture of such accessories as ceiling roses, tumbler switches, wall plugs, cut-outs, distribution fuses, &c., all of which are at present imported.

All such electrical fittings as watertight lanterns, deck fittings, ironclad plugs and sockets, hand-lamps, table lamps, plain glass globes, and the like, are now manufactured in sufficient quantities to meet the present curtailed demand. It is stated that in many cases they are superior to the imported article, and only in rare instances is there a marked inferiority.

No attempt has been made to produce insulated conductors and insulating materials (except porcelain), and the whole of the requirements have been met from imported stocks. The rubber now produced in Southern India, however, is of very high grade, and eminently suitable for electrical purposes, and there is no insurmountable obstacle to be overcome for the production in India of all types of insulating materials and insulated conductors.

Negotiations have been proceeding for some time with a large British electrical company for the erection of works at Sakchi for the manufacture of lamps, motors, and the more simple types of electrical machinery. In addition, a prominent Calcutta firm is starting a workshop for the manufacture and repair of certain classes of electrical machinery.

Prompt Return of Railway Wagons Urged.—While it is most important that additional wagons should be placed on the railways in order to relieve the present congestion which is seriously hindering the trade of the country, that is not the only way in which a remedy may be found. We are sure that traders will give sympathetic consideration to the appeal which appears in our advertisement pages to-day in which it is urged that if wagons were rapidly unloaded, released, and returned expeditiously, the result would be equivalent to getting more trucks on the railways.

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CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

The New Cable Standards.

I am obliged to you for inserting my letter in your issue of December 26th, and forgive you the printer's error "B & G" for "B & S" gauge. My promotion to the rank of captain also occasions me surprise, but I will not suggest that this is premature until a search in the records has been made.

The Institution's acceptance of 1/.044 in. wire for ordinary sub-circuits in house wiring will probably occasion a feverish demand for this size, which my firm, and presumably others, will lay themselves out to meet. Up to now it has ranked with 1/20 S.W.G. as little more than an embellishment to the list of V.I.R. cables, so that for a week or two the supply may not equal the demand. However, we will all do our best.

Meantime, there will be many wiring firms—and wiremen also—who will be shy at using the smaller 0.0015 sq. in. cable (1/.044 in.). The extra cost of wiring with the next new standard size, .002 sq. in. (3/.029) will be considerable, and 1/18 S.W.G. (1/.048), the old friend of the competition wiremen, should not be forgotten. I predict that it will be manufactured and used for many years yet in spite of the new wire standards.

The cost of wiring per point with 1/.044 in. will not be much less than with 1/.048 in., for there will be no gain in the cost of labour, and there is no doubt that the work with 1/18 will be better. Incidentally, it is of interest to compare the cost of 1/.044 inch C.M.A., and that paradoxical cable N/A-C.M.A., with that of 1/18 of equal qualities of insulation but larger copper section made by non-C.M.A. firms.

But those who want altogether non-association 1/.044 in. for low-priced wiring work shall have it in as large quantities as they desire, now that the I.E.E. has blessed it.

For the
Edison Swan Electric Co., Ltd.,
F. CHARLES RAPHAEL,
Manager Cable & Wire Department.

Ponders End, Middlesex.
December 31st, 1919.

In many of the letters you have published recently, the most important advantage of the new method of describing the size of cable has been overlooked.

I understand that it is intended that each size shall be described by its nominal sectional area in square inches, instead of by the number and gauge of the wires, thus 7/20 will be known as .007 or 19/16 as .06.

At present, in calculating cable sizes, it is necessary first to decide on the area, and then to translate that area into number and gauge of the wires, but with the new lists it is only necessary to order cable of a certain sectional area (except in the case of .003, which may be either 1/16 or 3/20).

It is difficult to learn a new way of describing an article of everyday use quickly, but I have proved for myself that the new method of describing cables by sectional area saves a great deal of time and trouble, and I am confident that the new system will be a great advantage to the industry.

W. Cross, M.I.E.E.

Newcastle-on-Tyne.
December 30th, 1919.

The "Lesco" Holder.

Lesco, Ltd., have supplied me with a sample of their new pattern lampholder, which is certainly ingenious. I have called their attention to the fact that the weight is taken entirely on two small indentations in the top part of the holder. This, I think, would not be safe, if the holder was hanging up in a high public building, and supporting, say, a heavy Holophane shade. Something more mechanical than two little indentations would be needed to make the holder entirely safe. This is more important, in that the holder is made from light spinnings and not from castings. The makers state that in actual use much of the weight is taken off the indentations by the fact that the top part is a tight fit. In the sample which I have, however, this is not the case, and the weight is really taken entirely on the indentations. My own feeling is that the lampholder would not be safe where there is any corrosion, such as happens in damp atmospheres.

It would be interesting to have the opinion of other engineers on the subject.

C. Turnbull.

Electricity Works,
North Shields,
January 5th, 1920.

The Fuel of the Future.

With reference to "Economy's" letter in your last issue, in which he reproaches me for not being broad-minded, apparently he did not read the opening sentences of "The Fuel of the Future and the Gas Companies," for it was stated therein that it was written because the B.C.G.A. were endeavouring to persuade the public that by using gas one was utilising the nation's coal in the most efficient way. The way is not closed to "Economy" to save the remaining 80 per cent. of the coal heat value by my article; all it has done is to show that as electricity is already more efficient than gas, a saving in the process will make it overwhelmingly so. If "Economy" will read his letter carefully he will see that he is in complete agreement with me, for in pointing out that it is the 80 per cent. waste of heat at the stations that must be corrected, he has obviously dropped gas out of his calculations. Therefore, if I am not broad-minded, he falls into the same category.

B. L. Klemens.

Blackheath, *January 5th*, 1920.

REVIEWS.

Principles and Practice of Electrical Testing. By R. G. Allen, B.Sc., A.R.C.Sc.I., A.M.I.E.E. Pp. 363, 286 figs, London: Messrs. Longmans, Green & Co. Price 18s. net.

The title hardly does justice to the scope of this work, since several of the earlier, and in many respects the most interesting, chapters deal with general theory concerning continuous and alternating-current circuits. These chapters take the form of a mathematical treatment of a series of problems and theorems from which much useful information may be obtained.

Coming to the part dealing with testing proper, we first find the measurement of high, low, and medium resistances fully described. Modern direct-reading commercial instruments are exemplified by an account of the "Megger" set for insulation testing, though no mention is made of the important adaptation of this instrument for the measurement of low resistances. Particular attention is paid to the measurement of insulation resistances of "live" systems.

Magnetic measurements with regard to permeability and core loss are next fairly completely dealt with, though the double yoke method, which permits of permeability tests on straight bars (or even on bunches of laminations) by the ballistic method, is not described.

Succeeding chapters deal with the measurement of temperature rise, inductance, and capacity, and follow usual lines.

A large amount of space is devoted to machine tests, and a full account of the methods available for measuring losses, efficiency and regulation, and for the determination of the various characteristic curves of generators and motors (for continuous and alternating currents), of converting plant, and of transformers is given.

An excellent feature of each test is that tables of results obtained from typical machines are given for the use of readers in furtherance of their studies. With regard to these tables an important criticism may perhaps be made, namely, that many of the columns or lines are not sufficiently labelled, only the symbol of the quantity concerned being given. Of course, in many cases this will be sufficient to identify both the quantity and the unit, but a much better plan is to label clearly each column with the name of the quantity, the name of the unit, and with the symbol (or formula by which the quantity is derived). The possibility of misunderstanding is then adequately prevented.

As will be gathered from the account already given, the book covers a very wide range of matter, the most notable omission being supply meter testing.

The diagrams, which have obviously been specially drawn for the book, are clear and well reproduced. The work will be useful to students of electrical engineering who have completed an elementary course, particularly if they have received a good mathematical training.

Water-power in France.—Mention is made of tidal power projects in France and of the new French law on water-power developments of all kinds. Experiments with a view to utilising tidal power are to be made under Government auspices in St. Briac Bay on the north coast of Brittany. The new law provides that no one may utilise tidal or other water-power without a State concession. Natural and artificial waters, canals, rivers, and lakes are included. In order to avoid legal work and expenses which would be prohibitive in the case of small concerns, the latter are exempted from the new law so long as the maximum power does not exceed 50 KW. There were in the basin of the Seine in 1910 some 149 hydro-electric equipments serving village lighting; of these, 36 were from 2 to 10 H.P.; 43 from 11 to 20 H.P.; 23 from 21 to 30 H.P.; 13 from 31 to 40 H.P.; and 8 from 41 to 50 H.P.—*Technical Review.*

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BUSINESS NOTES.

Trade with South China.—Those of our readers who are interesting themselves in trade with South China will find a long account of a visit paid to Swatow, Foochow, and Amoy by H.M. Commercial Secretary at Hong-Kong, in the *Board of Trade Journal* for January 1st.

American Foreign Trade.—Mr. J. P. Morgan's company has formed the Foreign Commerce Corporation of America, to carry on foreign trade. It is proposed to devise new means for continuing America's foreign commerce. The new concern will probably act in close co-operation with the Foreign Finance Corporation; both concerns, says the *Times* Financial Correspondent at New York, are backed by tremendous capital resources. They "may well be regarded as the vanguard of a systematic invasion of the world's foreign trade fields, and particularly those of Europe."

New Capital Issues of 1919.—Statistics issued by the London Joint City and Midland Bank, Ltd., give the following, among other totals, of the new capital issues during the past two years, and during the month of December, 1919:—

	1918.	1919.	Month of Dec., 1919.
Commercial, industrial, &c.	£10,837,139	£92,591,207	£11,071,697
Electric light and power	1,561,760	3,604,088	1,900,000
Iron, coal, steel and engineering ..	15,513,073	24,635,948	3,315,312
Telegraphs and telephones	—	5,455,000	4,555,000
Tramways and omnibus	133,200	1,449,247	—

Trade with Japan.—Mr. E. F. Crowe, C.M.G., H.M. Commercial Counsellor in Japan, is now in this country, and he will shortly make a tour of the provinces for the purpose of being interviewed by manufacturers and merchants who desire to obtain information to assist them in understanding the Japanese market, and in developing their overseas trade. Firms desiring to meet Mr. Crowe should communicate with the Department of Overseas Trade, 35, Old Queen Street, London, S.W. 1.

E.T.U. Members' Income-Tax.—At the Westminster Police Court on December 31st, according to the *Daily Telegraph*, more than 50 members of the Electrical Trades Union were summoned for non-payment of income-tax due on quarterly assessments. The men had been employed at the National Aircraft Factory, Waddon, near Croydon. Mr. R. T. Rayner, the collector for the district, said the whole of the cases has been under the consideration of the men's Union, and had been the subject of appeal to the Commissioners of Inland Revenue. The result was that the assessments were confirmed, and amended notices were served finally on August 12th. The men claimed as expenses a travelling time allowance of 4s. a day, which was paid by the firm each day. In addition they were paid 1s. a day travelling expenses.

Mr. Lark, solicitor, who appeared for a number of the defendants, asked for an adjournment in order that he might consult the Somerset House authorities. He had a letter from a superintending collector to the effect that the men were not to be assessed upon the actual cost of travelling to and from their work.

Mr. Rayner said the 4s. a day was claimed by the Commissioners as money earned.

The magistrate, Mr. Leycester, adjourned the cases for 21 days, so that the men might have evidence that the matter had received full consideration.

A Chinese Trade Bureau.—The British China Trade Bureau (Publicity Bureau for South China) has been transferred to the Federation of British Industries. The transference of the London organisation of the Bureau from its offices in Regent House, Regent Street, to the headquarters of the Federation is a step in the direction of practical co-operation between manufacturers and merchants. This Bureau was an organisation set on foot to provide an essential link between the home manufacturer and the distributing merchant in China on the one hand, and a consuming population of 50 millions of people on the other. It was realised that if British enterprise was to make headway against the powerful trade propaganda of the Japanese in this market, some form of counteracting activity had become necessary for British trade. The Bureau established its own organisation throughout the four provinces of Kwangtung, Kwangsi, Yunnan and Kaeichow, with the result that to-day it exercises a controlling influence over nearly 100 newspapers published in the vernacular. Amongst its other activities it is prepared, free of charge or commission, to introduce British manufacturers at home to British merchants in China, or *vice versâ*. The Bureau has in its possession a mass of valuable information relating to market conditions throughout the regions in which it operates. The new direction of its activities in London will be placed under the superintendence of Mr. Henry Hobden, who is now in charge of the China Section of the Overseas Trade Organisation of the Federation, and who was under Sir Arthur Steel-Maitland, in the Department of Overseas Trade, where he had charge of the Far Eastern Section.

Copper Prices.—MESSRS. F. SMITH & CO. report January 6th:—Electrolytic bars, sheets, wire rods and H.C. wire no change.

MESSRS. JAMES & SHAKESPEARE report January 7th:—Copper bars (best selected), sheets and rods, £167, an increase of £10.

Auction Sale.—By order of the Disposals Board (Ministry of Munitions) Messrs. Allsop & Co. will sell by auction on January 16th at Hollywood Lane, Fulham, a quantity of electrical fittings, building material, &c. See our advertising pages to-day.

Electric Lamp Charges.—The Middlesex Profiteering Appeal Tribunal dismissed an appeal by Messrs. Watson, Marsh and Co., Ltd., Brondesbury, against an order of the Willesden local committee to refund 2½d. of 10½d. charged for an electric bulb. The local committee argued that a reasonable profit would be secured by the sale of the bulb at 8d.—*The Times*.

Lead.—MESSRS. JAMES FORSTER & CO. report under date January 3rd:—

Since our report of December 20th, we have had seven market days with a turnover of about 20,000 tons, and an advance of £6 a ton—a record unsurpassed both in quantity and values. That speculation has had much to do with the position which exists to-day cannot be denied. Without it values would not have increased as they have done, but it is equally true that the intrinsic position is such that nothing could have prevented a large increase in price .... The market closes at the top, £46 5s. for April, and £45 17s. 6d. for January, and we wish we could think it would not go higher.

MESSRS. JAMES & SHAKESPEARE report that the price of English pig lead on Wednesday, January 7th, had advanced to £49, an increase of 50s. for the week.

A Milan Market.—We are informed by the BRITISH ITALIAN CORPORATION, LTD., of 12, Nicholas Lane, London, E.C. 4, that preparations are being made for holding a Trade Fair in Milan, from about April 12th, 1920, for a fortnight. The fair will not be an exhibition, a place where each exhibitor sets before the public only his best productions, but a market where producers of all nationalities can show to the trade, samples of their productions, and where buyers can ascertain in the shortest time and with the least trouble what goods are being produced, the terms and quantities offered, and the conditions of delivery. The stands offered are shops measuring 3·50 × 3·50 metres (about 11½ ft. square) floor space, completely enclosed, roofed in and with glass fronts, but not furnished. Sixty such stands are reserved for British producers and manufacturers. Roofed sheds and outdoor open spaces are also offered for machinery and large exhibits. The above Corporation has been appointed agent of the Fair Committee for the British Empire, and is authorised to deal with applications for space, &c.

British Trade-Mark Applications.—Appended is a summary of the recent applications for British trade-marks in respect of productions connected with the electrical trades and industries:—Thermaglio. No. 392,781. Class 18.—Electric heating, cooking, and lighting apparatus. Industrials, Ltd., 55, Effra Road, Brixton, S.W., June 27th, 1919.

Pat. No. 393,579. Class 6.—Electrically-operated machine tools. W. H. Clifford, Baron Clifford of Chudleigh, Madeley Road, Ealing, W., July 23rd, 1919.

Wizard. No. 395,038. Class 8.—Electric batteries, cells, and accumulators. Falk, Stadelmann & Co., Ltd., 85-87, Farringdon Road, London, E.C., September 9th, 1919.

Design, comprising small black circle with streak of lightning across. No. 393,623. Class 8.—Electric batteries. Siemens Bros. and Co., Ltd., Palace Place Mansions, Kensington Court, London, W. July 25th, 1919.

W. Co., Ltd. (initials of firm embodied in design). No. 392,879. Class 50.—Electrical fittings, &c., all made of wood). The Woodfyt Manufacturing Co., Ltd., 3, Ogle Mews, Upper Marylebone Street, London, W., July 2nd, 1919.

Automac. No. 396,254. Class 13.—Sparking plugs. Picard, Dobson & Co., Ltd., 536, Claremont Road, Rusholme, Manchester. October 20th, 1919.

Challenge. No. 393,609, Class 13.—Sparking plugs. The Challenge Manufacturing Co., Ltd., 41, Summer Row, Birmingham, July 25th, 1919.

Sparkite. No. 391,283. Class 13.—Vibrators, contacts and points for circuit making and breaking devices used on ignition systems. K. W. Ignition Co., 2,811, Chester Avenue, Cleveland. O., U.S.A., UMay 5th, 1919.

Electrical Manufacturing in India.—A new company has lately been formed in Calcutta with the title of the Electric Apparatus Manufacturing Co., with a capital of 500,000 rupees.

Charge of Theft.—At Leeds West Riding Court, on December 30th, Vincent W. T. Bradshaw, of Sunderland, and George Edward Pearson, of Farsley, were charged with the theft of electric switches and electric cables, to the value of £394, from the Barnbow munition works. Bradshaw had been before the Court a fortnight previously, when the case was adjourned for inquiries. Mr. F. J. F. Curtis, on behalf of the Public Prosecutor, said Bradshaw had made a voluntary statement, which implicated other persons. A further charge of conspiracy was made against both defendants, and Pearson was also charged with stealing a 25-H.P. electric motor, three fuseboards, and a transformer. Mr. W. R. Wilson (representing Pearson) asked for a further remand for a fortnight, and said his colleagues for Bradshaw and the Public Prosecutor were agreeable. The Court, therefore, granted the further fortnight's remand, Bradshaw being allowed bail in £1,500, and Pearson in £2,000.

Engineering Exhibition at Olympia.—The Machine Tool Trades Association is organising its second International Engineering and Machinery Exhibition to be held at Olympia from September 4th to 25th. The exhibition of machine tools and small tools is to be restricted to members of the Association, but a certain amount of space is still available for other exhibitors. The offices are at Queen Anne's Chambers, Tothill Street, Westminster, S.W. 1.

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Coal Mining in India.—Quite a large number of committees are sitting to consider questions affecting the expansion of industries in India. They include committees on coal production, and purchase of stores. In the meantime a summary of a report by Mr. Trehearne Rees, of Messrs. Forster, Brown & Rees, London, to the Secretary of State, on "Indian Collieries" has been issued at Delhi, says Reuter's Trade Service. Mr. Rees states that one-third of the coal in Indian coal mines is at present being lost by bad methods of mining, while three-quarters of a million tons are lost annually by the wasteful power working of collieries. The proposals contained in the report include the filling in of old workings to enable more complete extraction of coal, large organised schemes for improving conditions of labour so as to settle non-fluctuating labour populations near the mines, central electric power generation on a compulsory non-profit basis, modern coking and utilisation of by-products, colliery-owned sidings and light railways, and briquette manufacturing.

Belgian Electrical Industry.—A special department of the Ministry of Industry and Work has been called into being to assist the re-establishment of the electrotechnical industry in Belgium. It is styled l'Inspection de l'Industrie, and has published details of the former and present status of the electrotechnical industry. Before the war, it appears, electrical manufacturing firms were 41 in number, employing 8,695 workmen. Most of these firms were systematically plundered during the German occupation, and especially the larger ones, stocks of raw materials and finished goods being alike removed; only the smallest firms in certain districts escaped, the Germans apparently being minded to compensate themselves for our blockade by this method of action. The work of reconstitution has consisted, in part, in the recovery, where possible, of the machinery carried away, and in part, in the acquisition of new plant. The sum of these efforts is such that a recovery of 50 per cent. of the state before the war has been made, but only half of the workmen are at present employed on production, the rest being engaged in works of restitution. The actual recovery for the whole country being thus only about 25 per cent. The province most injuriously affected is that of Antwerp, that least affected being Brabant, on account of the secondary importance of the pre-war electrical undertakings there. The staff now employed numbers 4,275, and is steadily increasing. According to moderate estimates, the works may regain their normal productive capacity within the current year (1919), if no break in the supply of raw material, machinery, and labour supervenes. The acquisition of new supplies is, however, difficult, and emphasis is laid on the hindrance met with in the execution and cost of orders placed abroad, and it is considered that allied countries should make some sacrifices on behalf of their fellows in Belgium, if only for the selfish motive to preserve future access to this market. Notwithstanding the enormous difficulties met with in furnishing themselves with raw materials, and with the laudable desire of escaping from German subserviency, the Belgians have started six new works—one at Liége for fusible plates and cable clips; a glow-lamp factory at Deurne-Sud; a machine tool works at Brussels; a mine-signal works, &c.; these six works, with those previously existing, make a total of 47, which form the subject of the Governmental inquiry.—*L'Industrie Electrique.*

Swedish Electrical and Engineering Trade.—The *Financier* reports that, according to an inquiry that has been set on foot by the Electrical Industry Association of Sweden, the Swedish electrical industry has made splendid progress during the years of war. The combined share capital of Swedish electrical industries, which amounted to about 50 million kroner in 1914, has at the present moment reached a total of 230 million kroner. The total output value of the trade was about 20 million kroner in 1914, and would seem to have come to about 100 million kroner in 1918. However, it is anticipated that the industry must be fully prepared to meet much keener competition in the near future, both in the home and export markets.

It is reported in the daily Press that, as the result of trouble in Swedish engineering industry, 12 Stockholm factories, and three in the provinces, have closed down. It is expected that 16 more provincial factories will do likewise. Later reports indicate a large extension of industrial dislocation.

Electricity Works and Shortage of Plant.—The Electrical Development Association has been interesting itself in the deficiency of plant which is experienced by many undertakings, and would like to hear from those who are embarrassed in this way.

The British Industries Fair at Birmingham.—The arrangements for the British Industries Fair (Birmingham Section), to be held at Castle Bromwich Aerodrome, from February 23rd to March 5th, are approaching completion. The exhibitors number 650, and 100 000 sq. ft. of space has been taken. Plans for hospitality and entertainment to overseas buyers have been made. The chief feature will be general hardware and engineering—the latter being represented by 200 firms. All classes of brass foundry are to be adequately covered, particularly in relation to hot and cold water, gas and electric light fittings, and, in view of the national housing schemes, it would appear that manufacturers are paying special attention to the claims of builders' ironmongery, grates, gas ranges and stoves, and to electrical radiators and other electrical appliances in domestic use. The section devoted to chandeliers, candelabra, gas fittings, electric light fittings and accessories, and lamps of all kinds, including electric pocket lamps, is extremely well covered, and interesting developments are promised by enterprising firms. The tube industries, which cater largely for the gas and electric undertakings, promise a big display.

French Electrical Companies.—The German Alsatian company Elsässischer Kraftwerke has been converted into a French company, under the style of the Forces Electriques Alsaciennes. Its headquarters are at Schlestadt, in Alsace, and with a capital of 1,500,000 marks, it works centrals at Kapeltenmuhlen, Markolsheim and Schlestadt. It has lately been engaged in expurgating the German members from its board of management.

The Energie Electrique du Littoral Méditerranien has decided to raise its capital from 60,000,000 to 100,000,000 fr., in order to carry out sundry extensions and improvements tending to raise its capacity to 150,000 H.P., equal to a yearly output of 380,000,000 KW.-hours.

La Verrerie Scientifique is the style of a company established at Paris for the making and sale of X-ray tubes, and all apparatus of precision in glass and quartz. Its capital is 160,000 fr.

A company called the Etablissements Alba has been launched at Paris whose objects are the manufacture and sale of electro-mechanical apparatus. Its capital is 100,000 fr.

The Appareillage Electro-Industriel, which recently raised its capital to 1,500,000 fr., has now decided to add to its title the names "Petrier, Tissot et Raybaud."

The Société d'Eclairage Electrique des Automobiles, whose offices are at Courbevoie, has gone into liquidation.

£600,000 Thrown Away.—After being closed down for over five months, the Ebbw Vale Steel and Ironworks resumed operations on Monday. The works closed down last July, following a strike of skilled tradesmen. The stoppage cost the company £250,000, and the loss to workmen directly affected was another £250,000, in addition to a loss of wages amounting in all to about £100,000 to men who were not directly affected, making in all £600,000.—*Financier.*

What is a Pint?—The old Winchester gallon, long ago abolished here, is still in use, with its corresponding pints and quarts, in the United States of America. The difference (20 per cent.) is a handicap to both the British and the American exporter of commodities sold by measures of capacity. The Decimal Association wishes to collect specific examples of confusion, difficulty, loss of trade, or loss of money arising from this difference, and, in the interests of the British export trade, invites those interested to submit such examples to the Secretary, 229-231, Finsbury Pavement House, London, E.C. 2.

Catalogues and Lists.—CREDENDA CONDUITS CO., LTD., Chester Street, Aston, Birmingham.—Illustrated leaflet giving prices and descriptions of "Creda" electric irons and kettles.

AUTOMATIC AND ELECTRIC FURNACES, LTD., 281-283, Gray's Inn Road, W.C. 1.—Leaflet dealing with output and energy consumption of metal furnace pots for use with Wild-Barfield electric furnaces. Also Bulletin No. 17, entitled "The Location of Hardening shop Faults."

THE ENGINEERING APPLIANCE CO., 22, Cricklewood Lane, N.W.—Leaflet describing the E.A.C. charging panel for accumulator work.

BRITISH INSULATED AND HELSBY CABLES, LTD., Prescot and Helsby.—*Catálogo de Cables*, 50 pp. A priced and illustrated list, in Spanish, of cables of various types.

MESSRS. FALK, STADELMANN & CO., LTD., Efesca Electrical Works, 83-87, Farringdon Road, E.C. 1.—Catalogue No. 445 (24 pp.), giving illustrations, descriptions, and prices of "Efesca" lanterns and accessories.

THE BENJAMIN ELECTRIC, LTD., Brantwood Works, Tariff Road, Tottenham, N. 17.—A card, entitled "A New Year's Resolution," advertising the "Benjamin" reflector.

THE CHLORIDE ELECTRICAL STORAGE CO., LTD., Clifton Junction, Manchester.—A 24-page booklet dealing with "Exide" and "Clifton" portable accumulators and electric hand lamps. Priced and illustrated.

MESSRS. SIEMENS BROS. & CO., LTD., Palace Place Mansions, Kensington Court, London, W. 8.—Two battery showcards in colour have been issued. Both are available for merchants and traders on application. The larger one (approximately 18 in. × 11 in.) illustrates a selection of Siemens dry cells and batteries suitable for bells, telephones, indicators, &c., and gives a view of a portion of one of the battery shops at the works at Woolwich. The smaller card illustrates various sizes of dry cells for pocket lamps, torches, &c., a bird's-eye view of the Woolwich works appearing in the centre.

THE OVERSEAS ENGINEERING CO., LTD., 75, Curtain Road, E.C. 1.—List No. 46, an illustrated price-list of "National" motor starters.

MESSRS. MATTHEWS & YATES, Swinton, Manchester.—Lists Nos. 2/1, 103/1, and 128, dealing with "Cyclone" air propellers, electric blowers and exhausters, and electric vacuum cleaners.

Canadian Industries Exhibition in London.—An exhibition, exclusively devoted to Canadian industrial enterprises, is to be held in June next in London. It has the support of the Canadian Trade Commission, the Canadian Manufacturers' Association, and the Canadian Mission in London, and its organisation is in the hands of Mr. H. Greville Montgomery. Most of the ground floor space at the Royal Agricultural Hall has been definitely allotted to leading firms. Information can be obtained from the offices, 43, Essex Street, Strand, W.C. 2.

All-British.—A British Order in Council requiring that managing directors of British companies in China must be of British nationality, is reported to have given rise to feeling among Americans, as a number of our companies are managed by them, and they will have to leave their positions at 60 days' notice.

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New Bombay Power Company.—THE TATA POWER CO. is the name of a company which has lately been formed in Bombay with a capital of 90,000,000 rupees to undertake the supply of electrical energy for power purposes.

Book Notices.—Scientific Paper No. 353 of the Bureau of Standards: "Variation in Direction of Propagation of Long Electromagnetic Waves." The observed direction of radio waves as obtained with a direction-finder varies with time when long waves are used, such as those from very high power stations. The variations of direction are of the order of 90° for very long waves. No such large variations are found for short damped waves produced by spark apparatus. A method of increasing the sharpness of determination of direction has been worked out. A theoretical explanation of the variations of direction is given, based on the existence of media in the earth's atmosphere capable of reflecting and refracting the waves. Washington: Government Printing Office. Price 5 cents.

Scientific Paper No. 354 of the Bureau of Standards: "Principles of Radio Transmission and Reception with Antenna and Coil Aerials." The functioning of the two principal types of radio aerials is worked out quantitatively from fundamental electromagnetic theory. Experiments have verified the formulas and conclusions presented. Formulas for the current received in either antenna or coil aerial in terms of current in either type of transmitting aerial are given, as well as comparison formulas giving the relative performance of antenna and coil aerials under various conditions. The advantages of the condenser-type of aerial are presented. The theory and nature of radiation are discussed, and applied to the elucidation of some current fallacies. The basic principles of design of aerials are given. Desirable lines of future research are pointed out. The use of the coil aerial as a direction-finder, interference preventer, reducer of strays, and submarine aerial are not among the subjects treated. Washington: Government Printing Office. Price 10 cents.

Scientific Paper No. 351 of the Bureau of Standards: "The Dependence of the Input Impedance of a Three-Electrode Vacuum Tube upon the Load in the Plate Circuit." Because of the capacities between the electrodes of a three-electrode vacuum tube, the input impedance, which determines the input voltage supplied to the grid of the tube by the apparatus in the input circuit, depends upon the electrical characteristics of the plate or output circuit. In this paper theoretical relations are established which permit the input impedance to be calculated when the impedance in the plate circuit is known. These relations are also checked by experiment. Washington: Government Printing Office. Price 5 cents.

"Safety for the Household." Circular No. 75 of the Bureau of Standards, U.S. Department of Commerce. Washington: Government Printing Office. 127 pp. Price 15 cents.—This is a very complete "safety-first" publication, setting forth the necessary precautions to be taken in the every-day applications of electricity, &c. The first half of the book deals with electrical fixtures and wiring, and gives in minute detail methods of guarding against such accidents as shocks from lighting circuits, burns from arcs emanating from broken connections, and also warnings as to the dangers attending the inexperienced handling of fallen overhead wires. The proper voltages of various household circuits are given, special attention being paid to private lighting and power sets. Directions for the resuscitation of persons rendered unconscious by electrical shock are fully set out, the treatment of cases of lightning shock receiving separate notice. Following this is a section dealing with the use of gas, and giving descriptions of most of the usual accidents caused by carelessness in its employment, and the precautions necessary to avoid such occurrences. Treatment of asphyxiation cases is described very fully. A special note is made of the proper use of acetylene gas, with directions for the proper and safe storage of calcium carbide. The next section is devoted to the causes and prevention of fires; practically every way in which a fire may be started is detailed, and methods of prevention are suggested. Hazards arising from the use of chemicals then receive notice, and the concluding section is a compendium of miscellaneous risks and safeguarding measures which are a part of every-day life. The circular is well illustrated and indexed for quick reference.

Scientific Paper No. 355 of the Bureau of Standards: "The Determination of the Output Characteristics of Electron Tube Generators." Owing to saturation and rectification effects in three-electrode vacuum tubes, the currents which they deliver to any type of output circuit, when used as a generator, are heavily loaded with harmonics. Experimental results indicate that the frequency of the oscillating currents generated is the natural frequency of the output circuit. Hence this circuit behaves as a filter in series with the tube and the D.C. power system, and the useful output current is approximately sinusoidal, whatever the distortion of the tube currents, depending in amplitude solely upon the fundamental constituents of the tube currents. General expressions are derived for the power and current output in terms of static characteristics of the generating tube, and are corroborated by experimental results obtained with a particular tube. Washington: Government Printing Office. Price 5 cents.

"Colliery Manager's Pocket-Book Almanac and Diary for 1920." London: Colliery Guardian Co., Ltd. Price (in cloth) 3s.—This is the 51st annual edition of the pocket-book, a fact which almost renders further comment superfluous. The book being severely practical, the political alarums and excursions of the past year find no place in it, but the technical mining progress effected during 1919 is surveyed, and this section includes an interesting discussion of problems met with in electric shot-firing, which have been investigated. The use of underground conveyors in South Wales is favourably spoken of, but these appear to be worked by compressed air. Abundant statistics are given; we note that electric safety lamps in 1917 numbered 146,651, out of a total of 747,570, while the majority of the flame lamps were lighted electrically, and more than half the total had magnetic locks. Coal-cutters, driven by electricity, numbered 1,739, and by air 2,060; but over 16 million tons of mineral were got out by the former, and less than 12 millions by the latter. On January 21st, 1918, the electrical equipment of British mines aggregated 913,640 H.P., mainly underground. An excellent electrical section of 49 pages is given, but, curiously enough, we have not been able to discover any reference to the coming-into-force of the regulations in respect of plant installed before June 1st, 1911, on January 1st this year.

"All About Anthracite: the World's Premier Coal." By A. L. Summers. London: The Technical Publishing Co. Price 7s. 6d. net.

"Treatment of Harmonics in Alternating-Current Theory by Means of a Harmonic Algebra." By A. Press. Berkeley: University of California Press. Price $1.

The National Union of Manufacturers (Inc.) has issued a 16-page pamphlet giving, alphabetically arranged, names of members enrolled between August, 1919, and November, 1919.

Calendars, &c.—From the CONSOLIDATED PNEUMATIC TOOL CO., LTD., 170, Piccadilly, London, W. 1, we have received a wall calendar with monthly sheets, which are held down at bottom by an elastic holder. Each sheet has a fair-sized illustration of a Consolidated tool.

MESSRS. DOWNES & DAVIES, of 1 and 3, Stanley Street, Liverpool, have issued an attractive wall calendar with a study in colour of "Miss Springtime," already acknowledged here as the favourite patronised by another firm.

MR. GEORGE ELLISON, of Perry Bar, Birmingham, has issued a large wall calendar, with monthly slips below a richly coloured study of a woman. Beside the slips are neatly given the addresses, 'phone numbers, &c., of the firm's six branches in this country, and at foot the interesting announcement is made that Ellison's are also in evidence at Paris, The Hague, Copenhagen, Moscow, Milan, Burgdorf, Johannesburg, Sydney, and Christchurch (N.Z).

From the HILLBAR PRESS, of 76, Finsbury Pavement, London, E.C. 2, we have received a wall calendar with monthly sheets for 1920.

From the COMMERCIAL ELECTRICAL ACCESSORIES, LTD., of 9, Diana Place, Euston Road, London, N.W. 1, we have received a very serviceable desk blotting pad and calendar, with diary (interleaved with blotting) on the left-hand side, while down the right side there is a column of dates for the week with an indicator for changing daily. Any reader can have one of these pads on application to the company.

MR. FRED. H. JENNINGS, of 74, Cinder Bank, Netherton, Dudley, sends us an advertising device in the form of a Treasury-note wallet.

From MESSRS. W. H. WILLCOX & CO., LTD., 38, Southwark Street, London, S.E. 1, we have received a calendar in their usual style, with monthly turnover sheets.

Touring Exhibitions.—Sir Hamar Greenwood, M.P., Secretary to the Department of Overseas Trade, states that by way of supplementing the British Industries Fair, the Department is considering the possibility of starting a number of "movable shops" and touring exhibitions abroad in the interests of British trade. This is a revival of an idea which was discussed a good deal in pre-war years, both for rail and shipping exhibition purposes. The proposal is deserving of the fullest discussion among the trades, and we shall probably refer to the subject more fully later. These travelling exhibitions should, in our opinion, be accompanied by kinema sections for the display by industrial films of the operations in progress in our great engineering, electrical, and other factories where articles can be shown in course of manufacture.

Electrical Company's Claim Against War Office.—According to the *Morning Advertiser*, the hearing of the claims made by the International Electrical Co., Ltd., to the War Losses Commission for compensation in respect of War Office occupation of their premises at Kilburn, from April, 1918, to March, 1919, was begun in December. The claims include amounts of £1,350, for loss of profits, with an additional claim of £2,300 for the training of unskilled labour, £3,000 for depreciation, and an item of £900 for re-decoration. The first claim, the loss of profits and the cost of training unskilled labour, was dealt with by the Commissioner (Mr. W. F. Hamilton, K.C.) on December 19th. After hearing evidence the Commissioner stated that he considered there had been disturbance in the working of the company because of the military occupation. He intimated that before making any determination as to compensation he must read the whole of the evidence put before the Commission on previous occasions.

The Fixation of Nitrogen.—According to the *Financier*, the Aniline Organisation, composed of most of the leading German chemical factories, has doubled its share capital, which now amounts to more than 600 million marks, in order to build new factories for the production of nitrogen fertilisers. The process to be used is the invention of Prof. Haber.

Prices Advance.—THE STERLING TELEPHONE AND ELECTRIC CO., LTD., have issued notice to the trade to the effect that owing to the continued advance in wages and manufacturing costs, they have increased the advance on their current catalogues from 33⅓ per cent. to 50 per cent., subject to certain exceptions. The advance was to come into force as from 7th inst. A gummed slip has been issued for use in current catalogues.

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Trade Announcements.—The British Electrical Federation and most of its member companies have returned from the Manchester Hotel, to 88, Kingsway. As part of the building has been retained by the Government, the Federation engineering and stores departments will for the present be located at 11-13, Southampton Row, while the Electrical and Industrial Investment Co., and other finance companies will be at 4, Broad Street Place, E.C.

THE B.E. CO. (OF LONDON AND BIRMINGHAM), LTD., have altered their telegraphic address to "Ubbecolita," Cannon, London.

MESSRS. FINLAYSON & FRASER have commenced business as electricians at 11, Warden Street, Dingwall.

MR. WALTER T. KEETLEY, who is taking up the post of engineer and manager to the City Service Garage, Ltd., automobile and electrical engineers, Smith's Bank Chambers, Market Place, Derby, wishes to receive price lists.

The Great War Exhibition at the Crystal Palace.—The Crystal Palace is to re-open in May this year with the Great War Exhibition. We are informed that there are 50,000 sq. ft. of exhibiting space unappropriated on the ground floor (garden side), which has been reserved for an engineering and electrical exhibition. Manufacturers should communicate with the General Manager, Crystal Palace, S.E., if they are interested in the matter.

Liquidations and Dissolutions.—NEW ST. HELENS AND DISTRICT TRAMWAYS CO., LTD.—Winding-up voluntarily. Liquidators, Messrs. H. P. Conibear and E. H. Edwardes. Meeting of creditors at 5, Fenwick Street, Liverpool, January 16th.

D. HULETT & CO., LTD.—A meeting of creditors was called for January 7th, at 1, Walbrook, E.C. 4.

CRAMPS PATENT REVERSIBLE TURBINE, LTD.—A meeting will be held on February 2nd, at 5, Copthall Buildings, E.C., to hear an account of the winding-up from the liquidator, Mr. F. W. Seel.

PNEUMATIC TOOL CO., LTD.—A meeting is called for February 6th, at Egyptian House, Piccadilly, London, to hear an account of the winding up from the liquidator, Mr. H. L. Williams.

OULTON BROAD ELECTRICITY CO., LTD.—Meeting called for February 23rd, at Suffolk Chambers, Lowestoft, to hear an account of the winding up from the liquidator, Mr. A. Garratt.

S. T. PEMBERTON & CO., electrical engineers, 8, Church Street, Birmingham.—Mr. S. T. Pemberton and Mr. E. Marples have dissolved partnership. Mr. Pemberton will attend to debts.

PAYNE, BUSSEY AND SABBERTON, motor, electrical and general engineers, and ironfounders, Palace Street and St. Martin-at-Palace Plain, Norwich.—Messrs. C. R. Bussey, F. A. P. Payne and A. Bussey have dissolved partnership. Messrs. C. R. and A. Bussey will attend to debts.

JESSE ROPER & CO., plumbers and electricians, 82, Park Street. Peel Green, Patricroft, Lancaster.—Messrs. J. Roper and T. Grundy have dissolved partnership. Mr. J. Roper will attend to debts.

Unions Fraternising.—As a result of a Conference with the Parliamentary Committee of the Trade Union Congress last week, an agreement was reached between the National Association of Theatrical Employés and the Electrical Trades Union in regard to a dispute between the two organisations. The Electrical Trades Union set out to organise electricians in theatres and operators in kinemas, and the Theatrical Employés' Association questioned its right to do so. Each Union has now agreed to recognise the other's membership card in the industry.—*The Times.*

Italian Company.—For the manufacture of and trade in magnets and other electrical apparatus, the Fabbrica Italiana Magneti Marelli has been formed at Milan, with a capital of 7,000,000 lire.

LIGHTING AND POWER NOTES.

Accrington.—SALARIES.—The remuneration of three superintendents and four shift engineers has been considered. Their present salaries are:—Superintendents, with war bonus, &c., £277; senior shift engineer, with war bonus, £248; other shift engineers, with war bonus, £235. The following revised rates are now recommended:—Superintendents, £330; senior shift engineer, £282; other shift engineers, £264.

EXTENSIONS.—The electrical engineer has been instructed to prepare a scheme of mains extensions calculated to meet demands for some years ahead.

Aldershot.—SUPPLY FAILURE.—Owing to a failure in the electricity supply, part of the town was in darkness for several hours on Monday evening.

Bagenalstown (Ireland).—ELECTRICITY SUPPLY.—A number of local traders have combined to provide an electric supply scheme for their premises. The power station is to be erected on the banks of the canal.

Barnstaple.—IMPROVEMENTS IN SUPPLY.—In order to place the electricity undertaking on a proper footing, and to provide sufficient reserve for breakdowns, the Town Council considers it necessary to expend £14,000, as well as a further amount of £1,000 for mains.

Birmingham.—STORAGE-BATTERY INSTALLATION.—In order to cope with the increased demands upon the generating plant, which have necessitated the imposition of many restrictions, the City Council is taking steps to install a storage battery in the Water Street station. The estimated cost, based upon quotations by various firms, plus 10 per cent. to allow for contingencies, is £78,300. The cost of the battery alone will be £53,488.

Bialna.—DELAY IN LIGHTING SCHEME.—It was stated, at a meeting of the Urban District Council, that the lighting scheme was held up in consequence of the failure of Messrs. Lancaster's Steam Collieries Co. to reply to the Council's letter regarding the purchase of a bulk supply. The Council has decided to appoint a deputation to meet the company.

Bolivia.—DEVELOPMENT OF WATER POWER.—The *British Export Gazette* states that a Bill is before the Bolivian Chamber of Deputies for the development of the Republic's water resources, and that a British engineer has been giving advice during the drafting of the Bill. If this British expert's suggestions were carried out, the hydro-electric development of Bolivia would centre round La Paz, Tres Cruces, and Colquechaca. At La Paz it would be used for the Corocoro copper mines, and for lighting, cooking, and heating in the capital itself, a good market thereby being created for materials and appliances of all kinds. Indeed, it is proposed that a depôt should be established for accessories at La Paz. In the other cases, the principal aim would be the development of mining. Altogether, the initial cost of the three installations is estimated at about £2,000,000, but in addition to this there would be much other machinery and accessories required, and, considering the scheme has been formulated in accordance with British ideas, a very large proportion of the plant and material required should be supplied by United Kingdom firms.

Canada.—TURBO-GENERATOR TROUBLES.—In a letter to the *Electrical World*, Mr. J. W. Lightbody, of Calgary, states that much trouble has been experienced in Western Canada through the faulty insulation of the rotor windings, no fewer than five turbo-generators, totalling 10,000 KW., having been put out of commission recently by this defect. These machines are mostly of foreign manufacture, and the makers' drawings show that the insulating materials employed are fuller board and presspahn, which have proved inefficient for this class of work. The defective insulation causes a short-circuit of high resistance in part of the generator rotor-field, which sets up vibration. Later, several turbine-blades are stripped, and the vibration gradually increases until it reaches such a point that it becomes necessary to shut down the machine. In large power plants this short-circuiting, and the consequent high induced voltages, are guarded against by the use of electrolytic cells in parallel with the field windings, and Mr. Lightbody considers that this idea should be applied to smaller generators, as in the latter there is less room for properly insulated coils.

WINNIPEG POWER SCHEME.—Six sets of 28,000 H.P. each are being erected at Du Bonnet Falls on the Winnipeg River, 75 miles north of the city. The cost of this city plant is estimated as being between £1,200,000 and £1,400,000. A chain of stations will eventually be constructed on this river with a total output of over half-a-million horse-power. The Du Bonnet plant will be the largest link in the chain.

Castlewellan (Co. Down).—PRICE INCREASE.—Owing to the increased cost of labour, &c., it has been decided to raise charges for lighting and power by 20 per cent., bringing the cost up to 1s. per unit.

Chester.—ELECTRICITY CHARGES.—The Electricity Committee has examined an approximate statement of accounts for the half-year ended September 29th, 1919, and recommends that, as the present charges appear to be satisfactory, no increase be made during the current financial period.

Chile.—The Santiago Press has recently published some particulars on the authority of one of the directors of the Compania Nacional de Fuerza Electrica, of that company's programme of power generation. The first scheme to be proceeded with is a 30,000-H.P. station to be erected at Maitenes del rio Colorado (branch of the Maipo), near Santiago. Power will be transmitted thence to Valparaiso, and later to Rancagua. As soon as the electrification of the railway from Valparaiso to Santiago is definitely decided upon, the new company hopes to obtain the contract for the supply of electricity.

China.—WATER POWER.—If the provisional plans for the utilisation of the water powers of the Yangtze River materialise, British electrical engineers may be able to secure some important contracts. On the assumption that the flow of the river varies between 75,000 cb. ft. per second at low water and over 10 times that amount during the average flood, it is estimated that a total of 31,000,000 H.P. could be obtained. The scheme includes the construction of seven dams to maintain the river at flood level, and the estimated cost of the whole scheme is £8,260,000.

Continental.—ITALY.—The Consiglio Superiore delle Acque (Water Board) has approved of the important scheme of the commune of Tivoli, associated with third parties, for the development of the waters of the River Ariene. Some 700,000 H.P. of electrical energy will be produced, and the work will be taken in hand forthwith. The scheme is expected to have great influence on the industrial expansion of districts around Rome.

There has been formed at Milan the Elettrica Internationale, with a capital of 2,000,000 lire, for the supply of electricity in bulk.

Società Anonima Idro-elettrica del Sovio is the style of a company formed at Milan, with a capital of 200,000 lire, for the construction and working of electric plant.

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According to data collected by the *Italia Elettrica*, the power in kilowatts of electrical plant at work in Italy to-day totals 1,189,679. This is generated to the extent of 815,864 KW. by hydro-electric plant, and 373,815 KW. by steam and other plant. To these figures is to be added the plant existing in Venezia Tridentina and Giulia and in Dalmatia, amounting to a further 117,416 KW., generated for the most part by hydro-electric plant. This makes a grand total of 1,307,095 KW., produced by almost three-quarters of the water power under utilisation. The methods and extent of production vary greatly in each region. Lombardy takes the first place with 332,090 KW., of which 239,164 is generated by water plant and 89,926 by steam. Piedmont comes second with 292,069 KW. of which 258,891 is supplied by hydro-electric works and 33,178 by steam. These figures show that the use of water as a source of energy is greater in Piedmont than in Lombardy, but the latter makes a greater use of steam. The plants in Liguria, Veneto, Tuscany, Umbria, and Lazio are likewise not inconsiderable. Central Italy, on the other hand, is poor in electrical energy. The Basilicata has stations of a total capacity of only 683 KW., Calabria a little over 5,000, and Puglia 8,000 KW. Sicily and Sardinia have only a modest production of energy, being limited as to the former to 27,022 KW., and as to the latter to 7,837 KW. Sardinia and Puglia share the peculiarity of being the only districts in Italy without hydro-electric plant. Of the new provinces of Italy, the wealthiest in electrical energy is the Trentino, which has water plant to the extent of 51,010 KW. and steam of 600 KW.; Venezia Giulia has water plant of 5,605 KW. and steam of 11,896; Dalmatia has no steam plant, but possesses one conspicuous hydro-electric station of a capacity equal to 48,905 KW. These figures refer exclusively to plant at work. For a better estimation of Italian production of electric power there should be set forth the works which are under construction in almost every part of the peninsula, and more especially those using water for generation purposes. Following the essential modifications introduced in the regulations controlling public waters, and the simplification of the procedure for securing concessions, a large number of new concessions have been granted, and the plant in question must shortly commence working. Moreover, the recent provisions establishing a State subsidy in favour of the generation by water of electrical energy, albeit modest in amount, cannot fail to act as a spur to the creation of new undertakings. On the other hand, a larger output of native coal may be utilised for the erection of fresh steam plant.

Fifteen years ago Tuscany possessed no large transmission lines. Small coal generating stations provided energy for lighting to the largest cities only. In 1903 about 9,000,000 KW.-hours were distributed with about 330 km. of line. In 1918 Tuscany possessed 6,000 km. of high and low-tension lines, fed by 10 big new stations of an aggregate power of over 60,000 KW., and distributed 200,000,000 KW.-hours, serving 1,300,000 electric lamps and 12,000 motors. In the western half of Tuscany the current is water generated from the rivers Serchio and Lima, supplemented in the dry season by current from coal or oil-using stations. In the eastern half the energy is principally supplied from a station situated on the river Nera, 200 km. from Florence, and by lignite-fired boiler stations. Two other noteworthy stations are those at Larderello and Orentano, the latter using peat-gas for generating power. A number of minor installations utilise smaller water sources for the service of sundry localities.—*Ingegneria Italiana.*

In consequence of the increase in costs generally, and as an outcome of representations made by leading electric companies, the Italian Government has issued a Decree authorising the raising of the charges to consumers taking up to 100 KW. by 25 per cent., and to communes and State Departments taking up to 1,000 KW. by 15 per cent. Above 1,000 KW. the increase will be 10 per cent. The increase is to run for five years. Another law accords a subsidy of 10 lire per H.P. to new installations begun since January 1st, to continue for 15 years after entrance into working of the plant. New transmission lines having a pressure above 2,000 volts are also granted subsidies for 15 years, as follows:—Lines having a weight of copper above 1,000 kg. per km., 0·15 lire per kg. of copper used; from 500 up to 1,000 kg., 0·20 lire; below and up to 500 kg., 0·25 lire. Where metal electrically equivalent to copper is employed, the same subsidies apply. Like subsidies are also accorded to energy at 2,000 volts taken for use in agriculture or irrigation, while other and smaller subsidies are granted to minor agricultural operations.

RUMANIA.—With a view to utilising the water power which the country possesses, the Rumanian Government has established a department for the electrification of the railway network, the first section to be undertaken being that from Brassow to Sibin. Before carrying out the works, however, a special commission is to go abroad and examine existing installations.

SWEDEN.—Among the new companies recently formed in Sweden in connection with the utilisation of water power and the distribution of electrical energy are the Hede Elektriska Aktiebolag, Heda; the Pjätteryd Hofs Elektriska Kraft Aktiebolag, Vaxjo; and the Rosviks Elektriska Kraft Aktiebolag, of Rosvik.

FRANCE.—The coal shortage continues to occupy the serious attention of the Government and public authorities in France. Some days ago the Est Lumière power company, which supplies the eastern suburbs of Paris, suspended its supply. It has now resumed operations, but the supply is strictly rationed, so that each district in turn has a "lightless day." The power station at Vitry, which serves a large part of the suburbs, was shut down for two days last week, with the result that a series of tramway services were temporarily suspended. In order to economise electricity and coal the Paris Prefect of Police forbade the traditional Réveillon for New Year's Eve in cafés and restaurants. The Municipal Council is to reduce illumination in the main avenues and streets between the hours of 1 and 7 p.m. It is probable that "Summer time" will be introduced on February 1st, and remain in force till October 1st, by which an estimated saving of from 80 to 100 million francs will be effected, largely in the cost of lighting. Power stations are being charged 270 fr. (£11 at normal rate of exchange) per ton for coal, which in Great Britain costs only 45s. per ton.

A company has been formed, under the title of the Eclairage Electrique Légional, with a capital of 500,000 fr. Its objects include the distribution of power to the communes of Pertuis (Vaucluse), La Tour d'Aigues, Cucuron, and Ansouis.

SPAIN.—USE OF WATER POWER.—Recently published statistics show that the number of hydro-electric plants developing over 800 H.P. in 1918 was 85, producing the equivalent of 403,046 H.P. Installations of from 300 to 800 H.P. numbered 50, developing 23,890 H.P. There were 103 smaller undertakings, with an output of 11,394 H.P., making a grand total of 438,330 H.P., which is an appreciable advance upon the previous year's figure—384,297 H.P. Only 14 per cent. of Catalonia's water resources have been utilised up to the present. Works under construction will make use of a further 11 per cent., leaving 75 per cent. unexploited.

BELGIUM.—COMBINED POWER SCHEMES.—La Société Intercommunale Belge d'Electricité has completed plans for the establishment of a large central electricity generating station on the banks of the River Sambre, to meet the increasing demands for current for lighting and power purposes, which is being experienced by the Société d'Electricité du Bassin de Charleroi, and the Société d'Electricité du Bassin du Borinage. The scheme includes the taking-over by the Intercommunale Co. of the existing generating stations of the Charleroi and Borinage undertakings.

Dalton.—POWER SUPPLY.—A Provisional Committee has been formed for the Furness and South Cumberland district, to consider proposals for a central power supply.

The Dalton authorities have issued a circular for the purpose of ascertaining the number of possible consumers in that town. The prices are expected to be from 5d. to 8d. per unit for lighting, 1½d. to 3d. per unit for power, and 1½d. to 2d. for heating and cooking.

Darwen. — POWER SUPPLY.—Darwen Corporation is negotiating with the Lancashire Electric Power Co. for a supply of electricity. It has been decided to supply current to the Walpamur Works for motive power. The Corporation has also approved of application being made to the Ministry of Health for sanction to borrow £27,695 for electricity purposes.

Dundalk. — INCREASED CHARGES. — The Electricity Committee has recommended the following charges, as from January 1st:—Lighting: Private supply, 10d. per unit, subject to Board of Trade approval; contract supply, to be increased by 20 per cent.; artisans' dwellings, raised to 7d. per lamp per week. Power: Up to 250 units per quarter, 6d. per unit; from 250 to 500, 4½d. per unit; from 500 to 1,000, 4d.; from 1,000 to 2,000, 3½d.; from 2,500 to 5,000, 3d.; from 5,000 to 10,000, 2½d. per unit. The charges for heating and cooking will be raised by ½d. per unit, and the contract price per lamp from £3 to £3 10s. per annum. It is proposed to ask prospective consumers to guarantee a minimum payment before making the connections.

Dutch East Indies.—JAVA.—According to the latest estimates, the water power available for generating purposes is at least 5½ million H.P., and the Chief Engineer of the Government Department of Water-power and Electricity advocates greater State developments, in order to supply cheaper power, electrify railways, and to aid irrigation by the installation of electric pumping plants.

Glasgow.—INCREASING DEMANDS.—It is stated that the total output of the Glasgow power stations during the five years of war was greater than that for the 21 years immediately preceding. During the year ended May 31st, 1919, 170 million units were generated. The number of consumers increased during the year by 4,580 to a total of 40,680. The annual coal consumption is 300,000 tons. The two main stations are running with an overload during the winter months, but it is expected to have the new station at Dalmarnock in commission shortly.

Ilford.—DEFICIENCY.—As the Urban District Council has declined to accede to the request of the Government auditor to charge a deficit on the electricity account upon the rates, he has disallowed an item of £10,261. The Council has appealed against this decision.

Japan.—NEW TURBO-GENERATORS.—Two Westinghouse 25,000-KW. steam turbo-generators are being erected for the Osaka Electric Light Co., and will complete the largest steam-driven electrical installation in the Far East. The Osaka Co. installed three 3,000-KW. turbo-units in 1908, two more in 1910, two 5,000-KW. units in 1911, and by the addition of the units now being installed, the total capacity of the station will become 100,000 H.P. The company supplies a lighting load and also power to tramways, steel works, shipyards, copper refining plant, paper mills, electro-chemical plant, and other industries.

TOKIO EXTENSIONS.—The Electric Light Co. has decided to erect an additional power station on the River Sagami. This will bring the total capacity of the company's undertaking up to more than 10,000 KW.

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Lampeter.—The Town Council has under consideration an electric light scheme for the town.

Maidstone.—EXTENSIONS.—The Town Council has applied for a loan of £32,000 for work necessary to supply energy for the paper mills of Townsend, Hook & Co., of Snodland; and for a further sum of £1,095 for a high-tension cable for the extension to Tovil.

Newcastle-upon-Tyne.—COLLIERY ELECTRIFICATION.—Many new schemes are in progress in the Newcastle Electric Supply Co.'s area for electrifying collieries. The Seaton Delaval Coal Co. is putting down plant in five pits for main winding, pumping, ventilating, and hauling. The Wallsend and Hebburn Coal Co. is replacing a steam winder by electrical machinery, and is also adopting electric battery locomotives and road vehicles in place of the present steam system. The Stella Coal Co. has decided to install electrical machinery in its Claravale Colliery, chiefly for pumping purposes. Many other concerns are extending their use of power, and the Newcastle Electric Supply Co. is making wide extensions to meet the growing demand, including a 20-mile long, 20,000-volt transmission line.

Peterborough.—LOAN.—The City Council has decided to apply to the Minister of Transport for sanction to borrow £40,000 for the provision of a 1,000-KW. generating plant, and for other purposes connected with the undertaking.

Rotherham.—YEAR'S WORKING.—The borough electrical engineer reports that the total income for the year ended March 31st, 1919, was £108,873, and expenditure £88,359, a gross profit of £20,514. The balance carried to the appropriation account, after payment of loan interest, &c., was £2,514. The total amount of energy sold was 24,623,978 units, the bulk of which (21,744,409 units) was supplied for power purposes.

Salford.—DOCK EXTENSIONS.—In connection with further dock extensions, it is stated that the Manchester Ship Canal Co. intends having additional electrical installations put down.

Price Increases.—PARLIAMENTARY BILL.—Seven electric supply companies are promoting a Bill next session to enable them to exceed the present maximum charges. The undertakings concerned are:—Edmundson's Electricity Corporation, Ltd.; the Electric Supply Co., Ltd.; the Twickenham and Teddington Urban Electric Supply Co., Ltd.; the Penzance and District Electric Supply Co., Ltd.; the Ramsgate and District Electric Supply Co., Ltd.; the Ilfracombe Electric Light and Power Co., Ltd.; and the Camborne Electricity Supply Co., Ltd. The Bill proposes to ensure a dividend of at least 6 per cent. to shareholders per annum by increasing the maximum charge to 1s. 2d. per unit.

Southend.—DIESEL ENGINES.—Four sets of Diesel oil engines, removed from German submarines, have been purchased for use in the electricity works.

Spalding.—SUPPLY COMPANY.—A private company proposes to establish electricity works in the town. The Urban District Council was in possession of a provisional order for this purpose, but the time limit has been passed.

Stalybridge.—PROPOSED COMBINATION.—Acting upon a suggestion recently made by Sir John Snell, the Stalybridge, Hyde, Mossley, and Dukinfield Tramways and Electricity Board has appointed a Sub-Committee to confer with a Sub-Committee of the Ashton-under-Lyne Corporation upon the question of forming a Joint Electricity Authority under the Electricity Supply Act. It is agreed that the interests of both parties would be better served by a supply of power from one station.

Stone (Staffs.).—EXTENSION OF TIME LIMIT.—The Board of Trade has granted an extension of three months from January 8th to the Stone Gas and Electricity Co., in which to carry out the statutory powers with regard to electricity supply.

Todmorden.—PRICE INCREASE.—The scale of charges has been altered as follows:—Lighting—Scale B (maximum demand) for the first 100 hours of the maximum demand per quarter, 7d. per unit; for all units above, 3½d. per unit, plus 35 per cent.; scale C (double tariff), between 4.30 p.m. and 10.30 p.m., 7d. per unit, all other units, 3½d., plus 35 per cent. Heating and cooking—Scale D (flat rate), 2d. per unit, plus 40 per cent. Domestic uses—Scale E, 15 per cent. of the rateable value, and a charge of 1½d. per unit, plus 50 per cent. for all units used. Power—Scales F and G, present prices to be increased by 100 per cent. on July, 1914, rates. General—Scales B, C, and D, to be subject to a minimum charge of 2s. 6d. for each quarter; scale F to a minimum charge of 4s. per H.P. of demand per annum; scale G to be subject to a minimum charge of £1 per annum. Contracts, prices to be 100 per cent. above 1914 rates.

LOANS.—Sanction has been received to borrow a further £960 for an electricity sub-station. Application is to be made for power to borrow a further £500 for electric lighting services.

Torquay.—NEW POWER SCHEME.—The cost of the South Devonshire supply scheme, referred to in our issue of December 26th, 1919, is estimated at £300,000 by the Torquay Tramway Co.'s manager, but a representative of a private company thinks it will cost £400,000 for the generating station alone.

Walsall.—EXTENSIONS.—Owing to the greatly increased consumers' demands, the Town Council finds it necessary to proceed with its extension schemes at the earliest possible moment. In November, 1918, the maximum load was 8,326 KW., since when additional connections, amounting to 1,392 KW., have been made. Outstanding applications will add a further 3,714 KW., and so it is impossible to wait for a fall in plant costs before proceeding with the work.

York.—HYDRO-ELECTRICITY.—The Corporation's scheme for hydro-electric works at Linton Dock has been received with satisfaction by the Ministry of Health, but the Minister intimates that he proposes to defer sanctioning loans until the Council has submitted revised estimates based on tenders provisionally accepted. It is proposed to substitute underground cables for the overhead cables originally proposed, from York to Linton.

PROPOSED SUB-COMMITTEES.—The Electricity and Tramways Committee has recommended the formation of several Sub-Committees to deal with different branches of the electrical undertakings. It is proposed to appoint a Traffic Sub-Committee to attend to all questions relating to the tramways from the public's point of view; a Development and Extensions Sub-Committee which will also deal with charges to consumers; an Advisory Sub-Committee which will settle labour questions, working hours, wages, and conditions. Finally, a Works Sub-Committee is suggested, whose functions will be to attend to all matters relating to the power station, car-shed, mains, sub-stations, and water-power. The arrangements for the supply of energy in bulk will be in the hands of a Bulk Consumers' Sub-Committee.

TRAMWAY AND RAILWAY NOTES.

Barrow.—TRAMWAY PURCHASE.—The Ministry of Transport has sanctioned the borrowing of £107,750 by the Town Council to enable the latter to purchase the Barrow tramway undertaking. A sum of £96,250 has accordingly been paid to the Tramway Co., which relinquished control as from January 1st. The loan period is the maximum permitted by the Tramways Act—30 years—and the Ministry has stipulated that in addition to a sinking fund for repayment of the loan, an adequate renewals fund must be maintained. New cars will be obtained as soon as possible, to relieve the present overcrowding. The Tramways Committee has recommended that the practice of granting passes and reduced fare facilities to certain officials by the former company, be discontinued, only the staff on duty being permitted free journeys. The staff will number 124, and the question of salaries and wages is being looked into.

Blackpool.—TRAMROAD PURCHASE.—One of the largest transactions the Corporation has engaged in was completed on New Year's Eve, when over £240,000 was paid by the borough treasurer in respect of the purchase by the Corporation of the Blackpool and Fleetwood tramroad undertaking, which was handed over to the Corporation on that day.

Bradford.—ELECTRIC PARCEL VANS.—The Ministry of Transport has asked for details of working costs, &c., of the vans which have been in use by the Corporation for some years. These vans are railless trolley vehicles with the addition of storage batteries, which make it possible to employ them on roads not served by overhead wires. It is claimed for these vans that they are the cheapest form of road transport evolved, but their use is limited to a certain extent by the fact that tramway systems are not sufficiently developed in most small towns.

Belfast.—YEAR'S WORKING.—As a result of fare increases, the tramway undertaking has proved financially satisfactory. The total revenue for the year ended March 31st, 1919, was £406,300, as against £355,056 in the previous year. The total working expenses amounted to £257,162, leaving a gross profit of £149,137. After deduction of loan interest, income tax, and other fixed charges, the result was a net profit of £29,231. It is stated that the track is in a bad state, and also that overcrowding on the cars has reached a dangerous point. Fifty new cars were ordered last year, but delivery is not expected for some months.

Continental.—ITALY.—ELECTRIFICATION OF RAILWAYS.—The electrification of the Leghorn Railway will probably be accomplished in 10 years, as it has been decided that the use of low-grade fuels (turf and lignite) for supply is quite possible. The Società delle Torbiere d'Italia is constructing a 10,000-KW. station capable of an output of 40,000,000 KW.-hours per annum. Peat from the Massaciuccoli basin is to be utilised in this station, which has as its main object the supply of current for the State railways. It is intended to electrify the Roma-Sulmona-Castellammare line—a distance of 240 km. For this project a plant of 4,000-KW. capacity will be required, with an average employment of 3,000 hours per annum.

FRANCE.—The river Seine continues to rise, and, owing to the floods, 11 tramway routes from the centre of Paris have been suspended. Many factories have had to close for the same reason.

The electric power station at Jury is flooded, resulting in the stoppage of all tramway-cars to the south-eastern districts.

The Paris Municipal Council refuses to allow advertisements on tramcars and omnibuses, although it was estimated that this would bring in £20,000 annually, on the ground that, although this was done in London, Paris must preserve its originality.—*The Times.*

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Enfield.—RAILWAY ELECTRIFICATION.—In a letter to the Edmonton District Council, the G.E.R. Co. states that it is hoped the electrification of the Enfield branch line from Liverpool Street station will be completed shortly.

Ilford.—ELECTRIC VEHICLES.—For the collection of house refuse the Urban District Council is to purchase six electric-battery vehicles, at a cost of £1,325 each.

Jamaica.—KINGSTON STRIKE.—The tramway employés have acceded to the Governor's request to have their claims investigated by a Conciliation Board and to return to work pending the Board's decision.

Japan. — TOKIO UNDERGROUND RAILWAY. — The "Tokio City Co." has been formed, with a capital of 50,000,000 yen (about £5,000,000), for the purpose of constructing an underground electric railway. The formation of the company has been officially sanctioned, and it is expected that the first section, with a length of nine miles, will be completed in three years.

Lancashire.—FARE INCREASES.—The South Lancashire Tramways Co., whose system covers many industrial areas, increased the fares, by permission of the Board of Trade, on New Year's Day. Penny fares have been abolished, the minimum now being three halfpence, whilst other stages have been advanced on an average 25 per cent.

London. — PROPOSED FARE INCREASES. — The Underground Railway companies are seeking power to raise their charges to travellers. The new Bill proposes to abolish "workmen's" tickets and to increase the maximum charge per mile to 4d. first-class, and 2d. for inferior classes. If passed, the measure will double the rates laid down in the "Cheap Trains Act," of 1888. Parcel rates are also to be raised. The Metropolitan Electric Tramways, Ltd., has deposited a Bill for introduction next session to enable it to raise the fare charged on routes in Middlesex, London, and Hertford, to a sum not exceeding 2d. per mile, and also to make the minimum single charge not less than 2d.

Additional alterations in stopping places for tramcars and omnibuses, which have been recommended by the Advisory Committee, for the relief of traffic congestion, and have received the approval of the Ministry of Transport, came into effect on Monday.

It is announced that Mr. S. B. Joel has purchased, on behalf of the firm of Barnato Bros., the entire interest of Messrs. Speyer Bros. in the Underground Electric Railway Corporation. The share capital of the Underground Co., the controlling company in the combine, is £5,000.000, and it is estimated that one million represents the Speyer interest. Another million is held in the U.S.A., and the remaining three millions among British investors and small holders in France, Holland, and Germany.

TRACK SIGNALLING.—On Saturday night last the substitution of the electrically-operated track circuit system of signalling in place of the former manually-operated system was commenced on the South-Eastern and Chatham Railway line from Victoria.

During the rush hour on Monday morning a breakdown on the Bakerloo Tube Railway near the Elephant and Castle, caused about 20 minutes' delay.

Newcastle.—RAILWAY ELECTRIFICATION.—The N.E.R. Co. is contemplating fresh schemes for extending the electrification of lines in the Newcastle area. These include the main line between York and Newcastle, a distance of 80 miles, and also 31 miles of loop-line from Northallerton to Ferryhill, *via* Stockton.

Nottingham.—The Minister of Transport has confirmed the Nottingham Colwick Estates Light Railway Order, 1919 (authorising the construction of a light railway in the parish of Colwick and rural district of Basford, in the County of Nottingham), made by the Light Railway Commissioners.

Yorkshire.—TRAMWAY INDUSTRIAL COUNCIL.—Representatives of employers and employés of the chief tramway undertakings in Yorkshire, Lincolnshire, and North Derbyshire have been elected to form a Joint Industrial Council.

TELEGRAPH AND TELEPHONE NOTES.

Brazil.—The Telephone Co., Rio Grandense, of Porto Alegre, has secured a loan of 2,000 cantos to cancel its floating debt and improve its lines and offices. The loan is contracted by an issue of 13,500 bonds of 200,000 reis' nominal value each, with eight per cent. annual interest and two per cent. annual amortisation.

Chile.—The Chile Telephone Co., Ltd., an English company, secured a concession for 10 years in 1904 to lay an underground telephone service in various cities of the Republic, which concession was extended for another 10 years in 1911. According to the Sociedad de Fomento Fabril, the company has not carried out its obligations, and has taken up an arbitrary attitude towards individual complainants. The Sociedad in consequence has drafted a memorial, for presentation to the Government, praying for the nationalisation of the service, as also of that of electric light and power supply.

Denmark.—At midnight on December 31st, a strike of telephone operators began throughout the country. An emergency service was to be set up with Government telephones, connections being made with the hospitals, police, and fire brigades. This service was to be linked up with foreign cables. In the year 1917-18 there were 385,130,817 telephone conversations, or 131 conversations for every man, woman and child in the country.

Germany.—Telephonic communication between Denmark and Germany has been temporarily completely interrupted by snow and frost, while only one telegraph line to Berlin is working at present. The Lyngby wireless station is also temporarily out of action.

Mexico.—During the past year 15 new telegraph offices were opened for public use. The number of messages sent and received totalled 12,102,286. There were 1,879 km. of new lines constructed, 11,398 km. of lines repaired, and 4,753 km. of damaged line corrected. The extent of the telegraph system of the Republic at the present time is 87,117 km. During the year 76 permits were granted for the construction of private telephone lines.—*T. & T. Age.*

Nicaragua.—The Director General of Telegraphs and Telephones has ordered the construction of a line from Managua to Matagalpa *via* Bosco.

Post Office Engineers.—Owing to the inadequacy of the pay and prospects offered to qualified draughtsmen in the engineering department of the Post Office, especially as compared with the remuneration in the outside world, as many as 21 resignations out of a total staff of 260 have occurred during the past 18 months, and many others are meditating taking a similar step. In view of the altered conditions and the superior attractions outside, the whole scheme of civil service salaries is in need of revision. Otherwise the State will only attract the dregs to its service—a very serious outlook.—*Daily Telegraph.*

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the ELECTRICAL REVIEW *in which the "Official Notice" appeared.)*

OPEN.

Aberdeen.—January 31st. Electricity Committee. Two water-tube boilers, with superheaters, economisers, steel chimney and accessories. (See this issue.)

Bray.—January 30th. Urban District Council. Electricity Works. One 200-B.H.P. Diesel engine, direct coupled to a 135-K.V.A. single-phase alternator and exciter. (See this issue.)

Australia.—SYDNEY.—February 18th. One electrically-controlled tower clock and four dials, for Sydney sub-station. Chief Electrical Engineer's Office, 61, Hunter Street, Sydney.

PERTH, W.A. — February 10th. P.M.G.'s Department. 340 accumulators (schedule W.A.647.) (December 19th.)

Barnes.—January 20th. Urban District Council. Electricity Department. Supply of water-tube boilers, economisers, draught plant, turbo-alternators, condensers, air and circulating pumps, transformers and rotary converters. (December 12th.)

Barking. — Urban District Council. Second-hand air compressor (electric or steam). (January 2nd.)

Battersea. — January 21st. Borough Council. One 5,000-KW. turbo-alternator, with condensing plant; one 1,500-KW. rotary converter; pipework for the 5,000-KW. turbo-alternator; switchgear for the 5,000-KW. turbo-alternator and 1,500-KW. rotary converter. (January 2nd.)

Belgium.—January 17th. Belgian Post and Telegraph Authorities, La Salle Madeleine, Brussels. Telegraph and telephone cables.

Bradford.—January 28th. Corporation. Two electric battery locomotives. (December 26th.)

Chile.—March 15th. Comision de Puertos, Santiago. Electrical machinery (power and lighting) for the Port of Valparaiso. Comision de Puertos, Santiago, Chile. Copies of the specifications can be seen at the Chilean Legation, 94, Gracechurch Street, London, between 3 and 5 p.m.

Cavan.—January 12th. Electric Light & Power Co. Suction gas engine and plant; alternative tender for duplicates, electric generator and motor booster; alternative tender for duplicate, generator, electric storage battery, D.C. switchboard. (December 26th.)

Dundee. — January 23rd. Corporation. Electricity Department. Three 750-KW. converter sets; one 300-KW. ditto; 11,000 V., E.H.T. switchboard; two 750-KW., D.C. control panels; one 300-KW. ditto. (December 19th.)

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Halifax.—January 5th. Electricity Department. Supply of stores (including lighting fittings and electrical accessories, cables, meters, &c.), from February 1st, 1920, to March 31st 1921. (December 19th.)

Ilford.—January 27th. Urban District Council. Electricity Department. One 1,000-KW. converting plant, cooling tower, motor-driven air compressor, L.T. cables. (See this issue.)

Kingston-upon-Hull.—January 23rd. Electricity Committee. One 10,000-KW. turbo-alternator, with exciter, and one condenser outfit complete. (January 2nd.)

London.—ISLINGTON.—January 28th. Electricity Committee. Stores, including cables, meters, electric lamps, &c., for 12 months. (December 19th.)

FULHAM.—January 13th. Electricity Committee. Manufacture, delivery and laying, complete, duct, E.H.T. cable, &c., between the generating stations of Fulham and Hammersmith. (December 19th.)

HAMMERSMITH.—January 20th. Electricity Department. Wiring schemes for small property, boiler setting and furnace work, &c. (See notices in this issue.)

STEPNEY.—January 22nd. Electricity Supply Committee. Two water-tube boilers, chimneys, economisers, &c., and one 5,000-KW. turbo-alternator, with condenser, accessories and switchgear. (December 19th.)

CAMBERWELL.—February 2nd. Borough Council. 12 months' maintenance of the private telephones and electric bells at the Town Hall. Mr. F. J. Slater, Borough Engineer, Town Hall, Camberwell, S.E.

Manchester.—January 14th. Electricity Committee. One 2-ton electric lorry (specification No. 23); one 10/15-cwt. electric van (specification No. 24). (December 26th.)

Pontypridd.—January 30th. Urban District Council. Electricity Department. Rotary converter, transformer and switchgear. (See this issue.)

Tynemouth.—January 12th. Electricity Department. Ten 250-K.V.A. transformers. (December 19th.)

Venezuela.—June 30th. The Government *Gazette* of Venezuela publishes a decree inviting tenders for the installation of a wireless telegraphic station near Caracas. (See this column for January 2nd.)

York.—January 20th. Electricity Committee. Tenders for the carrying-out of a hydro-electric scheme at Linton Lock. (See this issue.)

CLOSED.

Accrington.—Corporation :—

For work on the electricity works cooling towers, £2,500.—Peter Brotherhood, Ltd.

Birmingham.—Electricity Supply Committee. Recommended. Storage-battery installation at Water Street power station :

Battery, £53,488.—Tudor Accumulator Co., Ltd.
Boosters, £9,002.—English Electric Co., Ltd.
Switchgear, £1,676.—Bertram Thomas.
Cables and racks, £3,772.—Callender's Cable & Construction Co., Ltd.
Estimated cost of building, £3,250.

Blackpool.—Wiring the new Regent Picture House and the new Bryn Tivy Boarding House. Myles & McCaffery.

Bury.—The Corporation has placed contracts with the undermentioned firms in connection with the pulveriser :—

Electric motor.—Electrical Construction Co.
Cables.—W. T. Glover & Co., Ltd.

Leyton.—Electricity Committee. Recommended :—

E.H.T. switchgear, £874.—A. Reyrolle & Co., Ltd.

New Zealand.—AUCKLAND.—The City Council has recently placed the following contracts for electrical material :—

CABLE.

Section 1.—High and low-tension cable :—
A. & T. Burt, Ltd., Auckland (manufacturers: Siemens Bros.).—£21,644.
Section 2.—(a) Triple-braided overhead cable :—
A. D. Riley & Co., Auckland (manufacturers: Western Electric Co.).—£7,844; (b) rubber cable.—Richardson, McCabe & Co., Wellington (manufacturers: Callender's Cable & Construction Co., Ltd.), £2,227.
Transformers, switchgear and oil filter.—National Electric & Engineering Co., Ltd., Auckland (manufacturers: General Electric Co., U.S.A.), £4,056.
980 ironbark dressed poles.—Redpath & Sons, Auckland, £2,760.
12 tons bitumen.—Ellis & Co., Auckland, £18 10s. per ton (subject to exchange.)
3,250 straight-stem insulators; 800 shackles.—Redpath & Sons, £485.

Todmorden.—Electricity Committee :—

Tank-lowering devices, discriminating gear, and three additional panels.—New Switchgear Construction Co.

FORTHCOMING EVENTS.

Electro-Harmonic Society.—Friday, January 9th. At 8 p.m. Holborn Restaurant. Smoking Concert. (See "Notes.")

Junior Institution of Engineers.—Friday, January 9th. At 39, Victoria Street. At 7.30 p.m. Paper on "Goods Handling and Control," by Mr. C. H. Woodfield.
Friday, January 16th. Chairman's address. "Meteorology and Engineering," by Mr. B. E. Dunbar-Kilburn.

Birmingham and District Electric Club.—Saturday, January 10th. At the Grand Hotel. At 7 p.m. Presidential address by Mr. H. W. Wolton.

Institution of Electrical Engineers (North-Midland Centre).—Tuesday, January 13th. At the Hotel Metropole, Leeds. At 7 p.m. Paper on "Large Power Transformers," by Messrs. A. G. Ellis and J. L. Thompson.

(North-Eastern Centre.)—Monday, January 12th. At the Armstrong College, Newcastle. At 7.15 p.m. Paper on "Scientific Management," by Capt. J. M. Scott-Maxwell.

(North-Western Centre).—Tuesday, January 13th. At the Engineers' Club, Manchester. Ordinary meeting.

(Scottish Centre.)—Tuesday, January 13th. At Princes Street Station Hotel, Edinburgh. At 7 p.m. Paper on "The Electrical Power Supply in the War Zone," by Major T. Rich.

(South-Midland Centre).—Thursday, January 15th. At the University, Birmingham. At 7 p.m. Joint meeting with Midland Junior Gas Association. Discussion on "The Uses of Gas and Electricity for Heating and Power."

(Wireless Section).—Wednesday, January 14th. At the Institution of Civil Engineers, Gt. George Street, S.W. At 6 p.m. Paper on "Wireless Direction and Position Finding," by Capt. H. J. Round.

(Students' Section).—Friday, January 16th. At the City and Guilds College, South Kensington. At 7 p.m. Paper on "The Development of Automatic Telephony," by Mr. J. H. Reyner.

Royal Institution of Great Britain.—Tuesday, January 13th. At Albemarle Street, W. At 3 p.m. Lecture on "Modern Development of the Miner's Safety Lamp," by Sir John Cadman.
Friday, January 16th. At 9 p.m. "Low-temperature Studies," by Prof. Sir James Dewar, F.R.S.

Institution of Civil Engineers.—Tuesday, January 13th. At Gt. George Street, S.W. At 5.30 p.m. Papers on Whitby, Blyth and Sunderland Harbours.

Association of Engineers-in-Charge.—Wednesday, January 14th. At St. Bride's Institute, Bride Lane, E.C. At 7.30 p.m. Paper on "Currency, Finance and Industrial Trading," by Mr. T. E. Gregory.

Society of Technical Engineers (North-Eastern District).—Wednesday, January 14th. At the Subscription Library, Fawcett Street, Sunderland. At 7 p.m. Mass meeting.
Friday, January 16th. At the Corporation Hotel, Middlesbrough. At 7 p.m. Mass meeting.

Faraday Society.—Wednesday, January 14th. At Burlington House, Piccadilly, W.1. Symposium and general discussion on "The Microscope: Its Design, Construction and Application." Exhibition, 2.30 to 4.15 p.m.; Discussion, 4.15 to 6.30 and 8.15 to 10.15 p.m.

Chemical Society.—Thursday, January 15th. At Burlington House, Piccadilly, W. At 8 p.m. Ordinary scientific meeting.

Belfast Association of Engineers.—Thursday, January 15th. At the Technical Institute. At 7.45 p.m. Paper on "Ship Riveting," by Mr. A. J. Lewis.

Paisley Association of Engineers.—Friday, January 16th. At the Technical College, George Street. At 7.30 p.m. Paper on "Electricity and Matter," by Mr. A. McLean.

NOTES.

Electrical Trades Benevolent Institution.—MOVEMENT AT GLASGOW.—We understand that a very strong Advisory Committee has been formed in Glasgow, thanks to Mr. W. W. Lackie, the city electrical engineer, to deal with matters affecting the E.T.B.I. in Glasgow and district. The committee, which is now at work, comprises the following :—Dr. Magnus MacLean (chairman), Mr. W. Roxburgh (hon. secretary), and Messrs. F. Anslow, G. L. Black, A. S. Hampton, W. W. Lackie, Alex. Lindsay, R. B. Mitchell, Arch. Page, J. S. Nicholson, J. E. Sayers, P. J. Sims, E. J. Skinner, and Joseph Taylor. In taking the initiative in this matter, Mr. Lackie has followed the example set by Mr. Hobbs, in Cardiff, which produced admirable results. The Advisory Committees will assist the Institution by reporting on local cases requiring assistance and by obtaining contributions, organising concerts, &c., to assist the funds.

Educational.—IMPERIAL COLLEGE, LONDON.—In *The Times* of December 31st, there appeared a long letter signed by 22 professors of the Imperial College of Science and Technology, advocating the claim of the College to acquire the right to grant its own degrees in science and engineering independently of the University of London, on the grounds that the existing system involved waste of effort on the part of the students, that non-matriculated students were debarred from the degrees of the University, and that the Imperial College was entitled to rank as on a University plane. In *The Times* for January 2nd, Prof. Humberstone opposed the proposal, which he regarded as calculated to weaken the University.

British Oil.—The well at Hardstoft is flowing at an average rate of 2,000 gallons a week; pumping machinery has not been installed. At the present rate of output the yield falls far short of a remunerative value. At the other wells no oil has been met with.

Electrically-welded Ships.—The first electrically-welded ship to be built in French yards has been launched at Caen; the vessel will serve as a floating workshop for the Société de la Soudure Electrique Française, and is 20 metres long, 4 metres beam, and 2·3 metres draught. It will be electrically equipped, and driven by a 35-H.P. motor.

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A.C. Telegraphy.—The experimental section of the French Post Office has installed plant at the Brest telegraph office to use alternating current to supply the telegraphic apparatus, and thus avoid the use of accumulators. The installation has given such satisfactory service that it is proposed to apply it in the main telegraph centres. The alternating supply is taken from three-phase mains through a star-star bank of transformers. On the secondary side the current is rectified by a mercury vapour rectifier with three cathodes. A buffer battery is connected between the neutral point of the secondary windings of the transformer and the cathode of the rectifier. Between the battery and the rectifier, an automatic switch disconnects the rectifier leads if the current changes its direction owing to drop of voltage across the rectifier terminals, and reconnects the rectifier to the battery when the voltage rises again. During the period of disconnection the Morse, Hughes, and Baudot telegraphic apparatus is supplied by the buffer battery alone. A red lamp signals this state of affairs, and if it will last for a prolonged period, a reserve battery of cells is brought into use. This battery is always kept ready for use, but the cells are kept dry until an emergency arises. In order that the arc of the mercury vapour rectifier may not become extinguished when the call for D.C. falls below the minimum value that will maintain the arc, a permanent shunt taking from 1·5 to 2 amperes, is connected between the cathode and the neutral point of the transformers. Normally the battery voltage is slightly lower than the rectifier voltage, so that the battery does not discharge, but is slowly charged. If a motor generator set were used to replace the local batteries of the Baudot sets, it could be driven by a D.C. motor connected to the buffer battery. This would simplify the above-mentioned arrangement by rendering the permanent shunt unnecessary, and it would render current reversal impossible and enable the automatic switch to be dispensed with.—*Technical Review.*

Washing Machines: Shortage of Materials.—The manufacturers of washing machines in the U.S.A. produced no less than 500,000 during 1919, representing a sale of £10,000,000. It is doubtful if this output will be exceeded, or even maintained during 1920, owing to the shortage of the necessary parts which are manufactured by separate concerns. The three chief items in washing-machine production are copper and tin sheets, wringers and wringer rolls and motors. The metal sheet manufacturers have not yet got back into their normal position, but it is considered a matter of a few weeks only. Wringer-roll manufacturers are not increasing their capacity, as they consider that the makers of the washing machines will soon produce their own rollers, and thus leave the roller makers with a good deal of practically useless plant on their hands. The total annual small motor output of the U.S.A. is about 1,500,000, and thus a third is required for the washing machine trade. Motors are, therefore, difficult to obtain, and prices are still increasing. The demand for electric washers still exceeds the present rate of manufacture.

The Electro-Harmonic Society.—At the smoking concert which will be held at the Holborn Restaurant, in the Venetian Chamber, to-night, at 8 p.m., Mr. L. L. Robinson will take the chair. The artistes will be:—Mr. Bernard Collins, tenor; Mr. Thomas Howell, baritone; Mr. George Gower, banjoist; Mr. Will Edwards, humorist; Mr. Foden Williams, humorist; Mr. Thomas Sidney, entertainer at the piano; Mr. Bernard Flanders, A.R.A.M., pianoforte solo and accompanist.

Winter Thunder.—The statements about the extreme rarity in this country of thunderstorms during the winter months are disproved by the fact that out of the first 28 days of December, lightning without thunder was reported on three days, and thunder and lightning on as many as 12 days, so that the atmosphere was electrically charged on at least 15 days. On the 4th ult. a number of places in England, Wales, Scotland and Ireland experienced a storm; and on the 19th ult., lightning alone was equally widely distributed. It was laid down long ago that thunderstorms could not occur northward of the latitude of Shetland, but this conclusion has been proved to be erroneous by the numerous instances of Arctic thunderstorms that have been collected and published, showing that they occur all round the polar region up to about latitude 80 deg. When it is remembered that the number of travellers in the inhospitable regions of the Far North has been very small, the frequency of the thunderstorms they have reported is surprisingly large.

Persian Progress.—According to *The Times*, Swiss technicians are being enlisted by the Persian Government for employment on the State railways, telephones, and telegraphs.

Science and International Relations.—The Paris correspondent of the *Morning Post* states that the question whether Allied scientists should renew relations with their German colleagues, has again been raised in Paris. The overwhelming majority of leading men appear to be firmly resolved that, for the present at any rate, they will have nothing to do with German scientists, or even with German science.

M. Emile Picard, the permanent secretary of the Academy of Science, in the course of an interview, said:—Until the scientists belonging to enemy countries manifest in an efficacious manner a new mentality, and until they repudiate all sympathy for those things which raised the indignation of the civilised world (the most shocking of which was the manifesto issued by the "93") it will be impossible for French scientists to renew personal relations with them. We shall continue to hold the belief that science without conscience is merely the ruin of the soul.

Prosecution under the Coal Mines Act.—According to a Sheffield paper, a miner, named Woodcock, has been summoned at the Barnsley West Riding Police Court, for two breaches of the Coal Mines Act in the Stanhope Silkstone Colliery by relighting his safety lamp with the electrical apparatus, which should only be used by authorised persons, and by breaking the padlocks of the apparatus. Defendant admitted relighting his lamp, but said he found the apparatus unlocked. The Chairman said defendant had committed a very serious offence and had jeopardised not only his own life, but the lives of his fellow workers. A fine of 30s. would be inflicted in each case.

Fatalities.—An inquest was held at Lofthouse, Nidderdale, last week, with respect to the death of an electric crane driver named Richard Hubbard (54), who had lost his life through coming into contact with a live wire at the Angrau transformer house in connection with the Bradford waterworks. The voltage was about 2,300, and death was instantaneous. The man had no authority to interfere with the high-tension switchboard, but persisted in doing so after being told to keep off when something had gone wrong. A verdict of "Accidentally electrocuted" was returned.

An inquest was held at Gateshead, on Monday, respecting the death of William Hewitson (49), a cokeyard labourer lately employed at the Marley Hill By-Products Works. Joseph Dryden, who started work with deceased at 10 o'clock on New Year's night, said they began to empty a truck near the pug-mill, which was driven by electricity. Half-an-hour later deceased said he was going to start the mill, and proceeded to the motor-house for the purpose of switching on the current. The pug-mill started, but after revolving four or five times, stopped. Witness went to the motor-house, and found deceased lying dead on the floor clear of the machinery. Dr. Smith said there were small scar burns on the lower part of the abdomen, and he could not see how they could have been caused except by electricity. Mr. W. Diamond, works manager, declared his conviction that death was not due to electric shock received in the motor-house, as the clothes of deceased were not burned, nor were his hands. The energy could not have passed through his clothes without burning them. The Deputy Coroner entered a verdict "That death was due to shock, but that there was no evidence to prove whether it was electrical or otherwise."

A Joint Electricity Authority for Bristol and District.—A meeting of electrical undertakers and County Councils within a radius of about 30 miles of Bristol was convened by the Lord Mayor of Bristol, and held at the Council House, Bristol, on January 2nd, to consider the propriety of promoting a joint electricity authority under the provisions of the Electricity (Supply) Act, 1919. Representatives from the following undertakings were present:—Bristol, Swindon, Stroud, Cirencester, Chippenham, Melksham, Trowbridge, Bradford-on-Avon, Keynsham, Chepstow, Gloucester, Frome, Weston-super-Mare, Cheltenham, Wedmore and Bath, and the County Councils of Gloucestershire, Somersetshire and Monmouthshire. The Lord Mayor of Bristol presided, and at his request, Mr. H. Faraday Proctor (Bristol Electricity Department) explained the provisions of the Act and the scheme which had been tentatively outlined. Considerable discussion took place, and it was ultimately resolved that the councils of the counties, cities and boroughs and other local authorities, and the boards of directors of companies, except as regards the County Councils, authorised undertakers operating within the limits of the proposed district, be requested to pass resolutions agreeing to the formation of a joint electricity authority under the Act, and to forming part of such authority, and in the case of local authorities to authorise their electricity committees to take such steps as may be necessary to carry out the arrangements, including the appointment of representatives on the joint electricity authority. It was further resolved that the authorised undertakers and others affected be requested to pass resolutions agreeing to contribute towards the preliminary expenses on a *pro rata* basis with other authorities, based on the number of units sold within their respective supply areas as per the last annual statement of accounts. An organising committee was appointed to prepare a draft scheme for submission to a future meeting. The following members compose this committee:—Alderman G. Pearson and Mr. H. Faraday Proctor (Bristol), the Town Clerk of Cheltenham, Mr. F. H. Corson, city electrical engineer, Gloucester, Mr. E. T. Gardom, clerk to the Gloucester County Council, Mr. F. Teague, city electrical engineer, Bath, the county surveyor of Somerset, and the electrical engineer of Swindon.

Appointments Vacant.—Fitter driver, for the Shoreditch Borough Council Electricity Department; overhead lineman (82s. 2d.), for the Preston Corporation Tramways Department; telegraph inspectors (£250 rising to £300 + £120), for the Government of Nigeria; shift engineer (88s.), for the Radcliffe Urban District Council Electricity Department; laboratory attendant (60s. to 80s.), for the Electrical Engineering and Physical Laboratories of the Sunderland Technical College; assistant mains engineers (350 taels per month), and assistant installation engineers (230 taels per month), for the Shanghai Municipal Council Electricity Department (the present rate of exchange for a tael is 7s. 9d., but this is abnormal); assistant lecturer and demonstrator in electrical engineering (£300), for the University of Sheffield Faculty of Engineering; electrical engineer for the Holmforth Urban District Council Electricity Department; meter room superintendent for the Sunderland Corporation Electricity Department. See our advertisement pages to-day.

Inquiry.—Makers of the "Tank" dry cell are asked for.

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Electricity in Mines.—REGULATIONS.—The General Regulations, Part III, Electricity (Section 60), July 10th, 1913, governing the use of electrical power in mines, have reached the time limit set in paragraph 137 (*b*). The latter paragraph directs that all regulations immediately preceding it are to become applicable to electrical apparatus in use prior to June 1st, 1911, on January 1st, 1920. These regulations relate only to underground apparatus except where overhead gear may directly affect the safety of persons in the mines. Cables, switchgear, motors, lamps, and signalling apparatus are fully dealt with. Regulation 137 (*a*) prescribes that exemption from these provisions may be obtained from the Secretary of State in cases of emergency or under special circumstances.

The Lancashire Branch of the National Association of Colliery Managers has resolved to apply for an extension of two years. It is stated that the five years of war, and, later, the moulders' strike, have made it impossible to comply with the regulations in the time given.

The Slough Motor Depot.—Recently we had an opportunity of visiting the extensive motor vehicle repair works at Slough, at the invitation of the Ministry of Munitions. Much criticism of this depot, some of which may have been deserved, arose both in the House of Commons and in the Press generally, but as we found for ourselves, no one who has inspected the works can help feeling that much of it was premature. It must be admitted that in the early days the prospect was not very inspiring to advocates of national economy, but since then many and varied changes have been made. Although the works are even now incomplete, the restoration and sale of surplus Government owned motor lorries, cars, and cycles is proceeding apace, and when this work has been completed, the Slough depot will be continued as a permanent establishment for the repair and maintenance of Government motor vehicles of all kinds. It bids fair to become an efficient and valuable national asset. At present the output of restored vehicles reaches about 240 cars and 50 cycles per week. The establishment covers an area of some 650 acres, of which 8 acres are covered by one shop alone. When the large number of different makes of vehicles owned by the Government, and the number of parts that make up a single vehicle are taken into consideration the problem of spares and component parts stores will be appreciated. The whole of the works are electrically driven, 3-phase energy being employed, and the distribution being by means of underground cables. The discussion which arose concerning whether the depot should take a supply from the public mains of the local supply authorities or whether, on the score of reliability of supply, should erect a generating station of its own, will doubtless be remembered. Eventually the latter course was adopted, and a station built which, when completed, will contain three Ljungström turbo-alternators rated at 1,000 KW. each, by the Brush Electrical Engineering Co., Ltd. At present the station contains one turbo-alternator of the above make rated at 500 KW., and running at 3,000 R.P.M., 50 cycles, 420 volts. The firing floor of the Babcock and Wilcox boilers is on the ground floor as are also the condensers and the "Sirocco" spray air filters, the turbines and switchboards being placed on the next floor. The various ventilating and dust-extracting fans and exhausters are driven by B.T.H. 3-phase motors, and the electric cranes are by Messrs. Morris, of Loughborough. Messrs. Benjamin Electric, Ltd., are carrying out the electric lighting installation, which has been planned on a scientific basis.

Electrical Developments in Spain.—In a recent report to his Government, the United States Consul-General at Barcelona states that the number of electric plants existing in Spain is now over 2,800, producing annually 54,800,000,000 KW.-hours of energy. As might be expected, Barcelona Province contains the largest number of plants, totalling 500 odd, while the Provinces of Alicante, Valencia, Gerona, and Saragossa come next in order of importance.

Hydroelectric plants in Spain increased from 170 in 1917 to 238 in 1918, whilst the power produced rose from 384,297 H.P. to 438,330 H.P. Of the total in 1918, 85 plants had a capacity of over 800 H.P. each, while 50 hydroelectric installations had each a capacity of from 300 to 800 H.P. Hydroelectric equipment already installed in the great industrial section of Catalonia produces 150,000 H.P., while works are under construction which will yield a further 128,000 H.P., but the total potential H.P. in these cases is 1,104,500, so that 826,000 H.P., or 75 per cent., will still be undeveloped. Four large companies control the power in Catalonia, one of them transmitting to certain stations at 110,000 volts for a distance of 114 miles. During 1918 a hydroelectric plant of 15,000 H.P. was commenced in Asturias, and one of 12,000 H.P. in Valencia, while large plants were also proceeded with in those provinces which had been commenced previously. The difficulties of the coal situation in Spain have in some measure stimulated efforts to utilise the power of waterfalls and mountain streams. Plans are being discussed for the greater application of electricity in the chemical and metallurgical industries, especially in the production of soda and sulphate of ammonia, in the refining of copper, in the treatment of the bauxites of Catalonia, in the preparation of aluminium, and in many other operations of vital importance to the progress of a country. The laws in force in Spain relating to the use of public water power are, however, the outgrowth of legislation of 1866 and 1879, enacted before the advent of hydroelectric enterprises. Rapid development has necessitated numerous additions to the laws, which by their diversity, caused certain misinterpretations. Accordingly, by royal decree, the provisions relative to securing concessions for the use of water power, and the classification of various bodies of water as public utilities, have been co-ordinated, and the Minister of Public Works has also proposed to reframe the law nationalising construction work in connection with water power, giving to the State the right of appropriation of all unworked concessions. It is proposed to divide the country into zones, and require the companies in each zone to form an association, the object being to nationalise the water power now under the control of foreign capital.

Electric railways and tramways were constructed and extended in various parts of Spain during 1918, and plans to electrify the railway from the Asturian coalfields were discussed; it is quite probable that the new road from Madrid to Valencia will adopt electric traction.

An electrochemical joint stock company has recently been formed in Granada to extract ferro-molybdenum and ferro-vanadium. It aims to produce also ferro-silicon and molybdic, tungstic, and vanadic acids, with their derivatives and by-products. This company has an electric furnace which is to be used in connection with the iron and steel production of the great enterprises in northern Spain.

Inductive Interference between Electric Power and Communication Lines.—Reference has been made in our pages to the investigation which has been carried on by the Joint Committee on Inductive Interference of the California Railroad Commission. This committee, it will be remembered, was engaged for a number of years on what was undoubtedly one of the most exhaustive and painstaking investigations ever made anywhere into the phenomenon of inductive interference between electric power and communication lines.

In the course of its investigation the committee compiled a large number of technical reports on many phases of the subject. Owing to the widespread interest aroused, the Commission was asked to publish the most important of these reports for general distribution, and this it has done. The volume is entitled "Inductive Interference between Electric Power and Communication Circuits. Selected technical reports with preliminary and final reports of the Joint Committee on Inductive Interference, and the Commission's general order for prevention or mitigation of such interference.

This publication is of special interest to electric railway, power, telephone, and telegraph engineers, manufacturers of electrical apparatus, and to governing bodies; the volume, bound in morocco leather, and including 1,060 pages, consists of the 30 most important technical reports of the committee, the preliminary and final reports of the committee to the Commission, and the general order No. 52 of the Commission prescribing rules and principles governing the construction and operation of power and communication lines for the prevention and mitigation of inductive interference.

A limited number of copies have been printed in addition to those subscribed for, and are being distributed by the California Railroad Commission, San Francisco, at the actual cost price of $10.00 per volume. Those who wish to secure a copy should place their orders with the Commission as early as possible.

Electrical Dehydration of Crude Oil.—According to the *Electrical Review*, of Chicago, electrical dehydration of crude petroleum has proved to be superior to other methods. When present in the form of large free globules, water will settle out from oil by gravity, but if the water is in a state of emulsion with the oil, it will not settle out at normal temperatures and pressures, even if the mixture be allowed to stand indefinitely. The removal of water at the well effects an important reduction in freight costs, besides eliminating the clumsy practice of allowing purchasers a rebate on the percentage of water which they were able to prove was contained in the crude oil hitherto delivered. There are 17 electrical dehydrating plants now operating in the Whittier district in California, and in many cases oil hitherto unfit for use is made marketable by electrical dehydration. The oil treated ranges from 15 to 50 per cent. of water, and the consumption of electrical energy is about 1 KW.-hour per 18 barrels of dry oil. The electrical dehydration causes practically no loss of gasoline, and the gravity of the oil is raised one or two degrees by the treatment. This increases the value of the oil sufficiently to pay all or part of the cost of treatment. The heating process, on the other hand, involves more or less deterioration of the oil. Careful tests indicate that, under the same conditions, the heating process costs 7.5 cents per barrel, compared with 1.5 cents per barrel (or 2 cents, including royalty) for the electrical process. Usually, the electrical dehydrator operates on single-phase alternating current at 11,000 volts. The emulsion of oil and water is passed between highly-charged electrodes, and the effect of the electrostatic field is to coalesce the particles of water and also coalesce the particles of oil. The water then settles readily by gravity. The average maximum demand per dehydrator is 4 KW., the average load factor 50 per cent., and the average power factor 98 per cent. leading. In districts where water is scarce, the water separated electrically has considerable value.

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Forthcoming Exhibitions.—The *Daily Mail* Ideal Home Exhibition which is to be opened at Olympia, London, W., on February 4th, will be the fifth of a series. There will be a full-size reproduction of part of the labour-saving home designed by Mr. C. J. Kay, L.R.I.B.A., which won the first prize in the *Daily Mail* labour-saving home competition. The only coal used in this house is for one anthracite stove to provide hot water; electric hot plates are employed to keep the food hot on its way to the table. In the kitchen there are an electric copper and cooking range, as well as an electric washer and ringer. In the labour-saving section of the exhibition will be shown many devices for lightening house work and doing away with drudgery. These will include an electric dish and plate washer, boot-polishing machine, and other electrical devices.

So large is the number of British manufacturers anxious to take part in the British Industries Fair to be opened at the Crystal Palace on February 23rd, that it has been found necessary to ration the space. Similar fairs are to be held at the same time at Glasgow and Birmingham. The Scottish one will be devoted specially to textile products, and that in the Midlands to hardware. Many thousand invitations have been issued to foreign buyers, and pamphlets in seven different languages have been distributed.

The International Fair, to be held at Brussels from April 4th to 21st, is being organised by the municipality with the financial support of the Belgian Government and the Province of Brabant. There will be important exhibits of electrical machinery, fittings, cables, telegraph and telephone apparatus, &c. The largest portion of the exhibition will be in the Parc Royal, in addition to an open-air space for agricultural machinery and the Palais Midi which will be reserved for large machinery requiring motive power.

The Crystal Palace will re-open to the public in May, 1920, with the Great War Exhibition. H.M. Office of Works has taken the whole of the space on the main floor for naval, military, and aircraft exhibits in connection with the war. On the ground floor 50,000 sq. ft. of space will be devoted to the engineering and electrical section. A feature which will attract attention will be the comprehensive oil exhibition. Full details may be obtained from the General Manager, Crystal Palace, S.E.

Physical Society Exhibition.—On Wednesday and Thursday the 10th annual exhibition of electrical, optical, and other apparatus, was held by the Physical Society, in conjunction with the Optical Society, at the Imperial College of Science, London. Particulars will appear in our later issues.

Electric Furnaces. — The equipment of 20 electric furnaces which, it is said, will form one of the largest electric furnace installations ever made, is now being shipped from the United States to the Glomfjord Smeltverk Co., Norway. Each of the 20 units includes a 1,300-K.V.A. single-phase main power transformer, a 26.2-K.V.A. series transformer, and a 26.2 K.V.A. induction regulator.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the* ELECTRICAL REVIEW *posted as to their movements.

Mr. A. LEWIS, of Farington Steelworks, near Preston, late of Cleveland and Durham Electric Power, Ltd., Middlesbrough, has been appointed works superintendent to Doncaster Corporation Electricity Works.

The Swedish Academy of Science has awarded the Nobel Prize for Physics for 1919 to Prof. M. Planck, of Berlin, and Prof. Starck, of Greifwald; the Chemistry Prize goes to Prof. F. Haber, of Berlin.

Mr. J. WILKINSON, M.I.E.E., who recently resigned the position of tramways engineer at Hull, has commenced business on his own account as an electrical and mechanical engineer at 4, Morpeth Street, Hull.

Prof. WILHELM WIEN, of Würzburg, has been appointed successor to Prof. Röntgen, of Munich, whose retirement was recently announced.

At a meeting of citizens, held at Birmingham on January 1st, Sir OLIVER LODGE was presented with an illuminated address and a motor-car, and Lady Lodge with a jewel, in recognition of distinguished services rendered to the University and to Birmingham. The recipients were proceeding on a visit to America.

Lieut. and Acting Capt. G. O. KING, London Electrical Engineers, has relinquished his acting captaincy on ceasing to be employed.

Lieut. J. O. BAIRD, M.C., Tyne Electrical Engineers, has been restored to the establishment of the Territorial Force.

Burnley Tramways Committee recommends that the salary of Mr. MOZLEY (the manager) be increased to £675, inclusive of all bonus, from £575 inclusive.

Mr. W. H. EVANS, foreman of the electrical department of Messrs. Guest, Keen & Nettlefolds, Ltd., of Dowlais, Merthyr Tydfil, having resigned, has been presented by those under his charge with a mahogany clock.

Mr. JAMES WILD, who has been manager of the Ramsbottom tramways for the past six years, has been appointed out of a considerable number of applicants to the position of manager of the Todmorden Corporation motor 'bus system at £300 per annum.

Mr. S. DERWEN JONES, Batley borough electrical engineer, has been granted a war wage increase, bringing his salary to £400 per year.

Capt. H. G. C. TUFNELL, A.M.I.E.E., London Electrical Engineers, has been restored to the establishment of the Territorial Force, of which he was a supernumerary whilst employed in extra regimental duties.

The Leeds City Council has been recommended to approve of the appointment of Mr. J. S. HAMILTON, second assistant engineer, as first assistant engineer of the tramways department at a salary of £500 per annum.

The Liverpool Corporation has been recommended to grant the tramways manager, Mr. C. W. MALLINS, a retiring pension of £660 per annum. Mr. Mallins has been with the Corporation for 22 years, 14 of which he has been manager, and was previously 23 years with the tramways company. He is retiring through ill-health.

Mr. HAYDN T. HARRISON, having completed his work for the Navy, has returned to his previous occupation of consulting electrical engineer. He is to be found at his office, 11, Victoria Street, London, S.W., or at his Research Laboratory, White Horse Lane, Canterbury, where he is in a position to carry out all classes of research and experimental work.

St. Helens Electricity Committee has decided to increase the salary of the electrical engineer (Mr. B. T. HAWKINS) from £00 to £600 per annum.

New Year Honours.—Several names of interest to the electrical and allied professions and industries are to be found in the New Year Honours List, and we have pleasure in tendering our congratulations to the following:—

Sir Albert Stanley, late President of the Board of Trade, upon whom a peerage is conferred.

Sir R. T. Glazebrook, C.B., F.R.S., late director of the National Physical Laboratory, who is appointed K.C.B.

Walter George Gates, assistant secretary to the G.P.O., who receives a C.B.

Sir Henry Birchenough, K.C.M.G., and Sir H. Trevor Dawson, M.I.C.E., M.I.M.E., R.N., upon whom baronetcies are conferred.

James Kemnal, F.R.S.E. (Babcock & Wilcox, Ltd.), who, in recognition of public services in connection with the manufacture of munitions, is made a knight.

Francis Grant Ogivilie receives the honour of knighthood, as do also Hugh Malcolm Robinson, C.B., I.G.O., Chief Inspector of Factories, and Prof. Arthur Schuster, F.R.S., late secretary of the Royal Society.

The appointment C.I.E. is awarded to Matthew Alfred Thompson, Deputy Director-General, Telegraph Traffic, Punjab.

We observe that a thoroughly well-earned peerage has been conferred upon Sir George Riddell, Bart., one of the best-known figures in the newspaper world—a man of shrewdness, foresight, and boundless energy.

Sir David Harrel, who receives the G.C.B., was chairman of the Interim Court of Arbitration, 1918-19, in connection with industrial questions, and chairman and member of Conciliation Boards and Inquiries.

Obituary.—MR. JOHN ORDE.—A familiar figure in Northern electrical engineering circles has been removed by the death, at the age of 59 years, of Mr. John Orde, principal in the firm of Messrs. John Orde & Co., coppersmiths and brassfounders, Newcastle-on-Tyne.

The *E.T.Z.* of December 4th records the death of Dr. M. DOLIVO-DOBROWOLSKY, formerly a director of the A.E.G., and a well-known pioneer in electrical engineering, at the age of 58 years. In the same issue the death of A. LESSING, a pioneer in primary battery manufacture, is reported.

NEW COMPANIES REGISTERED.

Heath Plugs, Ltd. (161,947).—Private company. Registered December 22nd. Capital, £12,000 in £1 shares. To acquire from A. E. Heath a sole licence to use certain patents relating to sparking plugs, to acquire the assets of Heath, Norton & Co., &c. The first directors are: A. E. Heath, 8, Tatcombe Gardens, S.W.4; H. Norton, 56, North Side, Clapham Common, S.W.; H. H. Hassall, 16, Christchurch Road, East Sheen; E. E. Glover, 47, Stanlake Road, Shepherd's Bush, W.; F. E. Preston, 7, Perceval Road, East Sheen. Registered office: 2, Sancroft Street, S.E.11.

Cascoll Engineering Co., Ltd. (162,006).—Private company. Registered December 23rd. Capital, £1,000 in £1 shares. Objects: To carry on the business of mechanical, chemical and electrical engineers, contractors, iron and brass founders, manufacturers of and dealers in motor cars and vehicles, &c. The subscribers (each with one share) are: C. F. Casperson, 54, Shaftesbury Avenue, Roundhay, Leeds, electrical engineer; R. Collins, Warrels Grove, Bramley, Leeds, mechanical engineer. The first directors are: C. F. Casperson and R. Collins. Secretary: C. F. Casperson. Registered office: 20, Garden Street, Marsh Lane, Leeds.

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Buglass & Jamieson, Ltd. (10,783).—Private company. Registered in Edinburgh November 29th. Capital, £6,000 in £1 shares. To carry on the business of electrical and mechanical engineers, millwrights' machinists, smiths, motor engineers, &c. The subscribers (each with one share) are: J. F. Buglass, 17, Janefield Place, Dundee, electrical engineer; W. E. Jamieson, 65, Church Street, Broughty Ferry, Forfar, electrical engineer. The first directors are: J. F. Buglass and W. E. Jamieson. Solicitor: Alexander Hardie Buglass. Registered office: 65, Trades Lane, Dundee.

H. F. Stephen, Ltd. (10,817).—Private company. Registered in Edinburgh December 26th. Capital, £10,000 in £1 shares. To carry on the business of electricians, electric light and power and general engineers, &c. The subscribers (each with one share) are: J. Mitchell, 92, Queen Street, Peterhead, fish curer; R. L. Mitchell, Ellishill, Peterhead, fish salesman; J. Mitchell, jun., Longhaven House, Cruden, Abredeenshire, fish curer; H. F. Stephen, Balmoor Terrace, Peterhead, engineer; F. W. Stephen, Morven Black House, Peterhead, fish curer. Minimum cash subscription, £3,500. The first directors are: J. Mitchell, R. L. Mitchell, J. Mitchell, jun., H. F. Stephen and F. W. Stephen. Qualification, 100 ordinary shares. Solicitor: C. G. Masson, 21, Broad Street, Peterhead.

Deans Electrical and Engineering Co., Ltd. (162,269).—Private company. Registered December 31st. Capital, £1,000 in £1 shares. To carry on the business indicated by the title. The subscribers (each with one share) are: H. J. Dean, 19, Leedham Road, Sheffield, eelctrical engineer; R. Lavie, 26, Scarcroft Hill, York, electrical engineer. The first directors are: H. J. Dean and R. Lavie. Qualification, 50 shares. Solicitor: W. Ramsden, Station Street Buildings, Huddersfield.

Commercial Ignition Co., Ltd. (162,156).—Private company. Registered December 30th. Capital, £3,000 in £1 shares. To take over the business carried on by W. Hill and C. J. K. Piggott as the "Commercial Ignition Co.," and to carry on the business of mechanical and electrical engineers, &c. The subscribers are: W. Hill, 85, Lavender Hill, S.W.11, electrical and mechanical engineer, 800 shares; C. J. K. Piggott, 40, Grandison Road, Clapham Common, S.W.11, electrical and mechanical engineer, 800 shares; L. P. Fulkes, 53, Belsize Avenue, Bowes Park, N.22, electrical and mechanical engineer, 400 shares. The first directors are: W. Hill, C. J. K. Piggott, and L. P. Fulkes. Qualification, £1. Secretary: H. Hill. Registered office: 95, Lavender Hill, S.W.11.

Halliwell & Good, Ltd. (162,167).—Private company. Registered December 30th. Capital, £3,000 in £1 shares. Objects: To carry on the business of electricians, mechanical engineers and manufacturers, workers of and dealers in electricity, &c. The subscribers (each with one share) are: C. N. Good, Chesham, Bennett Road, Crumpsall, Manchester, electrical engineer; J. R. Halliwell, 2, Princess Road, Crumpsall, Manchester, electrical engineer. Permanent directors: C. N. Good and J. R. Halliwell (chairman and managing director). Qualification of permanent directors, £250. Registered office: 61, High Street, Manchester.

W. Crookell & Co., Ltd. (162,199).—Private company. Registered December 30th. Capital, £1,500 in £1 shares. Objects: To take over the business of an electrical engineer carried on by W. Crookell at Middleton, Lancs., as "W. W. Crookell & Co." The subscribers (each with one share) are: W. Crookell, Water Street Works, Middleton, electrical engineer; G. A. Toms, 1, Warren Avenue, Cheadle, Cheshire, cashier. W. Crookell is first director. Secretary: W. Proctor. Registered office: Water Street Works, Middleton.

Electrical Depositing Processes, Ltd. (162,100).—Private company. Registered December 24th. Capital, £2,000 in 5s. shares. To acquire plant for the purpose of depositing or forming metals by chemical, electrical or other processes, &c. The subscribers (each with one share) are: C. V. Brearey, "Hartwell," North Farnborough, Hants, engineer; R. E. Rollings, Orlando, Great Northern Road, Dunstable, Beds, engineer. The first directors are: C. V. Brearey, R. E. Rollings, H. Lovelock, H. A. Graves and A. A. Ross. Qualification, 200 shares. Registered office: 19a, Coleman Street, E.C.

Electrical Maintenance Co. (Liverpool), Ltd. (162,072).—Private company. Registered December 24th. Capital, £2,000 in £1 shares. Objects: To take over the business carried on by H. V. Greenep, at Liverpool, as the Electrical Maintenance Co. The first directors are: H. V. Greenep, 133, Upper Parliament Street, Liverpool; E. Durden, 74, Buchanan Road, Seacombe; H. Copland, 1, Buchanan Road, Seacombe; H. Curphey, 8, Rock Lane East, Rock Ferry; C. G. Curphey, Olybane, St. John's Terrace, Seacombe. Registered office: 142a, London Road, Liverpool.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Laing Wharton, Ltd.—Satisfaction registered November 21st, 1919, of charge for £1,000, registered November, 1918.

L. Weekes, Ltd.—Debentures for £1,000, registered November 17th, 1919, charged on the company's undertaking and property, present and future, including uncalled capital.

Bristol Institute of Electro-Therapeutics, Ltd.—Debenture for £400 registered November 18th, 1919, charged on the company's undertaking and property, present and future, including uncalled capital. Holder: E. D. Thomas, 70, Hampton Road, Redland, Bristol.

CITY NOTES.

Adelaide Electric Supply Co., Ltd.

The gross revenue for the year ended August 31st, 1919, was £185,908 against £174,254, an increase of 6 per cent. After meeting management and general expenses in Adelaide and London, and providing for debenture interest and sinking fund, £959 is written off cost of issue of "A" preference shares, £3,000 is put to reserve for income tax, £5,000 to general reserve, 6 per cent. paid on the preference shares, 7 per cent. final, free of British income tax (making 12 per cent. for the year), on the ordinary shares, and £1,419 is carried forward plus £16,942 brought forward. During the first nine months of the year (to May last) there was a satisfactory increase in all departments of the company's business. The prospect of a record year was, however, upset by the prolonged strike of seamen in Australia, and the net profit for the year was in consequence seriously diminished, as the authorities imposed drastic restrictions upon the use of electricity, and for a time the supply of current for industrial power was prohibited. The effect of these restrictions was to dislocate the local industries of Adelaide and to reduce the company's sale of electricity by approximately 50 per cent. during the continuance of the strike. Capital expended during the year was £68,946, and there was written off capital account £22,481. The business is rapidly outgrowing the capacity of the existing power house at Adelaide, and a new power station is to be built at Osborne, Port Adelaide; a site has been leased. An issue of new preference shares for this purpose was made last July; the whole of the shares (250,000 of £1 each) were applied for and allotted at par. The development of the business during the year is shown below:—

Year ended	Consumers.	Lighting, &c., in KW.	Motors rated, H.P.	Total connections in KW.	Units sold.
August, 1918	21,917	15,856	11,351	27,207	10,775,934
„ 1919	25,049	17,629	12,618	30,247	11,239,069

Increase in consumers 14 per cent.; in power supply 11 per cent.; in total connections 11 per cent.; in units sold 4 per cent.; and in gross revenue 6 per cent. The resolution confirming the subdivision of the £5 shares into £1 shares is to be submitted at the close of the annual meeting to-day.

German Companies.

The Bergmann Elektrizitats Unternehmungen A.G., of Berlin, earned gross profits of 204,000 marks in 1918-19, nearly all of which has been applied to the depreciation of investments.

The A.E.G.-Unternehmungen, A.G., of Berlin, whose share capital of 10,000,000 marks is held by the A.E.G., reports net profits of 702,000 marks (pre-war £35,100) for 1918-19, as compared with 688,000 marks (£34,400) in the previous year, no sum being mentioned for depreciation in either period. It is proposed to pay a dividend of 6 per cent., as in 1917-18.

The Elektrizitats A.G. vorm Schuckert & Co., of Nuremberg, reports gross profits and balance forward amounting to 10,880,000 marks for 1918-19, as compared with 11,249,000 marks in the previous year. The sum set aside for depreciation is 4,269,000 marks, as against 3,500,000 marks, and the balance permits of the payment of a dividend at the rate of 8 per cent., as in the preceding year.

The Deutsch-Uberseeische Elektrizitats Gesellschaft, of Berlin, Buenos Ayres, &c., has issued a financial statement for the years 1917 and 1918. In the former year the gross receipts amounted to 21,644,000 marks, and after meeting general expenses, interest charges and rentals, and placing 4,222,000 marks to depreciation and reserve funds, as against 4,123,000 marks in 1916, the accounts show net profits of 9,178,000 marks, as compared with 10,790,000 marks in the preceding year. It is proposed to pay a dividend of 6 per cent. on the preference shares, as in 1916, and 7 per cent. on the ordinary shares, leaving 7,378,000 marks to be carried forward to 1918, as the results proved to be very unfavourable in the latter year owing to the extraordinary advance in expenses for coal. A loss of 530,000 marks, in fact, occurred at Buenos Ayres in 1918. The total gross revenue in that year was only 7,772,000 marks, rising to 15,150,000 marks with the amount brought forward. After defraying general expenses and other charges there remains a sum of 6,714,000 marks, of which 4,342,000 marks has been allocated to depreciation and reserve funds, and the balance applied to the payment of a dividend of 6 per cent. on the preference shares.

Manx Electric Railway Co.—Sir W. H. Vaudrey presided at the annual meeting held at River Plate House, E.C., on December 23rd. The total receipts for the year were £57,102, against £17,554 in the previous year and £40,160 in 1913. The expenditure was £25,601, as against £11,742 in the previous year and £18,740 in 1913. The result was a net profit of £31,501 against £5,812 in the previous year and £21,420 in 1913. An expert engineer had been called in to confer with the general manager, Mr. F. Edmondson, and it was proposed to extend and improve the plant in various ways. The accounts showed a debit balance forward of £31,411, whereas the profit as shown above was £31,501, thus leaving £90. Allowing interest on first debentures £9,000, there is now a debit balance on revenue account of £8,910.

Southern Canada Power Co.—During the year ended September 30th, 1919, distribution plants were extended to meet requirements of more than a thousand new customers, making a total of more than 9,000. New power development at Drummondville is in successful operation. Gross earnings $566,091 (against $475,009), profits $263,293 (against $210,517), interest $205,229 (against $162,359), surplus $58,064 (against $48,157).

South Wales Electrical Power Distribution Co.—Under the Bill now deposited power is sought to issue £500,000 5 per cent. prior lien debenture stock in addition to £314,148 stock of 1916 which has not yet been issued, in view of the necessary developments for giving requisite supply to industrial and other works and authorised distributors.

Stock Exchange Notice.—Application has been made to the committee to allow the following to be officially quoted:—

Edison Swan Electric Co., Ltd.—360,000 ordinary shares of £1 each, fully paid, Nos. 598,308 to 958,307.

North Wales Power & Traction Co.—According to the *Financial Times,* the profit and loss account for the year ended June 30th, 1919, shows a credit balance of £167 to be carried forward.

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Underground Railways of London.—It is announced that Mr. S. B. Joel has acquired the whole of the Speyer interest, estimated at about one million pounds, in the Underground railways group, including the L.G.O.

Capital Increase.—It is announced that the James Keith and Blackman Co. are contemplating an increase of capital by £120,000 in ordinary shares to £250,000. Undivided profits are to be capitalised and distributed among shareholders.

Bell Telephone Co. of Canada.—Quarterly dividend of 2 per cent., less tax.

Mackay Companies.—Quarterly dividend 1¼ per cent., less tax, on the common stock.

STOCKS AND SHARES.

TUESDAY EVENING.

THE volume of Stock Exchange business shows no signs of diminution. The first week of the New Year has brought more and more orders into the markets. The public are buying stock freely. Obviously the Board of Trade statements with reference to the demand that there is for British goods the world over has quickened the imagination of the investor and the speculator. Industrials occupy the principal place in the limelight, and markets are active in nearly all departments.

This applies also to the Home Railway market. The rise which started last week was further continued until checked by the attitude of the railwaymen in regard to the Government's proposals as to wages. The remarkable deal whereby Barnato interests have acquired the Speyer holdings in the Underground Electric Railways Co. has aroused as much interest as the proposal to raise fares has created protest. From the point of view of stockholders, it may be remarked that fares on the District Railway, as an example, are still low, and that travellers would have little cause for complaint if the rates were raised, provided accommodation were found for the passengers. To cite one instance, the first-class season from Hammersmith to the City in pre-war days was £2 a quarter. It is now £2 4s., a rise of 10 per cent. Manifestly it would not be unreasonable if this sort of rate were to be put up, although the season ticket-holders would certainly have reason for demanding that they should receive in return a prospect of getting a seat. Prices have improved in consequence of the Barnato deal, the Underground Incomes and the £10 shares rising 10s., and the shilling shares 11s. 3d. Districts are ½ higher; so are Metropolitans. Both the latter have been better still, giving way in sympathy with declines in the steam stocks on the railwaymen's protest.

There are few changes in electricity supply prices. County of London at 9⅜ are ⅛ better, but the preference fell an equal amount to 9¼, while City of London preference at 9½ and Charing Cross ordinary are 2s. 6d. up. A good deal of attention is being focused upon the relative advantage of ordinary or preference shares. Investment has become such a mixed problem that the old landmarks, safety on one hand and speculative possibilities on the other, have been almost swept away. The recent flood of new issues has had the effect of diverting money from the more sober securities which pay 6 per cent. or thereabouts on the money, and turning the capital into channels that offer 7, 8 or even more per cent. We are steadily approaching the time when the investor will either insist on 10 per cent. on ordinary shares, or he will be content to put up with some Post Office rate of interest from issues that promise large capital appreciation in the near future. These influences pull strongly in the Stock Exchange tide which moves quotations, and the tendency at present is certainly to realise the better class stocks in order to buy the more venturesome shares. This factor is apparent even in such securities as the best class of cable stocks. Easterns, Eastern Extensions, and Globe preference are amongst those which have yielded a trifle during the past week. United River Plate Telephones are 1-16 down, but on the other hand Chile Telephones hardened to 6⅞. Marconi shares improved to 4½ in the rush to buy the popular industrials, and other Marconi descriptions improved in sympathy.

To the man who is prepared to take risks, the shares of the Automatic Telephone Co. may be mentioned. They are, of course, frankly speculative, as everything else must be which is largely concerned with patent rights. That there must be some sort of automatic telephone in the near future is becoming apparent with the growth of the business, and probably it is only a matter of initial cost which causes the Government to hesitate before embarking upon the process at the present time. It is difficult to say what percentage of speculation and what of sound investment-possibility enter into the present price of Automatic Telephone shares, which is 31s. 6d., but for those who do not mind a speculation, fairly faced as such, the shares might be picked up in order to rest with others of higher class in the strong box which holds financial hostages for the future.

With the conclusion of the moulders' strike, a better tone has become apparent amongst engineering and kindred shares, but so far no marked advance has occurred. Babcock & Wilcox went up 3-16 last week, and are another 1-16 to the good now. British Aluminium gained a few pence. Siemens rallied to the extent of 2s. 6d., and are once more hard on the heels of 30s. India-Rubber shares at 17½ look cheap in their ex dividend guise. Canadian General Electric closed its subscription lists for the new shares last Monday, on which day the rights changed hands at 3s. premium. Midland Electric 7 per cent. preference have gone back to 4¾. London United Tramways debenture at 40 is a couple of points lower. British Electric Traction has risen to 40½.

Amongst foreigners, Anglo-Argentine Tramways have begun to recover; the first and second preference are both higher, and expectation once more fastens upon the hope that arrears of dividend on the former may be dealt with during the current year. British Columbia Electric stocks are harder, the preferred, with a rise of 2, being 7 up within a fortnight. Brazilian Tractions at 61 regained part of their loss. One of the features in the railway markets is the strength of Mexicans, the prices rising hand-over-fist. So far this has not been much reflected in the utility issues, but that these will follow in due course, provided Mexican Rails hold their improvement, may be regarded as fairly well assured. Mexican Light preferred is 5 points better. The rubber market is booming, attracting an enormous amount of trade from all over the country. Substantial rises have been secured by all the leading shares practically without exception, owing to the price of the raw material hardening to 2s. 10½d. per lb. It is a matter for doubt whether the boom has not been too rapid to last without some reaction occurring.

Edisons rose to 24s. on Tuesday afternoon, on a rumour that there may be something afoot between this company and the General Electric. The ordinary shares of the latter have hardened to 40s. bid.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1917.	Dividend 1918.	Price Jan. 6, 1920.	Rise or fall.	Yield p.c.
HOME ELECTRICITY COMPANIES.					
Brompton Ordinary	10	8	5⅞		£6 16 2
Charing Cross Ordinary	4	4	8	+ ⅛	6 18 4
do. do. do 4½ Pref.	4½	4½	9	—	8 8 8
Chelsea	5	8	8	—	5 0 0
City of London	8	8	12	—	6 13 4
do. do. 6 per cent. Pref.	6	6	9⅛	+ ⅛	6 6 4
County of London	7	7	9⅜	+ ⅜	7 9 4
do do. 6 per cent. Pref.	6	6	9⅛	+ ⅛	6 11 8
Kensington Ordinary	7	6	4½	—	6 6 4
London Electric	Nil	Nil	1⅜	—	
do. do. 6 per cent. Pref.	5	6	8⅜	—	8 17 10
Metropolitan	4	5	8	—	8 6 8
do. 4½ per cent. Pref.	4½	4½	8	—	7 10 0
St. James' and Pall Mall	9	10	6	—	8 6 8
South London	5	5	3 11/16	—	7 8 6
South Metropolitan Pref.	7	7	1	—	7 0 0
Westminster Ordinary	9	8	6½	—	7 12 5
TELEGRAPHS AND TELEPHONES.					
Anglo-Am. Tel. Pref.	6	6	90½	—	6 12 8
do. Def.	1½	88/6	22½	—	7 10 0
Chile Telephone	8	8	6⅞	— ⅛	6 5 6
Cuba Sub. Ord.	7	7	10⅜	— ⅛	*6 18 4
Eastern Extension	8	8	16	— ¼	*5 0 0
Eastern Tel. Ord.	8	8	167½	—1	*4 15 7
Globe Tel. and T. Ord.	7	8	16½	—	*4 19 3
do. do. Pref.	6	6	9¾	— ⅛	6 3 1
Great Northern Tel.	22	22	23½	—	9 7 2
Indo-European	13	13	48½	—	6 18 4
Marconi	20	25	4½	+ ⅛	5 17 8
Oriental Telephone Ord.	15	10	2 5/16	—	4 14 1
United R. Plate Tel.	8	8	7 1/16	— 1/16	*5 5 10
West India and Panama	1/8	1/8	1 1/16	— 1/16	Nil
Western Telegraph	8	8	17xd	—	*4 14 2
HOME RAILS.					
Central London Ord. Assented	4	4	58⅜	—	6 16 9
Metropolitan	1	1½	26	+ ½	4 16 2
do. District	Nil	Nil	21½	+ ½	Nil
Underground Electric Ordinary	Nil	Nil	3	+ ½	Nil
do. do. "A"	Nil	Nil	7/9	+ 1/16	Nil
do. do. Income	4	5	87½	+ ½	*5 14 3
FOREIGN TRAMS, &c.					
Adelaide Sup. 6 per cent. Pref.	6	6	3⅛	—	7 14 10
Anglo-Arg. Trams. First Pref.	5½	Nil	8⅜	— ⅛	—
do. do. 2nd Pref.	—	—	8½	+ ¼	—
do. do. 5 Deb.	5	5	61⅛	—	8 2 8
Brazil Tractions	—	—	61	+ ½	—
Bombay Electric Pref.	6	6	13½	—	4 9 0
British Columbia Elec. Rly. Pfce.	5	5	62½	+1	8 0 0
do. do. Preferrred	Nil	2½	56½	+2	4 8 9
do. do. Deferred	Nil	Nil	52½	—	Nil
do. do. Deb.	4½	4½	62½	+1½	6 16 0
Mexico Trams 5 per cent. Bonds	Nil	Nil	42⅛	—	Nil
do. 6 per cent. Bonds	Nil	Nil	29	—	Nil
Mexican Light Common	Nil	Nil	17⅛	—	Nil
do. Pref.	Nil	Nil	30	+5	Nil
do. 1st Bonds	Nil	Nil	53½	+1	—
MANUFACTURING COMPANIES.					
Babcock & Wilcox	15	15	3⅜	+ 1/16	*4 12 2
British Aluminium Ord.	10	10	1 3/16	+ 1/16	5 12 3
British Insulated Ord.	25	12½	2	—	6 5 0
Callenders	25	25	8¼	—	7 11 6
,, 6½ Pref.	5	6½	4 7/16xd	—	7 2 1
Castner-Kellner	25	20	3 7/16xd	—	3 15 7
Crompton Ord.	7	10	21/6	—	9 6 0
Edison-Swan, "A"	—	10	1 1/16	—	8 8 0
do. do. 5 per cent. Deb.	4	5	79½xd	—	6 5 9
Electric Construction	10	10	1 7/16	—	9 8 2
Gen. Elec. Pref.	6	6½	19/6xd	—	6 12 6
do. Ord.	10	10	40/-	—	*5 0 0
Henley	25	25	2½	—	5 11 1
do. 4½ Pref.	4½	4½	8⅜	+ ⅛	6 4 2
India-Rubber	10	10	17½xd	—	*5 16 0
Met.-Vickers Pref.	—	—	2 1/16	—	5 14 0
Siemens Ord.	—	10	29/6	+2/6	*6 15 7
Telegraph Con.	20	20	26½	+ ½	*4 10 6

* Dividends paid free of Income Tax.

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AN ELECTRICALLY HEATED THEATRE.

The heating of large buildings such as theatres, blocks of offices, or flats has always been a difficult and costly undertaking, and to-day it is not made any easier by the high price of coal, which is used for the systems of steam heating that are in vogue in most places. Such considerations, coupled with the fact that the old system proved very unsatisfactory, induced the management of the Lyric Theatre, Hammersmith, W., to install electrically-heated radiators. The system, which we

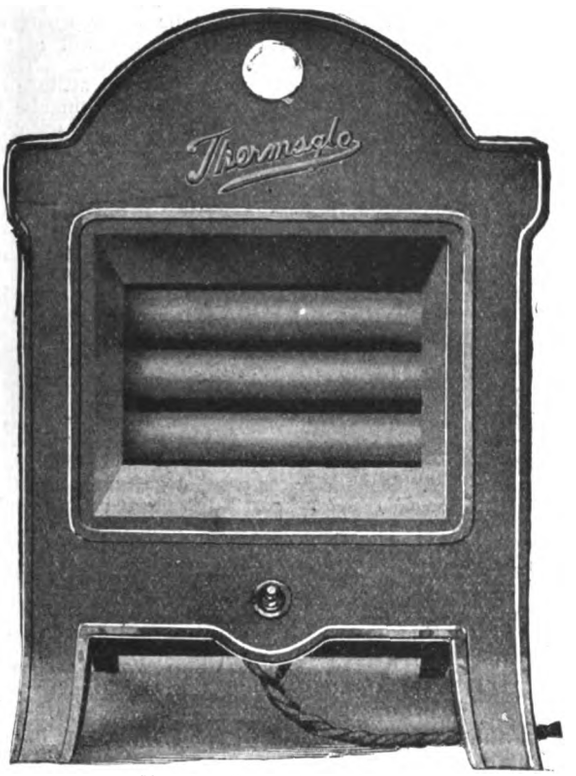

Fig. 1.—Quain 3-bar Fire.

were recently privileged to inspect, is, we believe, the first of its kind to be installed in any large building in this country; the London County Council authorities, whose regulations have been strictly complied with, are watching the experiment with a good deal of interest, as are also other London theatre managers and certain Yorkshire municipal authorities.

At the present time when the problems of heating in connection not only with housing schemes, but also with industrial heating, are receiving considerable attention, the results obtained with this installation should be of more than usual interest. On the occasion of our inspection the installation had been at work for some time, and it is gratifying to record that it has fulfilled all expectations with regard to reliability and efficiency.

Electrical heating was decided upon only after full consideration of other systems, and it has now displaced throughout the whole building the gas-heated radiators which were formerly used. It will probably come as a surprise to some readers that the installation of the electrical system was found to be 65 per cent. cheaper than a system of hot-water pipes to give the same results. Moreover, it has proved to be 50 per cent. cheaper to run than the displaced gas system. These figures are not estimated, but are based on several weeks' running costs, and further, the electricity supply, which is taken from the public supply mains, is not charged for at what might be termed a low rate.

The Quain Electric Co., Ltd., whose "Thermaglo" radiators have been installed throughout the theatre has during the past three years supplied electro-steam radiators in considerable numbers to the War Office and Admiralty for use in aircraft hangars, particularly where "lighter-than-air" machines are housed. The special advantage in this connection lies in the fact that the radiator is thoroughly "gas-tight," and thus altogether obviates the risks of fire and explosion always present where there is the possibility of inflammable fumes, gases, or articles reaching a flame or even a radiant-heated surface. Experience during the war period enables this claim to be made with justice.

The electro-steam radiator is particularly useful where warmth is required without radiant heat; it is self-contained, fire and fool proof, devoid of radiant surfaces, and its freedom from noxious fumes renders its use ideal from a hygienic standpoint for bedrooms and nurseries. In public buildings or conservatories, low-temperature heating by convection is desirable; it is obviously better than a system employing small high-temperature heaters which overheat patches of seating accommodation in their immediate vicinity.

Thermaglo radiators are suitable for either direct or alternating currents of any phase. The Quain heating element can be applied to every apparatus and process in which heat is utilised; it provides high temperatures, and maintains them at any given degree, up to 1,800 deg. C., without appreciable variation and with no risk of melting or fusing. The element consists of a resistance wire closely wound upon a hollow support of silica, which is itself enclosed within a silica casing. The apparatus burns equally well in a vacuum in or out of water, and being relatively small, compact, and simple in structure, it can be adapted for any purpose the user requires. For steam radiators its application ensures stability of temperature, and owing to the absence of super-heated surfaces it prevents vitiation of the atmosphere. High-grade nichrome alloy wire and specially-graded silica quartz glass are used in the element.

An example of the multi-bar fires installed in dressing rooms and offices is shown in fig 1. The number of these fires installed is seven, each with a consumption of 1,500 watts. The centre bar is controlled by the switch at the wall plug, while the other two are con-

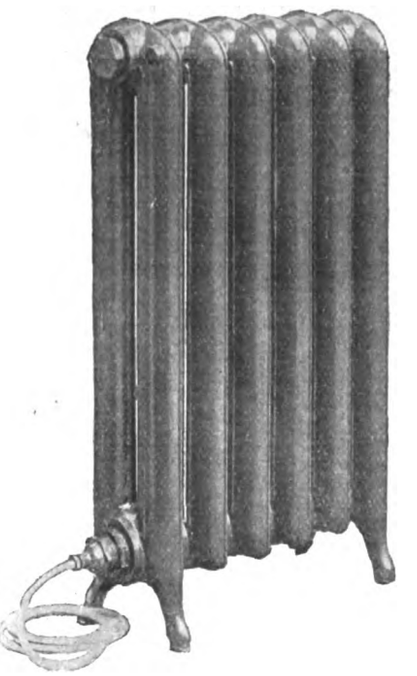

Fig. 2.—Thermaglo Electro-steam Radiator.

trolled by the switch on fire itself. The glowing red-hot bars of quartz are pleasing to the eye, and make a room look cosy. The fires, it is claimed, give a real radiant heat with high thermal efficiency, and the added advantage that the element is protected from wear. The electro-steam radiator, fig. 2, is the type of which 30 are used throughout the main body of the Lyric Theatre, as well as in the corridors and on the stage,

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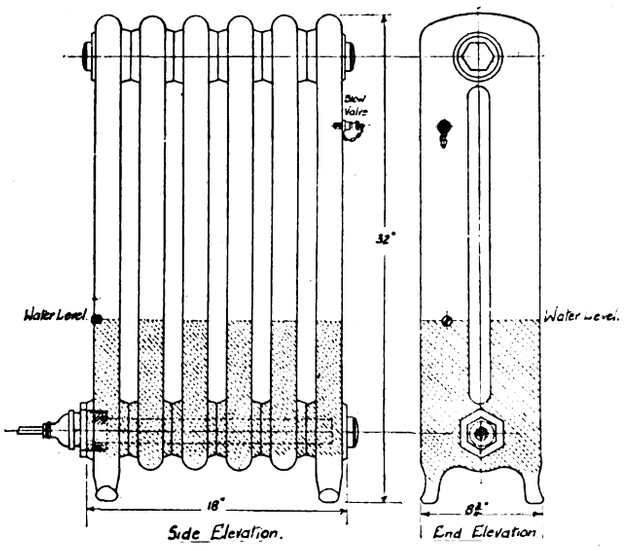
placed either singly or in pairs. Formerly trouble was experienced with the draughts which originated at the main entrance to the theatre, and blew along the corridors. These have been entirely eliminated by placing two radiators against the wall immediately facing the swing entrance doors so that the air is warmed as it enters the building.

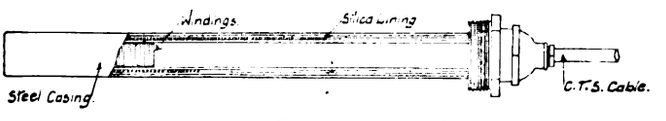
In figs. 3 and 4 are seen respectively the side and end elevations of the electro-steam radiator. Fig. 5 shows a complete 1-KW. heating unit, and fig. 6 the details of the gas-tight fitting and connections. The



FIGS. 3 AND 4.—SIDE AND END ELEVATION OF RADIATOR.

standard radiator, which weighs approximately 165 lb., is suitable for heating 1,000 to 1,200 cu. ft. of air space under average conditions, the radiating surface being 20 superficial feet and the loading 1,000 watts. Each radiator is fused separately, and they are all under the control of one person from one switchboard. They are on for six hours each day, the system being to switch them on at noon, off at 3 p.m., and on again from 6 to 9 p.m., which is found to be sufficient to heat the whole theatre to a comfortable temperature. We

FIG. 5.—HEATING ELEMENT.



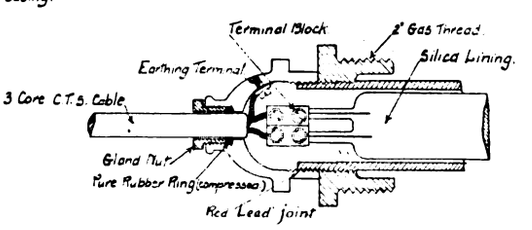


FIG. 6.—GAS-TIGHT FITTING.

understand that the system of ventilation is now receiving attention, and by certain improvements that are to be made it is expected that still more efficient results will be obtained from the heating system.

In conclusion, we have to thank Mr. A. P. Horne, business manager, for facilitating our inspection of the installation; Mr. Davies, electrician, who carried out the installation and explained its details; and Mr. J. R. Spink, who supplied drawings from which the above illustrations were reproduced.

Tradesmen Using the Royal Arms.—The *London Gazette* for January 2nd, contains lists of tradesmen in London and elsewhere, who hold warrants of appointment to Royalty, with authority to use the Royal Arms.

SCIENTIFIC MANAGEMENT: A SOLUTION OF THE CAPITAL AND LABOUR PROBLEM.

DISCUSSION AT GLASGOW.

AT Glasgow, on December 9th, Capt. J. M. Scott-Maxwell's paper, an abstract of which appeared in our issues of December 19th and 26th, was read and discussed before the SCOTTISH CENTRE of the INSTITUTION OF ELECTRICAL ENGINEERS.

Mr. A. PAGE agreed that any system which would increase efficiency and eliminate waste was likely to meet with approval, providing it was accompanied by raising the status of the worker. But how were they to get rid of the suspicion of the unions which led to so much friction and was the main cause of limitation of output? Until that was accomplished, any attempt at motion and time study would be futile. The gaining and retention of the goodwill of the worker was the essence of successful management. There was increasing evidence of a more sympathetic attitude on the part of the employing class, and there was promise in the activities of the Joint Industrial Councils. The scientific handling of labour was the most difficult part of Dr. Taylor's system, and a great deal of spade work would require to be done before the British workman would agree to make an automaton of himself in return for the satisfaction of knowing that he had completed his job with the minimum of effort.

Mr. J. H. BUNTING said they should now be convinced that scientific management was the best, if not the only way, to increase production in this country. He saw no reason why the principles of scientific management should not be introduced into the factories of this country, not necessarily in the form in which it was introduced by Dr. Taylor. He thought, however, that they would have to do something for themselves before asking Government support. He had seen the principle introduced in a modified form, and it was attended by remarkable results. If, however, it was introduced at present they were likely to have the trade unions up against them. The employer needed as much education in this respect as did the worker. Any person who seriously considered the paper would improve his business.

Mr. MORRISON pointed out that they would have to convince the workers that the idea was not to give something for nothing; if higher wages had to be paid they must have increased output. If employers did not get a move on the workers would step in, force their hands, and introduce the principle for themselves.

Mr. T. C. HERBERT said he had for long been convinced that scientific management was the panacea for most of their industrial ills. Strongly as the author had put the human aspect of the problem he had not put it strongly enough. He would have liked it emphasised that the whole basic idea of scientific management was the substitution of help and assistance by the functional foremen for the mere bullying and driving of the ordinary general foreman. The mere fact that encouragement and help took the place of vindictive criticism and punishment must necessarily improve the relations between capital and labour. It was, of course, true that scientific management detached and eliminated false effort and secured efficiency in avoiding waste in both materials and human energy, but its foundation was, he suggested, an alteration in the attitude of the employer to the employed. Much of their difficulty the author rightly ascribed to the sheer ignorance of the so-called business man who often was neither an engineer nor an accountant, but virtually a stock exchange trickster. Such a man often failed to realise the sanctity of human life, and had not even discovered that to wear a man out was bad economics if only because it took time and money to train his successor. Such a man often failed to realise the utter idiocy of reducing a piece rate once fixed. However, the author had perhaps done full justice to this aspect of scientific management. The conversion of the labour leaders to his views was a task which he trusted the author would soon see accomplished.

Mr. JAMES RICHARDSON said all agreed with the first principle of scientific management proposals. It appeared to him that they were likely in the course of the next few years to be faced with a crises which could only be met by adopting the principles advocated by the author. As to the application of the principles, they had not staff officers on hand able to apply them, and were looking to the universities and technical colleges to meet the defect.

Mr. L. M. JOCKEL expressed his conviction that scientific management would come. In the meantime much could be done on the elemental side of the question, say in the introduction of simple elementary reforms which led to economy and improved results.

Mr. W. KEOCHIE pointed out that certain factories were largely run under scientific management, but they had not adopted the title because of its cold-blooded suggestiveness. The system where tried was working satisfactorily, but the proper spirit had to accompany its introduction. If the men were treated in a humane fashion the best results would follow—the application of the system might also get over the bogey of shorter hours and higher wages.

Capt. J. M. SCOTT-MAXWELL, briefly replying, explained that he did not mean that they should wait for the formation of National Boards before applying the system, but if each made an effort they must have some national or central organi-

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sation. Meanwhile, they ought to start national propaganda. He agreed that in many cases employers were worse than the workers. That was what brought scientific management into disrepute in America. By the proper operation of scientific management they not only made more profits, but shortened hours and raised wages as well. The system had been referred to as cold-blooded in its suggestiveness, and he had heard it termed murderous. Taylor was not that sort of fellow. He had great concern for his workers, and in the Taylor factories, where the system had been a success, harmonious relations prevailed. He would have emphasised the "good to humanity" potentialities of the system had he been addressing trade unionists or socialists, but it was the employers he wished to get at now. The system taught the men; it did not drive them, and the provision of instructors formed a valuable link between the two sections. As the Employers' Federation had to deal with labour, that body would have to be tackled first. Staff training in the principles of scientific management took five years in America. It was special training, and they were not likely to secure it if the matter was introduced in piecemeal fashion in different workshops. It was more likely to come by national propaganda. The idea that because scientific management had had a bad record in America it would be bad here was a mistake. It was possible that a bad employer might use the system to the detriment of the employés, but there was nothing to show that the system was bad in itself. Scientific management was simply a system for measuring human effort.

DISCUSSION AT BIRMINGHAM.

AT Birmingham, on December 17th, the paper was read and discussed before the SOUTH-MIDLAND SECTION of the Institution.

Mr. A. PHILLIPS said he was a firm believer in the application of scientific management as a means of obtaining increase in production. Time study, the fixing of rates, and the elimination of all unnecessary motions in the performance of work, would go a long way to reduce the cost of production; but Taylor scarcely visualised the conditions that were bound to obtain under what was recognised at the present time as "mass production," and this would require very careful consideration on the part of manufacturers who must apply it. The number of skilled workers, instead of being less would be greater; they would, however, be engaged in producing the necessary equipment for the unskilled workers. The amount of production would then be increased by hundreds per cent. The field of unskilled workers would necessarily be leavened by many who would have attempted, but failed, to reach the amount of skill requisite for the more skilled occupations; also from the ranks of the unskilled operators on machines would undoubtedly arise (as well as from the ranks of skilled labour) men who would fill high administrative positions in the works. He believed that it was quite reasonable to have a condition in which people would carry out the purely mechanical repetition part of production, and need not necessarily regard their work as their whole life, but merely as a means of providing them with the necessaries of life. Shorter hours, congenial conditions of labour, in so far as the sanitary and hygienic arrangements of the establishments in which they had to work were concerned, would, he believed, render those who worked under such conditions happier, realising that they might enjoy and live a more full and happy life in their leisure time, which would be much greater than it had been hitherto. That it would be necessary to subject themselves to a certain amount of discipline they would readily agree to when they realised the great advantages that, not only they but the community at large, would derive from this method of intensive production. The requisite thing at the moment was to educate the people to realise the necessity of this condition. He saw no reason why the great majority of those who were doing preparatory work to equip themselves for higher positions in other spheres of industry, should not devote a part of their time to attending to the world's productive machinery, thereby directly benefiting themselves and also the community. While payment by results was what they were all anxious to get, yet payment by piece work was not always the most satisfactory method. What was needed was a balanced number of parts, and this result was best attained by careful calculation of the number of pieces one could get with safety from any given machine. The great difference between this method and the system of individual piece work was that although payments were made by results, the results were predetermined, and not left to the initiative of the individual.

Mr. C. BELL-WALKER referred to that aspect of the question bearing upon labour unrest, and was of opinion that the cause was mainly psychological; increased pay and efficiency would not cure, but might possibly aggravate it. The best work was rarely performed with the object of making money, but arose from a pride and interest in it. A large proportion of the nation endured unparalleled suffering and privation during the war for practically no pay, and no financial inducement would have so stimulated them. The danger of the Taylor system was the tendency to reduce men to the level of parts of machines. A piece-work system of payment, although at present the most successful and practicable, was not the system that should be aimed at, because the worker's and employer's material interests were antagonistic, the former's being to do the least amount of work for the greatest amount of money, and the latter's to give the least money for the greatest amount of work. It had never been proved that high wages in themselves were a cure for labour unrest.

Mr. J. A. HANNAY stated that management could not be called scientific if any difference was allowed to come between capital and labour. It was absolutely essential to approach these matters from a broader and national standpoint. He hoped the author was not going to make the mistake of holding out a promise of a speedy solution of the capital and labour problem by scientific management. It would take a great many years to solve the difficulty, but scientific management would undoubtedly play a very great part in the solution. The author had omitted to mention the essential matter of education and training of young men who were preparing to enter into various industries. He, the speaker, considered that present educational means were totally inadequate, and before they could expect to have really scientific management many schools and training colleges would have to be overhauled and restaffed. He considered it a scandal that the teaching profession was not better supported and the very best possible men selected. In the future scientific management in the engineering industry would have to devote more and more attention to tool room, jig and tool design, and equipment, and there should not be the slightest cause for anxiety on the part of the workmen in developing improvements to the greatest possible extent; this would be where they would eventually find nearly all their skilled men. The want of an adequate supply of skilled men was preventing tool rooms from being thoroughly developed, with a consequent loss of a very large amount of production. He emphasised the fact that if capital and labour could only agree and concentrate more and more on tool equipment that would automatically solve innumerable problems. With regard to the workers' objection to repetition work as being uninteresting, he did not think there was anything to fear, providing the worker was adequately recompensed, and able to work under healthy conditions.

Lieutenant H. SOPER said, with regard to the suggestion that an industrial research organisation should be set up on national lines, that practice had proved that in individual works the installation of scientific management was best carried out by starting with a small section and using that as an object lesson to convert other sections, until the whole had been converted. In view of the distrust with which scientific management was at present viewed by uninformed employers and employed, he suggested that if the Government were to take up the work it should commence with a number of model factories at which both employers and trade union representatives could familiarise themselves with the subject.

Mr. N. MARTIN regarded the researches of Taylor as an attempt to set up standards of measurement for that most elusive of all quantities, human activity, and he regarded his work as the opening of a new era in industrial history, when instead of being content with a rough quantitative idea of the amount of human activity, based on financial results an exact quantitative analysis could be made beforehand of the amount of activity required to produce a definite result by standard methods. From what he had seen of the Black Country a very large proportion of the workers were employed in repetition work, in which no rational human being could be permanently interested. They worked not for the intrinsic interest of the work, but to earn their daily bread. It was in such cases that Dr. Taylor's work offered to the worker, without increasing the monotony of his work, a greater reward for his labour.

Mr. W. H. EDWARDS said that scientific management had for a long period been used and improved upon by firms in this country, but there were hundreds of factories where no system was used, while in some instances various systems were used, even in the same factory, one department being up to date, and another using ancient methods. An important matter was the education of the skilled man for such positions as manager, supervisor, foreman, designer, end toolmaker. Many boys who had a technical school training found it difficult to get into large works unless they were satisfied to be dumped on a repetition machine and their efforts stultified; manufacturers and others should offer facilities to such students.

The Magneto Industry in France.—As in Great Britain, there has been a great development of the magneto manufacturing industry in France since the commencement of the war. At the commencement of hostilities, it is estimated that the annual requirements in France in the way of ignition magnetos amounted to 7,500 machines, fully 90 per cent. of which were supplied from Germany. To meet war-time requirements, several old-established firms, as well as a number of new undertakings, undertook the manufacture of magnetos, and eventually, both as regards output and quality, the home manufacturers were able to meet the whole of the French needs, the production rising to 1,500 magnetos per month. Efforts are being made to maintain the position thus attained, and in addition to meeting the orders for magnetos from French motor-car manufacturers, an export trade in the machines is now being developed.

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NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

The Mira Igniter.

A British-made ignition unit, as an alternative to the magneto, and utilising energy from the starting and lighting equipment of the car, has been placed upon the market by the HIGH TENSION Co., of Belvedere Road, Westminster, London. The unit, fig. 1, of which Mr. M. A. Codd is the inventor, consists of a transformer coil of coarse and fine wire suitably insulated, mounted on a rotating shaft complete with condenser and contact-breaker similar to that used in magnetos. The whole apparatus and connections are simple and strongly made. The transformer, with its contact breaker, is rotated by the engine within an insulating distributor body carrying the necessary number of terminals. The top of the distributor body carries a cover, which contains a cam ring, having the necessary number of cams to depress the contact-breaker spring according to the number of cylinders to be fired. Projecting from the insulating body of the transformer is a distributor comb, which passes the spark from the transformer to the heads of the terminals in the distributor leading to the plugs. There is a spark gap of about 1/64th in. in each case. The base of the distributor carries a tubular bearing, which extends within the transformer and round its driving shaft, terminating in a ball thrust bearing located below the contact-breaker plate. The contact-breaker cover carries the spring-loaded contact brush, which bears on the live stud in the centre of the contact-breaker plate, whereby the current from the accumulators is led to the transformer, by which it is raised to a voltage sufficient to enable it to jump the gap at the plug points and leaves the transformer by way of the distributor comb. The appliance is interchangeable with most modern magnetos, and is fixed to the bedplate in the usual manner, the igniter shaft being connected up to the engine through a flexible coupling. It is claimed for the "Mira" that it gives equal results to a magneto at high speeds, and is far better at low speeds for the reason that the energy of the spark does not fall off as the engine speed decreases. The effect of the spark gaps between the distributor comb and the terminals, it is claimed, is that greasy or sooty plugs are rendered more positive in action owing to certain high-frequency phenomena. Easy starting is a main feature of the device, and is of importance when using starters, as the strain on the battery is thereby reduced. The igniter does not give increased output of spark energy with increased speed: parts that may require renewal are readily accessible, and it is claimed to be water and damp proof, and the ignition can be advanced or retarded as required.

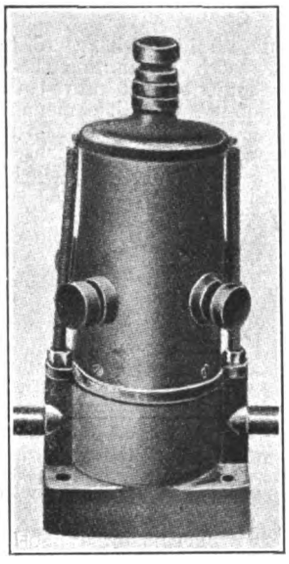

FIG. 1.—MIRA IGNITER.

A New Railway and Tramway Station Indicator.

Anything that can be done to afford relief to the serious overcrowding of underground railways and tramways will be greatly appreciated. It is held that the overcrowding is at least to some extent due to the fact that a large proportion of the passengers are not sure of the order of the stations, and are, therefore, not prepared to alight promptly when the train draws up at the platform at the station where they want to get out. Such a condition causes confusion amongst passengers attempting to board the train and those alighting, which in turn delays the departure of the train, and may very easily lead to trains running on a short headway "piling up" quickly. To overcome these difficulties an illuminated indicator, which we had an opportunity of inspecting recently, has been designed by MESSRS. INDICATORS, LTD., of 11, Southampton Row, London, W.C. 1, and is, we understand, to be installed shortly, first on the Great Northern to Moorgate Street tube, and then will be extended to the Inner Circle and the Metropolitan system generally. The device is also applicable to tramway working where information concerning fares, &c., can be given as well as the stopping places and other matters of interest, and it is to be tried as an experiment on the Highbury to Westminster L.C.C. tramway route. The indicator, which forms the subject of several patents, can be made to any size for any number of stations; the device is controlled from a master switchboard in the driver's cabin, it is set at the start of the journey, and as soon as the train starts it works automatically. Its most ingenious feature seems to be the system of wiring; this forms the subject of a separate patent, and no matter how long the train is or how large the number of stations on the journey, it is only necessary to run four wires from coach to coach. Essentially the device consists of a long box, part of which is shown in fig. 2, which is divided into the same number of compartments as there are stations on the line. A glass panel fronts each compartment on which is engraved the name of a station, a small map, and other information regarding shops, theatres, &c., in the district served by the station. Behind each panel electric lamps are fitted which enable it to be illuminated. As the train leaves a particular station the panel for the next station at which the train will stop is lit up, all the others remaining dark, so that the passenger has early visual indication of the station which is being approached, and he can, therefore, make his preparations to alight accordingly. As the train commences to slow up, a blinker light placed in a prominent position comes into operation as an additional warning. If certain stations are missed, the panels for such stations remain in darkness, the words "Not stopping at" appearing above them, but at the same time the panel for the next station stopped at is illuminated. The operation of the system is simple; a stop is provided at the side of the track near each station, which engages a projecting pivoted arm carried by the moving vehicle. The arm is slotted to receive a pin fixed to a vertical bar in such a manner that the impact causes the bar to rise. The latter, sliding in guides, is provided with collars which compress a spring, which in turn returns the arm to its normal position when the lever has passed over the stop. As the bar rises it makes contact with a switch arm, and thus closes the circuit on a solenoid which operates the arm of a step-by-step mechanism, causing it to move forward through one step. The energy for this circuit is obtained from a battery or other suitable source. When the core of the solenoid reaches its uppermost position, a second solenoid is energised, which releases the switch arm, allowing it to fall into its normal position, the solenoid is thus de-energised and the device becomes ready for the next impulse. The whole mechanism is so interlocked that each step must be completed correctly before the next step in the sequence of operation is commenced. The solenoid and lever mechanism is in duplicate, one set being used when the train is moving forward and the other when it is reversed. This ensures that the step-by-step switch is not thrown out of gear when the train is shunted. As an extra precaution the whole mechanism can be thrown out of gear when required. An ingenious arrangement is employed to overcome

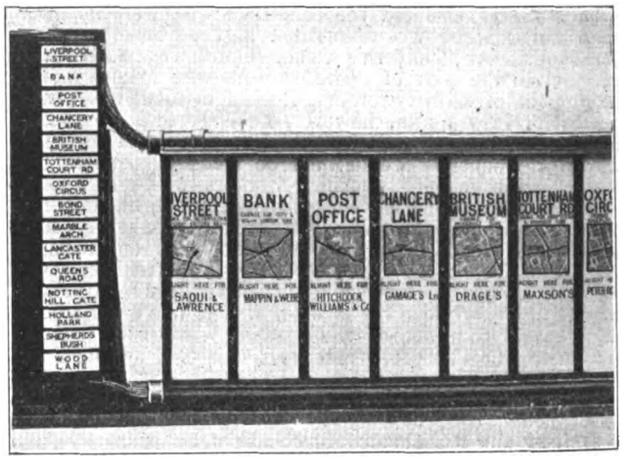

FIG. 2.—RAILWAY STATION INDICATOR.

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the difficulty encountered owing to certain trains not stopping at all stations. A special switch for each station is fitted in the driver's cab, which on being closed connects the stop on the rotary switch corresponding to the stations which are to be missed to the next stop in the series. In conclusion, we have to thank Mr. Paul H. Waller, director, for placing at our disposal the illustration and the particulars set out above, describing a device which enables a train or tramcar to tell the story of its own movements from station to station. The passenger has only to glance at it to be sure whether the train stops at his particular destination, and it also warns him as to the next station ahead.

An Electric Motor Cycle.

A new electrically-driven combination motor-cycle and side-car has recently been seen on the streets at Ipswich. The machine in question, we understand, was built at the Orwell Works of Messrs. Ransomes, Sims & Jefferies, Ltd., to the specification of Mr. P. A. G. Mossay. The parts employed in its construction are described as having been merely assembled and not specially made for the purpose; if a suitable frame and motor were specially designed it could be much improved. Even in its present form the cycle is credited with travelling 30 miles on one charge of the battery, which is accommodated under the seat of the side-car, under favourable conditions and on good flat roads. The advantages of such a machine include extreme simplicity of control, noiselessness, and the absence of objectionable fumes and fire risk. Its speed is about 12 M.P.H., but it will mount hills even with the low-powered motor that is used, and the machine has been running for three months quite satisfactorily. The running cost is another point in favour of the machine. With power supply at 2d. per unit, a full charge of the battery, representing a distance of 30 miles, would cost 6d., which would give 0.2d. per car-mile as the cost of fuel, whereas with petrol at 3s. per gallon the cost would be 6d. There is no doubt a field of usefulness for an electric cycle car for town work.

TRADE STATISTICS OF CANADA.

THE following figures, showing the imports into and exports from Canada of electrical and similar materials during the year ended March 31st, 1918, are taken from the recently-issued trade statistics. Figures for the year 1913-14, being the last normal year of trade, are given for purposes of comparison, and notes of any increases or decreases have been added. The 1916-17 figures were published on p. 596 of our issue of December 20th, 1918.

IMPORTS.

	1913-4 Dols.	1917-8 Dols.	Inc. or Dec. Dols.
Copper wire, plain, tinned, or plated.—			
From United States ...	115,000	23,000	– 92,000
Electric light carbons and carbon points.—			
From United States ...	39,000	51,000	+ 12,000
,, Other countries ...	50,000*	—	– 50,000
Total ...	89,000	51,000	– 38,000
* Germany $40,000.			
Incandescent lamp bulbs, &c.—			
From France	2,000	1,000	– 1,000
,, United States ...	110,000	223,000	+ 113,000
,, Other countries ...	20,000*	10,000	– 10,000
Total ...	132,000	234,000	– 102,000
* Austria-Hungary $14,000.			
Electrical apparatus not mentioned (insulators, batteries, telegraph and telephone instruments).—			
From United Kingdom	809,000	93,000	– 716,000
,, France	29,000	4,000	– 25,000
,, Japan	—	10,000	+ 10,000
,, Sweden	80,000	2,000	– 78,000
,, Switzerland ...	3,000	—	– 3,000
,, Italy	5,000	—	– 5,000
,, United States ...	5,515,000	8,091,000	+ 2,576,000
,, Other countries ...	156,000	—	– 156,000
Total ...	6,597,000	8,200,000	– 1,603,000
Petrol engines.—			
From United Kingdom	111,000	5,000	– 106,000
,, United States ...	2,457,000	6,661,000	+ 4,204,000
,, Other countries ...	2,000	—	– 2,000
Total ...	2,570,000	6,666,000	+ 4,096,000
Steam engines.—			
From United Kingdom	50,000	1,000	– 49,000
,, United States ...	386,000	339,000	– 47,000
,, Italy	19,000	—	– 19,000
Total ...	**455,000**	**340,000**	**– 115,000**
Steam boilers.—			
From United Kingdom	112,000	15,000	– 97,000
,, United States ...	273,000	237,000	– 36,000
,, Sweden	—	12,000	+ 12,000
Total ...	385,000	264,000	– 121,000
Manufactures of india-rubber and gutta-percha (except tires, clothing, and similar goods).—			
From United Kingdom	231,000	179,000	– 52,000
,, France	9,000	1,000	– 8,000
,, Japan	—	11,000	+ 11,000
,, United States ...	776,000	881,000	+ 105,000
,, Other countries ...	81,000	—	– 81,000
Total ...	1,097,000	1,072,000	– 25,000
Electric motors, generators, and dynamos.—			
From United Kingdom	136,000	22,000	– 114,000
,, Sweden	103,000	2,000	– 101,000
,, United States ...	1,542,000	1,894,000	+ 352,000
,, Other countries ...	26,000*	—	– 26,000
Total ...	1,807,000	1,918,000	+ 111,000
* Germany $14,000.			
All machinery not mentioned, except sewing machines, textile machinery, printing machinery, &c.—			
From United Kingdom	1,702,000	274,000	– 1,428,000
,, France	79,000	—	– 79,000
,, Switzerland ...	49,000	—	– 49,000
,, United States ...	12,811,000	14,649,000	+ 1,838,000
,, Other countries ...	181,000*	21,000	– 160,000
Total ...	14,822,000	14,944,000	+ 122,000
* Austria-Hungary $8,000.			
Lighting fixtures of metal (including electric).—			
From United Kingdom	31,000	4,000	– 27,000
,, France	8,000	8,000	—
,, United States ...	637,000	432,000	– 205,000
,, Japan	1,000	12,000	+ 11,000
,, Other countries ...	28,000*	—	– 28,000
Total ...	705,000	456,000	– 249,000
* Germany $14,000.			
Iron and steel wire, single or stranded, covered with cotton, linen, silk, rubber or other material, including cables so covered.—			
From United Kingdom	304,000	1,000	– 303,000
,, United States ...	563,000	234,000	– 329,000
,, Other countries ...	11,000	—	– 11,000
Total ...	878,000	235,000	– 643,000
Mica.—			

EXPORTS.

To United Kingdom ...	36,000	6,000	– 30,000
,, United States ...	156,000	451,000	+ 295,000
,, Other countries ...	17,000*	—	– 17,000
Total ...	209,000	457,000	+ 248,000
* Germany $13,000.			
Electrical apparatus.—			
To United Kingdom ...	25,000	119,000	+ 94,000
,, Newfoundland ...	9,000	35,000	+ 26,000
,, United States ...	67,000	452,000	+ 385,000
,, France	3,000	1,068,000	+ 1,065,000
,, Spain	—	19,000	+ 19,000
,, Other countries ...	3,000	474,000	+ 471,000
Total ...	107,000	2,167,000	+ 2,060,000
Machinery (other than threshing, linotype, washing, and sewing machines).—			
To United Kingdom ...	48,000	897,000	+ 849,000
,, Newfoundland ...	56,000	111,000	+ 55,000
,, New Zealand ...	9,000	6,000	– 3,000
,, Argentina	9,000	5,000	– 4,000
,, France	21,000	86,000	+ 65,000
,, United States ...	195,000	1,549,000	+ 1,354,000
,, Russia	—	34,000	+ 34,000
,, Australia	41,000	12,000	– 29,000
,, Spain	—	4,000	+ 4,000
,, Other countries ...	27,000	218,000*	+ 191,000
Total ...	406,000	2,922,000	+ 2,516,000
* Japan $121,000. India $19,000.			
Petrol engines.—			
To United Kingdom ...	—	8,000	+ 8,000
,, Newfoundland ...	73,000	149,000	+ 76,000
,, United States ...	12,000	11,000	– 1,000
,, Other countries ...	3,000	4,000	+ 1,000
Total ...	**88,000**	**172,000**	**+ 84,000**

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ELECTRICITY IN TIN MINING.

By D. M. W. HUTCHISON, B.Sc., M.I.E.E., and W. J. WAYTE, A.M.I.E.E.

(*Abstract of paper read before the* INSTITUTION OF ELECTRICAL ENGINEERS.)

THE Federated Malay States furnish the product known in the metal market as "Straits tin"; the exports in 1913, the last normal year, were 50,127 tons of metal, value approximately £9,800,000. The labour force employed in tin mining in the same year numbered 225,000, 216,000 of this number being Chinese, but the adoption of machinery and other causes have resulted in recent years in a large decrease in the number employed. Machinery, which is already used to a large extent, is likely to come into use much more in the near future.

Mines under Chinese management in 1918 produced about 70 per cent. of the total output, and as there are less than half a dozen electrically-driven Chinese mining plants there should be great scope for the electrical engineer in the immediate future.

In 1917, 7,600 kilowatts of generating plant and 8,300 horsepower of motors were installed on tin mines, but the majority of mines where power is employed still use steam, generally in a very wasteful fashion.

The increase in the cost of firewood owing to its scarcity, the discovery in recent years of a valuable deposit of coal in Selangor suitable for burning on mechanical grates, and the necessity that now exists for working low-grade propositions on a large scale, are three factors which are bound in the near future to result in the installation of up-to-date economical power plants for mine working.

The pre-war rate of pay for Chinese labour was 60 cents (1s. 5d.) a day; it is now about 80 cents (1s. 10½d.).

Men in charge of electrical machinery have by law to possess certificates of competency issued by the Examining Board under the Electricity Enactment. This law extends to European engineers, who, however, if associate members of this Institution, are not called upon to appear before the Board.

The rate of pay varies greatly with the individual, especially in the higher grades, but the following are approximate rates paid in Perak:—

2nd grade chargemen $24 per month (£2 6s. 11d.).
1st grade chargemen $40 to $75 (£4 13s. 9d. to £8 15s. 8d.).
2nd grade engineer $120 to $200 (£13 11s. 2d. to £23 8s. 8d.).
1st grade engineer $350 to $450 (£39 to £50 14s. 7d.).

OPEN CAST MINING.

A typical large open cast mine in full working consists of one or more huge oblong pits in the ground, perhaps 80 feet deep and many acres in extent. At one end of each pit will be an incline consisting of a double line of rails up which the ore is hauled to the puddler station; in another position a similar incline for the removal of overburden, which is dumped out of the way, into an old working for preference.

The puddler station is furnished with rails and a double-drum winch which serves to haul up the full trucks and lower the empty ones.

The karang (ore) is dumped into the puddler, mixed with water and churned, the mixture being led to sluice boxes through a coarse screen.

The sluice box consists of two or three compartments 200 feet or so long, furnished with removable slats across the bottom which catch the heavier tin particles and allow the lighter sand and slimes to escape to the tailings dump.

The chief uses for power are for hauling, pumping (both for unwatering the mine and for supplying water for the puddlers and sluice boxes), and for puddler driving and lighting the mine at night.

The question of generating on a large scale in central stations and distributing to mines has been discussed many times, most recently by a Commission appointed to inquire into various questions connected with tin mining. The authors do not consider that the prospects of a power company would be very rosy.

A co-operative power station to supply a group of well-proved mines is a different proposition altogether and seems to be the solution of the problem.

HYDRAULIC MINING.

In hydraulic mining proper the ground is cut by jets of water projected by monitors under a natural head of from 50 to 400 ft., and the mixture if necessary elevated by hydraulic elevators to the sluice boxes where the treatment follows the procedure outlined under open cast mining. The hydraulic method is used on some of the largest properties in the country.

Where economy in the use of water is necessary, or where the ratio of head to lift is less than about 5 to 1, making the economical use of elevators out of the question, or where the total head would be unnecessarily high for the monitors, it is usual to install gravel pumps and to use part of the available head for generating electricity to drive these pumps, the remainder being used for the monitors.

The gravel pump is a centrifugal pump of special make provided with renewable liner and wearing plates, capable of raising any stone which can enter its open-ended suction pipe. Its efficiency is naturally not high; the combined efficiency of pump and motor works out at about 42 per cent., the mixture pumped being about 5 per cent. solid by bulk.

As an average the efficiency of pump and pipe work may be taken at about 38 per cent., as against 16.6 per cent. for the elevator.

A suction dredge consists of a centrifugal pump to supply a monitor jet, together with a gravel pump to elevate the mixture.

Given a certain water power, 28 per cent. more work can be done by employing the water power to generate electricity to drive gravel pumps than by using it for elevators.

The pump works with a shallow open sump and a suction lift of 15 ft. or so as a rule, and delicate speed regulation is necessary to keep the water level in the sump constant.

As three-phase current is generally used owing to convenience in distribution, it is the usual practice to drive the pumps by induction motors and to regulate the speed by rotor resistances. In some cases the motors are run at full speed and throttling pieces put in the delivery pipe, which has the effect of introducing artificial head, thus cutting down the delivery. Both these methods are, of course, wasteful, but it is probable that they will continue in use in preference to the use of direct current.

In the divided-volume system the cutting is done by jets of water under natural head directed on to the working face by monitors, the size of the jet being usually about 2 in. diameter.

The whole of the available pressure water is piped to the mine and there utilised partly to supply monitors and partly to generate electricity for the purpose of driving gravel pumps to elevate the mixture cut by monitors.

The extra amount of water available for cutting, and consequently the extra ground cut by substituting gravel pumps for elevators, is considerable.

The gravel pump is capable of a maximum lift of about 100 ft., although it loses efficiency, except in the largest sizes, at lifts much over 70 ft.; but pumping in two lifts by gravel pumps, where necessary, is hardly less efficient than pumping in one, whereas to use elevators in two lifts is an exceedingly inefficient process.

It is the usual practice where a high fall is available to use the first part of the fall for generating electricity, which is transmitted to the mine for driving gravel pumps. The remainder of the fall is used for monitors, and as of course all the water which passes the Pelton wheels in the electric power station goes on to the monitors, this may be called the divided-head system.

BUCKET DREDGING.

Bucket dredging is a form of alluvial mining which has become very popular in the Federated Malay States during the last few years, and will doubtless become more so, as the richer and more easily worked alluvial deposits become exhausted. By this means, low-lying tin-bearing land of low grade can be worked at a profit which would not be practicable by any other method.

At the present time 17 dredges are operating in the F.M.S., only one of which is driven electrically, so that with a cheap supply of power tin dredging should open a wide field to the electrical engineer. The best values are usually on limestone, so that the dredge and machinery must be of very robust construction to withstand the severe shocks which are of frequent occurrence.

TYPICAL INSTALLATIONS.

The most modern example of hydraulic-electric mining in the Federated Malay States is the Batu Karang mine of the Idris Hydraulic Tin Co., Ltd., which is worked entirely by gravel pumps driven electrically, the power for generating current and cutting purposes being obtained from water on the "divided-head" system.

The pipe line to the power house is 81 chains long and is designed to carry 400 to 450 cu. ft. of water per minute, the gross head being 955 ft. and the effective head 935 ft. The diameter of the pipe varies from 21 in. to 16 in.

The plant installed consists of two Pelton wheels, each of 700 B.H.P., 750 R.P.M., with governors of the oil-pressure type fitted with hydraulic automatic servo-motors operating combined needle nozzles and deflectors. These drive through flexible couplings two alternators, each of 450 KW., three-phase, 50 periods, 400 volts, with the exciter overhung on an extension of the alternator shaft.

A bank of three single-phase transformers raises the pressure to 3,000 volts for transmission.

The transmission line is 1½ miles in length and consists of bare copper wire, with an earth wire. The poles are of steel with cast-iron bases and buckled plates. The lightning

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arresters at each end of the line are of the horn type with powdered carbon "Brazil" resistances. These arresters in conjunction with the earth wire have been found to give good protection against lightning.

The water after leaving the Pelton wheels is discharged into the intake of the lower pipe line outside the power station.

The pipe line is 1½ miles in length, 16 in. in diameter, and a pressure of 170 lb. per sq. in. is obtained at the bottom of the mine where the water is used for cutting purposes with monitors.

The sub-station contains one bank of single-phase step-down oil-cooled transformers, each of 125 K.V.A. rating, 1,600/230 volts connected star-star, and one bank of single-phase transformers as above, but of 50 K.V.A. rating. The neutral point of each group of transformers is earthed through a resistance.

The total height from the bed-rock to the sluice box varies from 70 to 90 ft., and a double-stage system of working is arranged with gravel pumps. The larger gravel-pump motors are all provided with liquid controllers connected in the rotor circuit and capable of reducing the speed 50 per cent. continuously if required.

The Idris Mine is equipped throughout with electrical machinery of British manufacture.

At the French Kampar Mine most of the property is being worked on the suction dredge system. Power is generated in two stations, the original hydro-electric plant consisting of two horizontal radial outward flow turbines working under the unusually high head for this class of machine of 1,312 ft.

The Diesel station, which is quite close to the hydro-electric plant, houses a Diesel engine driving a 400-KW. alternator.

The total capacity of the two plants in parallel is 744 KW., but for ordinary running the Diesel is looked upon as a stand-by to the water power which is apt to run short at times. The pressure is 6,000 volts, three-phase, with insulated neutral.

Kampar is a town situated at the foot of a large range of mountains, and it experiences lightning storms of remarkable severity, hence the lightning arrester gear deserves attention.

At the power house end the gear is housed in a separate building, and comprises horn-gaps and water leaks. The former have a break of 5 mm. and a resistance consisting of a column of alkaline electrolyte contained in two open-ended earthenware tubes provided with electrodes. The water leaks are of the enclosed type consisting of two glass tubes in parallel, 800 mm. long and 14 mm. internal diameter, connected between each phase and earth. A continuous circulation of water is maintained through the tubes. Flat choke coils are placed in the power house.

At the sub-stations, horn-gaps with 7-mm. openings under cover with flat choke coils are installed on the high-tension side, the transformer neutrals being earthed on the secondary side.

This arrester gear gives good results except in heavy storms, when it is considered advisable to shut down. At the mine gravel and nozzle pumps are installed.

The Lahat Mines, Ltd., are a good example of open-cast working, the depth at the present time being 145 ft., but bores have been sunk to a depth of 250 ft. from the surface and the bedrock has not been reached.

The karang is raised to the puddlers in trucks up two inclines 600 ft. long, each served by a 40-B.H.P. electric winch. Power is also used for pumps and puddlers, energy being purchased from another mine.

The Tin Bentong Mine is being worked by an electrically-driven bucket dredge. Power is generated by a hydro-electric plant and transmitted 4½ miles to Bentong at 11,000 volts.

A unique feature of the installation is the use of water containing an abnormal amount of sand in suspension.

There is naturally a considerable amount of wear of nozzles, needles, and buckets, but the fact remains that the presence of considerable amounts of solid matter in water does not prevent its use with moderate spouting velocities.

The lightning arresters in the power house and sub-station are of the aluminium-cell type surmounted as usual with spark gap and charging device. Between each line and earth and between line and line there are two cells in series. This arrangement has worked well.

The connection from the shore to the dredge is made by a three-core cable. The cores are insulated with vulcanised india-rubber, laid together, and wrapped overall with five laps of varnished cambric; the cable is then served with compounded jute and armoured with galvanised iron wire. The weight of the cable is taken by barrels floating in the dredge paddock.

LOCAL CONDITIONS.

The authors draw attention to certain details in the specification of machinery which, often disregarded entirely, are of vital importance.

The climate of the Malay Peninsula is moist and hot, the shade temperature rarely exceeding 90 deg. F. The rainfall varies from 90 to 130 in. for the year.

It is not advisable to generate at a higher pressure than 2,200 volts, owing to the rapid deterioration of insulating materials due to the moisture-laden atmosphere.

For transmission so far 11,000 volts is the highest pressure in use. For higher voltages special precautions would probably be necessary on account of the dampness of the atmosphere.

For new installations the authors recommend a voltage of 400 at motor terminals for a three-phase alternating-current system.

It is a common sight to see motors, which have been rated on the assumption that they would be used in a temperate climate, working continuously up to their full load as marked on the name plate, and even at overloads; this accounts to a great extent for the large amount of rewinding that has to be done. The temperature of the air should be taken as 95 deg. F. under cover, and the following temperature-rises should not be exceeded: Generators and motors after six hours' run at full load, 63 deg. F.; motors driving intermittent loads after one hour's run at full load, 70 deg. F.

The water-tube boiler is most suitable. The use of the marine type with steel casing would probably be an advantage, as neither material nor labour for brickwork is good. A type using one length of tube only is advisable.

Turbines are being used for plants of 500 KW. and over. Larger condensers will be required than in England as the temperature of the cooling water will be about 86 deg. F. to 90 deg. F. The most suitable high-pressure switchgear is the totally enclosed ironclad sliding-carriage type. It must be insect and lizard proof, all ventilating holes should be covered with fine gauge wire netting, and all instruments should be enclosed. For low and medium pressures the ordinary marble-panel central-station type is quite satisfactory.

For high pressures multicore paper-insulated lead-sheathed armoured cable should be used. For low and medium pressures rubber-insulated cables may be used.

In view of the difficulty of drying out transformer windings after they have been immersed in oil, moderate sizes should be shipped in oil from the factory. Air-cooled transformers are not desirable.

For transmission lines steel poles are advisable, wooden poles of the necessary length being expensive and hard to obtain. With steel poles an earth wire is essential.

At certain periods of the year thunderstorms are of frequent occurrence, and lightning is very severe in some localities. Protection for overhead lines can best be obtained by:—

1. The use of step-up and step-down transformers for all but very short lines and by heavily reinforcing the insulation of the transformer coils nearest to the line, in conjunction with arresters of the horn type with carbon resistance in series with the earthed horn, or with electrolytic arresters.
2. An earth wire above the power wires, earthed at frequent intervals.
3. Earthing the neutral point of the generator and step-down transformer on the low-tension side.

In no case within the authors' knowledge where step-up and step-down oil-cooled transformers have been used, has damage by lightning been experienced other than to the line; on the other hand, in those plants where air-cooled transformers have been used or the generators have been connected direct to the line, failures of transformers, switchboard instruments, and generators, have invariably occurred even where earth wires have been used.

For lighting circuits a voltage of 230 must not be exceeded, and this may best be obtained from a small transformer; if single-phase, the centre point of the winding should be earthed, if three-phase the neutral point. The voltage between any two wires should not exceed 230. There have been several fatalities due to shock on alternating-current lighting circuits where the potential to earth was 230 or over.

Mine distribution is invariably effected by overhead wires on hard wood pole lines, the minimum height being nominally 18 ft. Connections between lines and switchgear are made by rubber cables, bare wires not being allowed within 7 ft. of any building. Rubber insulation lasts about 18 months if exposed to the weather, but so far no satisfactory substitute has been found to replace it; probably three-core rubber-insulated armoured cable would last longer, as the rubber would be shielded from the direct rays of the sun.

The only type of mine switchgear that can be called safe is the totally enclosed interlocked ironclad type. No-voltage and overload releases should be fitted in all cases. All iron work and motor frames must be earthed, and usually this means an earth plate to every motor.

Motors wound for voltages above 500 are not necessary for the majority of mining work, and, except in large sizes, are undesirable.

Former-wound stator coils should be used in preference to hand-wound. With semi-closed slots it has been found that coils of the "cut and push through" type are the most satisfactory. The slot insulation of all former-wound coils should be of mica moulded on to the coil after winding, the coil being treated under vacuum with a suitable impregnating solution before being placed in position in the slot.

Trouble with hand-wound coils has been frequently experienced, more especially in high-voltage motors, due to the difficulty of packing the wires tightly inside the slot and excluding air.

Manufacturers also frequently wind the coils so that the end turns are adjacent and have to withstand the full voltage of the coil.

Where speed regulation is specified, brushes and slip-rings should be of liberal design, and the latter should be well spaced to prevent short-circuits in starting. The most satisfactory type of resistance is the cast-iron grid, trouble having been experienced with liquid resistances.

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The connections between switch-panel and starter and between rotor and resistances are best made by three-core armoured cable equipped with sealing boxes, but single-core rubber-insulated cable if properly protected is quite satisfactory for medium pressures.

Winches should be of the double-drum variety with motor, resistances, switches, and tramway-type controller mounted on a bedplate of structural steel, the whole arrangement being as portable as is consistent with strength. The best arrangement is to mount driving spur wheel and band brake between the drums; this, without unduly increasing the width of the winch, gives the drums a wider pitch. The pitch of the rails is usually from 4 ft. 6 in. to 6 ft. 6 in., and a drum pitch of 3 ft. 9 in. gives good results.

As a high-speed puddler runs at 120 R.P.M. it is usual to employ a single-reduction back-geared motor in conjunction with a belt drive, a flywheel being generally used to help the motor at the moment the karang is dumped. Gears should run in an oil bath, otherwise owing to the dust and grit which is always about they become intolerably noisy.

The centrifugal pump is invariably used, as the water pumped contains grit in all cases. Purchasers of pumps should obtain characteristic curves for each pump they purchase.

When the alluvial deposits have been turned over and over by processes of increasing efficiency until their valuable contents have been exhausted, a time will come when lode mining will receive more attention.

As lode mining is sure to be carried out by European companies in future, we may look forward to the time when there will be a fairly heavy demand for electrical power from this source.

The engineering problems in lode mining are practically similar to those encountered in gold mining.

Finally, the authors urge all mine managers to install proper recording instruments, and to keep accurate records of power costs as a matter of routine; by omitting to do so one of the advantages of the electric drive is thrown away.

NEW PATENTS APPLIED FOR, 1919.

(NOT YET PUBLISHED.)

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32,040. "Methods of transmission with alternating-current systems." A. M. TAYLOR. December 22nd.
32,044. "Sparking plugs." C. E. PERKS. December 22nd.
32,060. "Telegraph and telephone insulators." E. D. M. SCRIVENOR and TAYLOR, TUNNICLIFF & Co. December 22nd.
32,064. "Electrical coal-cutting machines." HUNTER & JACK, W. A. JACK and F. A. SCOTT. December 22nd.
32,066. "Automatically-operated electric switches." P. S. BROOK and J. A. HIRST. December 22nd.
32,080. "Production of electric oscillations for radio telegraphy or telephony." F. S. CHAMBERS. December 22nd.
32,090. "Protective devices for electric circuits." BRITISH THOMSON-HOUSTON Co. (General Electric Co.) December 22nd.
32,109. "Sparking plugs." O. G. NEAT and W. S. SHEPHARD. December 22nd.
32,132. "Manufacture of plates or sheets by electro deposition." S. O. COWPER COLES. December 22nd.
32,136. "Ionic valves." G. HOLST and NAAMLOOZE VENNOOTSCHAP PHILIPS GLOEILAMPENFABRIEKEN and E. OOSTERHUIS. (Holland, December 31st, 1918.) December 22nd.
32,138. "Controlling means for carburetters, magnetos, &c." O. H. DYKE and L. A. ROBERTS. December 22nd.
32,164. "Electrical heater for wells." D. DIVER. December 23rd.
32,194-5. "X-ray apparatus." BRITISH THOMSON-HOUSTON Co. (General Electric Co.) December 23rd.
32,197-9-10. "Electric lamps." W. R. BULLIMORE. December 23rd.
32,006-7. "Sparking plugs." C. M. HORN. December 23rd.
32,206. "Trip mechanism for electric-ignition devices for internal-combustion engines." A. J. ADAMS. December 23rd.
32,231. "Manufacture of dry batteries for pocket lamps, &c." M. ZEILER. December 23rd.
32,244. "Thermionic valves." H. ST. J. DE A. DONNISTHORPE. December 23rd.
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32,289. "Electric switches, &c." J. P. ANNACKER. December 24th.
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32,311. "Electric vaporiser." G. ENGLAND. December 24th.
32,327. "Electrically-operated mechanism for driving clockwork trains, &c." F. HOLDEN. December 24th.
32,328. "Engine starters." V. BENDIX. December 24th. (U.S., December 19th, 1917.)
32,346. "Electric circuit controllers." F. BECHOFF. December 24th.
32,371-3. "Electric arc lamps." F. BOARDMAN, F. R. BOARDMAN and R. V. BOARDMAN. December 24th.
32,372. "Reflectors for electric, &c., lamps." F. BOARDMAN, F. R. BOARDMAN and R. V. BOARDMAN. December 24th.
32,374. "Shades, globes and reflectors for electric, &c., lamps." J. MASON. December 24th.
32,392. "Sparking plugs." E. F. BURRILL and S. E. GRUBB and T. E. NANKIVELL. December 24th.
32,393. "Reception of electro-radiant energy." F. A. KOLSTER. December 24th. (U.S., March 31st, 1916.)
32,404. "Portable electric lamps." A. COHEN, H. W. MILLER and F. ZSINKOVITS. December 24th.
32,405. "Telegraphic wireless systems." H. J. DRANE, B. FRANKLIN and A. T. M. JOHNSON. December 24th.
32,409. "Magnetic separators for treating ferrous ores." F. QUINONERI. December 24th.
32,411. "Transmissions of electro-radiant energy." F. A. KOLSTER. December 24th. (U.S., November 27th, 1916.)
32,413. "Aerial systems for wireless signalling." S. B. SMITH and G. M. WRIGHT. December 24th.
32,415. "Reception or transmission of electro-radiant energy." F. A. KOLSTER. December 24th. (U.S., January 30th.)
32,425. "Housings of electrical switchgear." A. H. CURTIS and IGRANIC ELECTRIC Co. December 24th.
32,450. "Electric heaters." H. F. MACLAUGHLIN and SIMPLEX CONDUITS, LTD., and L. M. WATERHOUSE. December 29th.
32,451. "Electric switches, circuit breakers, &c." V. HOPE. December 29th.
32,452. "Electric switches." V. HOPE. December 29th.
32,454. "Telegraph printing systems." AUTOMATIC TELEPHONE MANUFACTURING Co., H. H. HARRISON and S. R. SMITH. December 29th.
32,474. "Automatically-adjustable ignition for internal-combustion engines." HORSTMANN CARS, LTD., and S. A. HORSTMANN. December 29th.
32,491. "Electric liquid heater." A. E. KALLAGHAN, C. A. KALLAGHAN, T. KALLAGHAN, and J. A. SMITH. December 29th.
32,495. "Telephone receivers, transmitters, &c." S. HOCKLY. December 29th.
32,517. "Duplex cable signalling." L. COHEN. December 29th.
32,533. "Commutators for Ford car engines." A. E. LAMKIN. December 29th.
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32,576. "Magnetos." AMERICAN BOSCH MAGNETO CORPORATION. December 29th. (U.S., February 20th.)
32,588. "Regulating mechanism for electrical insulators." SOC. ANON. DES ETABLISSEMENTS L. BLERIOT. December 29th. (France, December 28th, 1918.)
32,597. "Magnetos for multi-cylinder engines." AMERICAN BOSCH MAGNETO CORPORATION. December 29th. (U.S., March 27th.)
32,611. "Mounting blades on the electric, &c., fans." W. S. BULPITT. December 30th.
32,624. "Apparatus for electric welding." R. F. WOODBURN. December 30th.
32,654. "Sparking plugs." W. A. HARBER. December 30th.
32,658. "Apparatus for electrically-controlling railway trains through the track." A. R. ANGUS. December 30th. (Sweden, October 10th, 1917.)
32,670. "Electro-mechanical devices for producing vibratory motion." H. J HANKEE. December 30th.
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32,732. "Control of crane hook motions actuated by alternating-current electro motors." H. MORRIS, LTD., and W. N. WESTON. December 31st.
32,753. "Electric fans and the like." J. B. MALPASS (Pottle). December 31st.
32,763. "Electrodes for oxidising nitrogen." F. H. LORING. December 31st.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1917.

3,604. ELECTRIC CABLES. C. J. Beaver and E. A. Claremont. March 12th, 1917. (135,874.)

1918.

17,429. IGNITION APPARATUS FOR INTERNAL-COMBUSTION ENGINES. American Whaley Engine Co. November 2nd, 1917. (120,887.)
18,072. ELECTRO-MAGNETIC WAVE TRANSMITTING AND RECEIVING SYSTEMS. P. D. Eckersley. May 5th, 1919. (135,895.)
18,076. ELECTRO-MAGNETIC WAVE NAVIGATIONAL ARRANGEMENTS. J. E. Murray and J. Robinson. November 4th, 1918. (135,896.)
19,906. METHOD OF AND APPARATUS FOR THE CONTROL OF ELECTRIC SUPPLY PLANT. H. J. Read and W. J. Brandsom. December 2nd, 1918. (135,922.)
19,955. ELECTRICAL EQUIPMENT OF MOTOR VEHICLES. W. A. Cocking and W. E. Hean. December 3rd, 1918. (135,926.)
19,985. ELECTRIC VAPORISERS AND HEATERS. Electro Steam Radiator Co. November 30th, 1917. (121,285.)
20,004. WIRELESS RECEIVING GEAR. British Thomson-Houston Co. and R. C. Clinker. December 3rd, 1918. (135,932.)
20,178. ELECTRICALLY-PROPELLED TRUCKS, TRACTORS AND LIKE VEHICLES. P. A. H. Mossay. December 5th, 1918. (135,951.)
20,241. ASSEMBLING AND SUPPORTING TUBULAR POSTS FOR CARRYING ELECTRIC INSULATORS. L. Joubert. December 6th, 1918. (135,953.)
20,650. ELECTRIC HEATER FOR AUTOMOBILE RADIATORS AND WATER STORAGE TANKS. J. D. Browder. December 11th, 1918. (135,964.)
20,910. ELECTRIC RINGING KEYS. J. Davis & Son and G. Dearle. December 16th, 1918. (135,971.)

1919.

139. ELECTRIC IGNITION SYSTEMS FOR INTERNAL-COMBUSTION ENGINES. Dayton Engineering Laboratories Co. January 2nd, 1918. (122,184.)
806. ELECTRICAL EARTHING DEVICES. R. S. Woods. January 11th, 1919. (136,002.)
1,266. COMBINED ELECTRIC SWITCHES AND PLUG CONNECTORS. M. J. Railing, J. H. Farthing and J. B. Levee. January 17th, 1919. (136,006.)
1,752. LAMP SHADE TILTING DEVICES. A. S. Cubitt. January 23rd, 1919. (136,012.)
2,145. VARIABLE RESISTANCES PARTICULARLY ADAPTED FOR USE IN ELECTRIC WELDING. Quasi-Arc Co. and A. P. Strohmenger. January 29th, 1919. (136,016.)
2,569. IGNITION OF INTERNAL-COMBUSTION ENGINES. C. H. T. Alston. February 1st, 1919. (136,022.)
3,024. STORAGE BATTERIES FOR ELECTRICITY. G. F. Cooke. February 7th, 1919. (136,026.)
3,555. ELECTRIC ARC FURNACES. W. E. Moore. February 13th, 1919. (136,034.)
7,498. RADIO-TELEGRAPHIC TRANSMISSION SYSTEMS. W. J. Mellersh-Jackson. (A. Taylor.) March 25th, 1919. (136,059.)
8,085. MACHINES FOR USE IN THE MANUFACTURE OF ELECTRIC INCANDESCENT LAMPS AND THE LIKE. British Thomson-Houston Co. (General Electric Co.) March 31st, 1919. (136,062.)
10,755. MANUFACTURE OF MANGANESE AND ITS ALLOYS IN THE ELECTRIC FURNACE. C. L. Lenoir. January 8th, 1914. (126,303.)

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A RED RAG TO JOHN BULL.

FOR a long time past it has been obvious to everybody interested in export trade matters that, though we and our American Allies worked together as one people in order to win the war, that spirit of unity would be in danger of extinction when we settled down to the operations attending post-war trade competition. To the idealist it may seem a thousand pities that it should be so, and even to average commercial minds it may appear that the world-need for manufactures is so great that for a time, at any rate, there will be enough for all to do without indulging in big talk reviving former asperities and causing irritation to those easily influenced by such things. Personally, we have become so accustomed to the extravagant statements of ambitious advocates in other countries, European and otherwise, as to their lick-creation intentions, that we decline to quake at the utterance thereof. In this, we confess to something in common with the President of the Board of Trade, who declines to "shiver" at the prospect of foreign competition. Foreign competition is going to be keen—there is no doubt about that, and it seems certain that, sooner or later, British manufacturers, if they have the support of the workers, are going to do their part to make it so. Have not our industrial organisations been preparing for a long time, so that they might be equal to the attack when it came? And are they not preparing also to deliver attack when the situation requires it? Yet though there is this preparation proceeding in many countries, it seems to us that it might be a little more gracious on the part of some people if, in these early days, they were a little less aggressive. We recognise that in all nations there will always be some who will be unable to refrain from dreams of exercising world-power commercially. Sometimes, as in Germany during certain stages of the downfall of Prussian Militarism, statements designed to make our British blood run cold were made by men whose idols now lie broken into fragments. Much of this sort of thing was mere camouflage to hide the fear that they were losing. Is it likely that we shall be upset by what we will call the bad taste of some of our prosperous trans-Atlantic industrial friends?

We are not concerned, in making these remarks, with the world schemes of United States electrical export organisations that have been established to satisfy some of the general hunger for electrical manufactures, for we have not come across tactless speeches from these sources expressive of world-power intentions. We are touching the subject now because correspondents in New Zealand are showing signs of anger at the utterances of a certain Mr. Montague, who "bears the discredit of having framed" the "Webb-Pomerene Act passed by the U.S. Legislature" in 1918. This Act, to which we alluded at the time, was intended to exempt American foreign trade combinations from the provisions of the Anti-Trust Legislation of the U.S. Mr. Montague has been addressing certain textile authorities, textile traders having decided to avail themselves of the Act and put up £4,000,000 to "carry on." Nobody can object to that, even if it does, as a New Zealand paper says, enable them to employ "all the iniquitous dodges conceived by the most scoundrelly of trust magnates, and which would place them behind prison bars if attempted in their own country . . . . in an endeavour to throttle competition." It is a game that two, or three, or even twenty, can play if they are so minded—deplorable as it seems after we have fought side by side for higher purposes on the battlefields of Europe. What we do take mild exception to, is such talk as this from Mr. Montague, or any other American world-power hot-head:—

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"We have provided the machinery by which the whole of the energy, the wealth, and the brains of each American industry, will co-operate to crush down foreign opposition in foreign markets, and secure those markets in their entirety for American manufacturers."

If this were the first time we had heard this sort of thing, we *might* have to think whether to obey the popular demand "Hands up!" while the brigand bagged the booty. As it is, however, we prefer to order pistols for two—that is more like the British way. Mark the hurry and hustle of this American booster! Fancy the American trade being deprived of *all the energy* and *wealth*, and even the *brains* too, now required to run its Home industries, because they are to be diverted to crush out a few poor innocent, helpless, stupid foreign worms "in their entirety." And after that? "We will tack the cost of it all on to the price," and make the "foreigner" pay, said one, Steenbohm by name.

Shall we be pardoned for daring to remember that our trans-Atlantic cousins got into our markets, and became prosperous right there, while we were at death-grips exhausting Germany? Can it be that something has disappointed those of whom Mr. Montague and Mr. Steenbohm are representative? Is the outlook not so promising as they expected it to be? Are the stars in their courses not leading all the buyers of the world in the right direction? Without waiting to witness the blush of shame—or pride—on the cheek of Brother Jonathan, let us hasten to credit our splendid Ally with a desire to continue to dwell in normal harmonious commercial rivalry with other peoples—Peace Treaty or no Peace Treaty—and let us regard Mr. Montague's outburst as an exceptional, but, perhaps, inevitable, pleasantry heralding the beginning of the biggest trade war the world has ever seen.

Manufacturing Costing Systems.

In his recent paper before the Institution of Electrical Engineers on "Scientific Management," Capt. Scott Maxwell drew attention to efficient costing systems as an essential feature of scientific management. The point, however, did not receive much attention in the discussion, perhaps for the reason that the author himself asked that principles should be concentrated upon by the various speakers, rather than details. The importance of efficient costing systems and staffs, however, is emphasised by the inauguration of the Institute of Costs and Works Accountants. This is not a Trade Union, but an addition to technical societies of considerable importance to the engineering and other industries, for it is its object to promote the higher efficiency of those engaged as works accountants in order to render them more valuable to their employers. In spite of all that has been said and done with regard to scientific management, there is evidence that the importance of the position of works accountant is too often under-estimated in relation to its value in assisting the management in framing its policy. Moreover, it is not recognised as fully as it should be that costing is an intricate and costly business, which needs some knowledge of the particular industry in order effectively to carry it out. Many firms have formulated new ideas on this question as the result of experience gained during the war, when costing had to be approached from quite a different angle to that which was followed previously, and these firms are not likely in future to hand the work of costing over to any clerk, as is even now too often the case. The engineering trades may well investigate what the printing trade has done in this connection. Several years before the war it was found that the costing system in the printing trade was more or less in a hopeless muddle, and some of the leading firms got together and formulated a costing system which has now been standardised to such an extent, that it is claimed it can be applied to any business, whether the number of employés be three or three thousand. Obviously the primary function of the works and costs accountant is to provide the works manager or the managing director, or both, with periodical figures of the cost of the various products in the firm's programme, in order to assist in the formulation of a policy. Indeed, the works accountant should be looked to for advice in interpreting what his figures purport to show. Looked at from this point of view, it will be seen how separate and distinct are the works accountant and the chartered accountant, yet this is not always appreciated, for the so-called works accountant, if he goes by such a name, is too often expected to work under the direction of the chartered accountant, who merely comes in half-yearly or yearly, for audit purposes. Moreover, the experience of many firms during the war was that even chartered accountants are not always *au fait* with the intricacies of works costing in its highly-developed state, for many were the disputes with the Government chartered accountants concerning the ever-vexed problem of overhead charges. There is, too, a certain irony in the fact that in America, the reputed home of scientific management, there was even greater trouble than here between the Government chartered accountants and firms working on Government contracts on these questions of the proper allocation of costs in arriving at total costs for the purpose of adding the agreed rate of profit. Perhaps, however, it would be unfair to lay these difficulties too much at the door of the chartered accountants and to overlook altogether the idiosyncracies of the other side, which may reasonably be suspected of indulging in a little leg pulling, in order to run up the costs, and, consequently, the profit. However, looked at from the purely commercial point of view, no firm with any pretensions to scientific management can expect to reach the highest state of efficiency without a sound works accountant, a man who knows something of the technical side of the business he is engaged in, and who can offer advice which can be relied upon. So much for the position of works accountant. The question of the system to be adopted is equally important, and in the engineering trades at the present time there is need for co-ordination and standardisation. This is one of the planks of the new Institute, which is out to deal with industry by industry in an endeavour to introduce some degree of standardisation, in so far as it is not affected by peculiar local circumstances. We have the example of the printing trade before us, and a large field for work lies before those who have undertaken this task.

Electricity Supply.

It is unfortunate that writers in the lay Press on technical subjects often do not take the trouble to make sure of their facts before they plunge into the ink-pot. We have on many occasions pointed out the injury that may result from the erroneous impressions thus conveyed to the public mind, but examples continue to multiply. For instance, in *The Times Trade Supplement* a contributor states that the Electricity (Supply) Bill was divided into two parts: the first part gave complete autonomy to the existing undertakers, while the second took it away from them, and also deprived them of the ownership of the generating stations. The former has become an Act; the latter, it is stated, will be reintroduced next session, and "autonomy will be cut short the moment the new Bill becomes (if it ever should become) an Act." We recently explained at some length that this was not a true statement of the facts. Certainly the first part is more or less true; undertakers have a free hand to co-operate in the formation of joint electricity authorities, on which they will have direct representation. But to say that "autonomy will be cut short" in the event of the new Bill being passed, is incorrect; such joint authorities as are then already formed will be practically unaffected by the new Act, and the way will still be open for others to be formed, with the additional incentive of the sword of Damocles hanging over the parties, lest they should prove reluctant, or unable, to enter into co-operative arrangements by voluntary action. We agree, of course, that it is very urgently desirable that undertakers should "get busy" as quickly as possible with joint schemes; it is far better to do so voluntarily than under compulsion. But we repeat that, even had the whole Bill become an Act, the door would still have been open for companies to enter into arrangements with other undertakers, and to dispose of their plant to the joint electricity authorities by agreement, without coming under the "standard price" clause at all.

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Industrial Organisation.

AT the end of October last there was published, under the auspices of the Garton Foundation, a most interesting pamphlet of considerable importance in the present position of the world of industry. It is called "The Industrial Council for the Building Industry," and purports to contain what is described as "the story of a revolution in industrial development," together with the full text of the Foster Report on "Organised Public Service in the Building Industry."

It is to be hoped that this well-written pamphlet, of 153 pages, published at the modest price of 1s., will be widely read. It will afford leading to those who hope for a real change of heart on the part of both employers and employed, and encouragement to those who are groping towards the light; while even those (and they exist on both sides) who believe in coercion and industrial war as affording the only path to improvement cannot fail to be impressed by the results which have already been achieved, and the greater advances which appear probable in the immediate future.

The inaugural meeting of the Industrial Council for the Building Industry (Building Trades Parliament) took place at the Central Hall, Westminster, on May 29th and 30th, 1918. Thus it was established before any of the Whitley Committees or Councils, and, indeed the whole conception of the scheme was bigger, better, and earlier than Whitleyism.

The spirit of aggression and stubborn resistance, the advocacy of coercion, and the preaching of open enmity between employers and employed, had reached a point in 1914 at which the smallest spark might cause a disastrous explosion. The employment of two non-Union electricians at the new offices then being built for the Pearl Assurance Co., in Holborn, brought out all the Trade Unionists engaged on that contract. The Board of Trade arbitrator pronounced against the Unions, and the strike began. A national lock-out of all building trade operatives would have been commenced on August 15th of that year, but for another and infinitely greater and more terrible conflict.

A young man, named Malcolm Sparkes, who was then a director of a large joinery works near Willesden, was one of those who had been drawn into the dispute, and he was moved thereby to try to discover, in his words, "a solution big enough to break through the old barriers of hostility and suspicion, and carry all before it." For 18 months the only concrete result was an unnoticed paper read before a group of friends, who were all keen social students, but when, in February, 1916, the Unions in the London building industry presented fresh demands, and gave notice to terminate their truce with the employers, Mr. Sparkes took the bold course of writing to the secretary of the Amalgamated Society of Carpenters and Joiners, and suggested, in plain terms, the setting up of a National Industrial Parliament for the building industry. The keynote was to be public service. All were to unite their efforts, and endeavour to organise the industry so as to serve this end in the completest possible way.

The Trade Unions concerned discussed the matter, and eventually made a definite proposition to the National Federation of Building Trades Employers of Great Britain and Ireland, in a letter dated January 17th, 1917. How that letter brought about meetings, negotiations, and discussions, which led finally to the establishment of the Building Trades Parliament, should be read in the pamphlet now under consideration. It will be found an enthralling story.

Mr. Sparkes had published an article on the Industrial Parliament scheme in *The Venturer* for December, 1916, which attracted the attention of the Right Hon. J. H. Whitley, M.P., and caused him to request the author to prepare a special "Memorandum on Industrial Self-Government," which reached the printers on January 28th, 1917.

The scheme was earlier than the Whitley scheme. Bigger ideas went to its making. It was, and is, free from the defect we have so often pointed out in these columns—the defect of ignoring the trained technical worker. He finds his right place in the Building Trades Parliament. If you want to know how, read the pamphlet.

It is a great pity that the shop stewards' movement in the engineering industry seems to be based on organised antagonism. By continually encroaching on the control, first of the workshop, then of the factory, and, finally, of the administration and costing, the workers hope to eliminate the capitalist employer. The pamphlet states that the Industrial Parliament has, on the other hand, been described as organised voluntaryism (barbarous word—why not "voluntarism"?). Surely this is the better method.

The ground covered by the Foster Report is immense. The report deals with subjects upon which we have commented on other occasions, and in connection with other interests; as, for instance, the maintenance of constancy of employment by the regularisation of demand, and the conditions of entry into the industry. The decasualisation of labour, and the provision of work in other directions when actual building could not absorb all the workers available—afforestation, preparation of sites, demolition of condemned slums—receives careful attention. Research, education, remuneration of the management, and the hiring of capital are all dealt with, and the Committee's conclusions provide much food for thought. The vexed question of scientific management, by some thought to be closely allied to nigger-driving, is touched upon; and in general this Committee, composed of eight employers and eight operatives, got right away from the idea of restriction of output, and showed that the way to progress is for everyone to do just the best of which he or she is capable.

"To See Oorsels."

THE prime motive of the "Informal Meetings" of the Institution of Electrical Engineers is, we believe, to encourage the more diffident—or the less self-assertive—of the members to practise the art of debate, with the comfortable consciousness that their remarks will not appear in cold print. That is an excellent arrangement, and has been justified by the success of the meetings, though the principle has not always been strictly observed by some of our contemporaries. We have already drawn attention to the peculiar choice of subjects for the informal meetings of the current session, which would appear to indicate the presence of an undue proportion of the journalistic element on the Managing Committee, with a morbid propensity for "talking shop"; how else can we explain the choice of "Engineering Advertising" for one meeting, and "The Functions of a Trade Journal" for another? Perhaps the title of the former subject, in spite of the principle to which we have referred, contains the solution of the mystery.

However, that is by the way; the subject is chosen, and on Monday next we shall sit at the feet of Gamaliel and receive instruction as to the place in the cosmos that we are expected to fill. Are we to appear before the Court of Public Opinion as witnesses, defendants, or, perhaps, co-respondents? or shall we merely occupy the congenial *rôle* of students? Like Councillor Kelly, at the M.T.A. Conference, we are tempted to ask: "Where do we stand?"

Fortunately we have a clear conscience, and even if we have ventured to open our columns to articles on the commercial value of "The Engineer's Wife," and the converse question—the commercial value to his wife of the engineer—we have committed no breach of decorum in the handling of those delicate subjects.

For the rest, assuming that we are in the witness-box, our proof of evidence is simple and concise: The functions of a trade journal are to collect and distribute news and information, technical, social, and commercial, bearing upon the industries concerned; to provide a medium for the interchange of views and the solution of industrial problems; to make known to the world the products and achievements of British manufacturers and engineers; to protect the public against the wiles of knaves and the illusions of the ignorant; and generally to promote the welfare of every branch and section of the industry concerned by every possible means.

Those are the main functions of a trade journal as we understand them; there are many minor ones that we could cite, but we are not writing a paper—no doubt they will receive attention at the meeting.

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THE ELECTRIFICATION OF THE MELBOURNE SUBURBAN RAILWAYS.

(*Concluded from page* 40.)

Rolling Stock.—The trains are operated on the "multiple unit" system, under which, instead of employing locomotives, every second or third car is equipped with motors; the weight of these cars is thus available for adhesion purposes. A complete train (fig. 8) is made up of a number of motor-cars and trailers, easily varied to suit the changing conditions of traffic.

In the case of Melbourne, while it was at one time intended to make up each "unit" of a motor-car and a trailer, both equipped for driving from one end, only a limited number of trailer cars have, for the present, been equipped with driving apparatus. The normal six-car train has a motor-car at each end, with a third motor-car at the centre of the train. No special type of car has been designed for Melbourne, the existing rolling stock being as a rule utilised. Some 45 per cent. of the rolling stock will consist of compartment cars with swing doors, the remainder being of a combination type, having sliding doors and cross-seats, with a corridor.

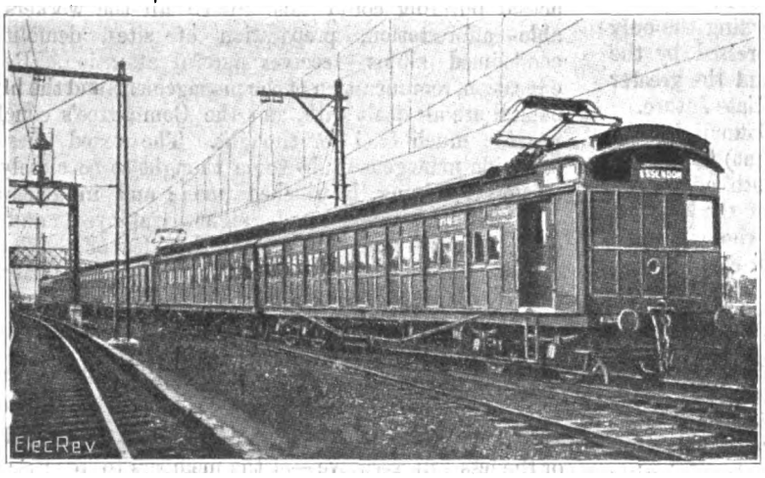

FIG. 8.—SIX-CAR SLIDING-DOOR TYPE TRAIN.

As no new swing-door cars are being constructed for the electric lines, the bodies of the existing cars are being transferred to new underframes and bogies of a type uniform with those used in the sliding-door cars. Some of the sliding-door trailer cars have also been running in the steam service, but new sliding-door motor-cars are being constructed for the electric service. The swing-door cars are very similar to those used on British railways. The sliding-door cars have a centre passage-way throughout, but no vestibule, so that it is not possible for passengers to pass from one car to another. The whole of the rolling stock was built in the State Railway workshops at Newport.

Each motor-car has four motors of 140 H.P., the gear ratio being so proportioned that the maximum speed will be 52 M.P.H. on level tangent track. They are of the G.E. 237 type, normally for 750 volts.

The total pressure of the pantograph on the contact wire is such that, with a reasonably clean wire, the pantograph is able to collect considerably over 500 amperes, which is the normal maximum operating current for each motor coach, without sparking, from a contact wire of 0·25 sq. in. cross-section. The pantograph has a working range between 14 ft. 6 in. and 21 ft. 6 in., the working pressure being maintained by means of springs. It is brought into and taken out of action by pistons in cylinders mounted on the frame of the collector, fig. 9. Air pressure for the initial operation of the pistons is supplied, in the first instance, by a hand-pump installed in the guard's compartment; the motor pumps can then be started up, and the subsequent air pressure obtained from the main brake reservoir. The pantograph is then controlled by means of two electro-pneumatic valves operated electrically or by hand.

In order to reduce the line voltage to one suitable for the master-controller and other control circuits, a dynamotor is used consisting of a single field, and an armature with two identical armature windings and commutators.

The master-controller is of standard type, but as the actuation of the contactors is automatic, the controller only has four points in the forward direction and two in the reverse direction. The air compressor, governor, emergency and trip valves are of the usual type.

Permanent Way.—The system consists of approximately 335 track miles, including sidings; most of the routes are double track, but those from South Yara to Caulfield, and North Melbourne to South Kensington, are four-track routes, while for three miles there is a six-track route. The normal permanent way construction is 100 lb. per yard, T-section rail double spiked to untreated sleepers of hard wood, there being about 15 in. of bluestone ballast. The track gauge is 5 ft. 3 in., with 11 ft. 8 in. centres, while minimum structure clearance above platform level on tangent track is 7 ft. from track centre, increased to 8 ft. on 12-chain curves. The minimum curve is of 9 chains radius, while the maximum grade of any importance is one of 2 per cent. For nine miles the average grade is 0·85 per cent., the maximum permissible speed on this section being 52 M.P.H. Practrically all curves have a 150-ft. easement approach.

Overhead Equipment.—The equipment of the track with overhead contact wires for operation at 1,500 volts was designed to provide the advantages of a flexible construction which would secure the best conditions for current collection by the pantographs on the trains and to maintain the total copper section required per track without auxiliary feeder cables. The number of conductors was kept at a minimum in order to avoid interference with signals, only one catenary wire and one contact wire being employed over each track, fig. 10. The supporting droppers between the catenary cable and contact wire are terminated at the lower end by a short length of chain, so that the tendency of the contact wires to lift under the

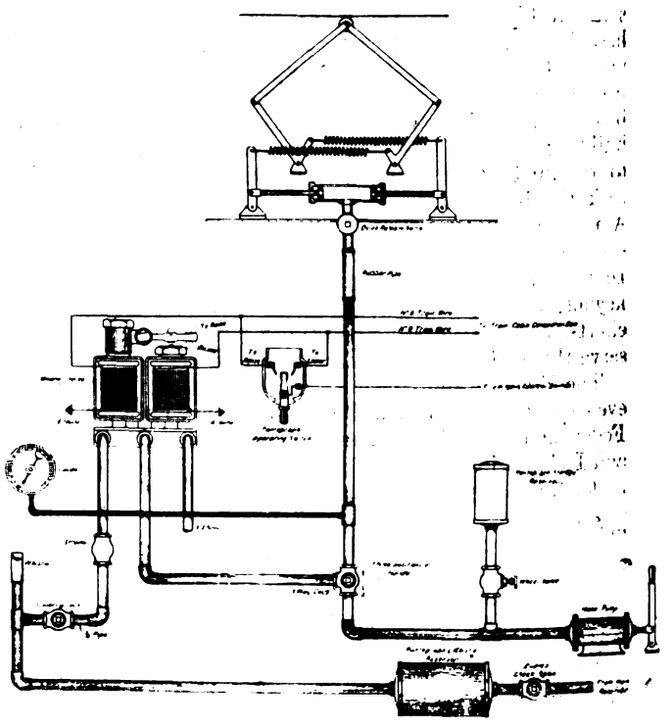

FIG. 9.—PANTOGRAPH.

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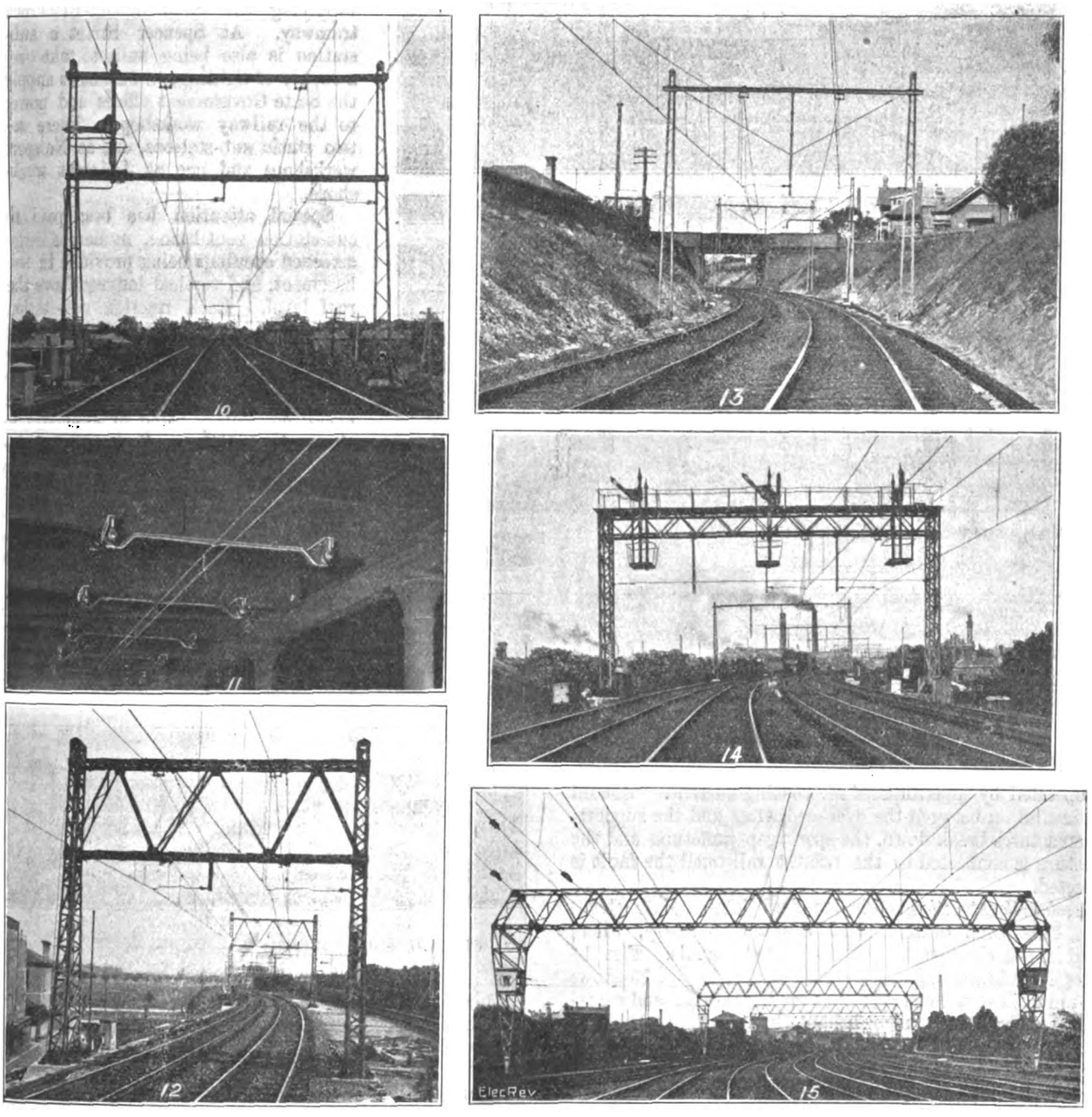
upward pressure of passing pantographs is not restricted by the weight of the dropper or of the catenary cable to which it is attached at the upper end.

The normal construction on main suburban tracks provides for 0·25-sq. in. hard-drawn, grooved copper contact wire, supported by flexible droppers at intervals of 15 ft. from a stranded hard-drawn copper cable of 0·25 or 0·375 sq. in. There is thus a minimum equivalent of 0·5-sq. in. section of copper over each track. The contact wire is automatically tensioned at each end of each 3,000-ft. length to approximately 2,500 lb., and is anchored near the centre of every such length. The catenary wire normally has a 10 ft. 9 in. sag at the centre of a 300-ft. span at 60° F., with a minimum tension of approximately 3,200 lb.

The normal contact-wire height is 16 ft. 6 in. over the main suburban tracks at 70° F., but over grade crossings the minimum height is 18 ft., while under low bridges, which are numerous, the minimum height is 14 ft. 6 in. above rail level, giving a vertical clearance of 12 in. between the contact-wire collecting surface and the underside of bridge. As the maximum height of the projecting ventilators on the country rolling stock is 14 ft. 2 in., considerable care had to be exercised in erection to preserve the clearances provided. The standard contact-wire suspension is maintained, but beneath low bridges, fig. 11, and to ensure that the pantograph would not raise the contact wire more than 2 in., a maximum grade of 1 in 150 was adopted for the line, and, where possible, a grade of 1 in 250, except where speeds were limited. In some cases rigid droppers have also been used. The dropper connections between the catenary and contact wires were measured and cut to a special dropper table, which provides the necessary adjustments to allow for grades; the droppers were then erected on the field with practically no adjustment, and a well aligned line has been obtained, whose vertical movement responds uniformly to changes of temperature, the catenary wire being stressed well within its elastic limit to provide for this. The importance of this precaution will be realised with temperature limits between 27° F. and 175° F. Where a steam service is also being used, the insulators are arranged so as to avoid the direct blast of the locomotive exhaust.



FIGS. 10 TO 15.—OVERHEAD STRUCTURES.

The whole of the fittings were specially designed for the equipments by the consulting engineers in conjunction with the contractors.

Supporting Structures.—The supports for the catenary construction consist of pairs of tensioning anchor structures, fig. 12, about 3,000 ft. apart with light intermediate structures at 300-ft. intervals on the straight track, and closer on curves. Fig. 13 shows the supporting structures on a curve.

Earthing.—All overhead equipment structures, signalling bridges, and overline road bridges to which line work is attached are bonded to the track rails through a paper spark

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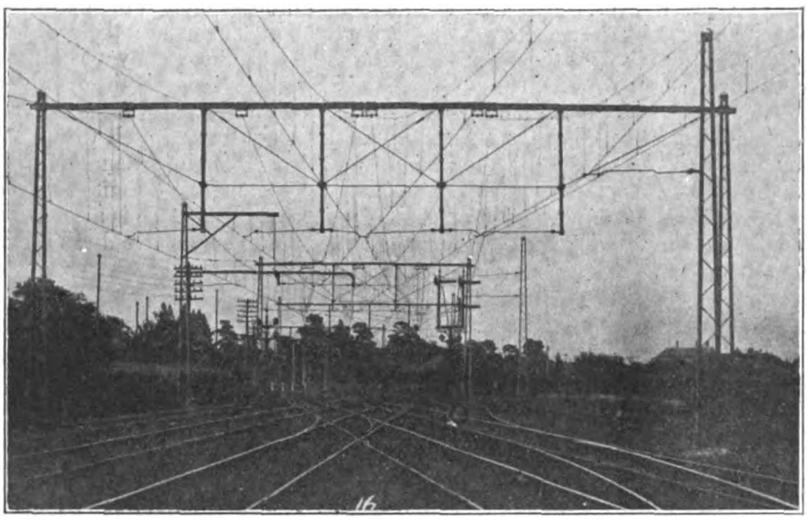
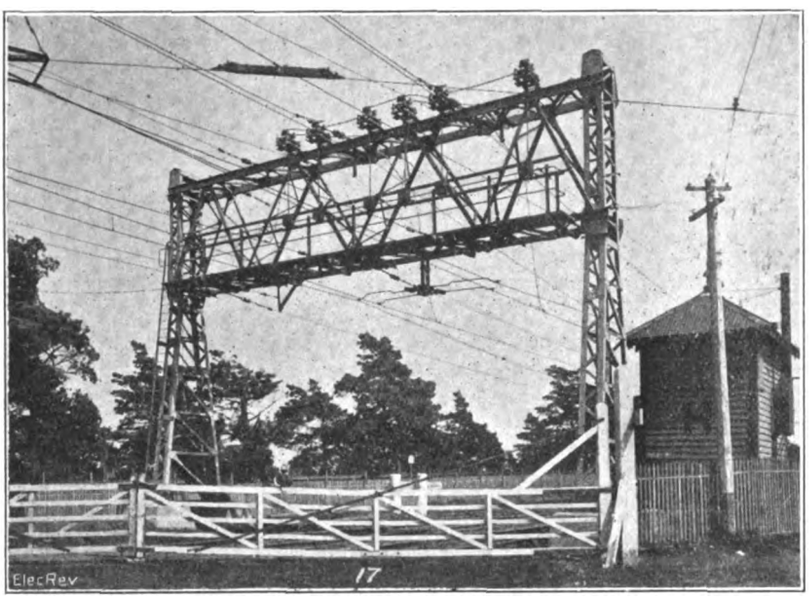
gap 0·001 in. thick, between two aluminium disks, so that they are normally insulated from the rails. This is necessary to limit the unbalancing of current through the impedance bonds connecting the signalling track circuits which are operated by superimposed alternating current. Should the insulation between the overhead wires and the supporting structures break down, the spark gap punctures and the structure is connected to the nearest rail until the fault is corrected.





FIGS. 16 AND 17.—SPECIAL OVERHEAD STRUCTURES.

Special Construction.—The standard intermediate structures have been designed and adapted to carry, where possible, the single-arm, power-operated signals. Fig. 14 shows a combined four-track signal structure, fig. 15 shows five-pin arch structures spanning up to 120 ft., and carrying the overhead equipment load of 13 tracks on an 18-chain curve. They are also designed to carry a distributed signal load of about six tons. Figs. 16 and 17 give a good idea of special wiring, it being noted that no contact wires are crossed at the pantograph running level.

Sectioning and Insulation.—The up and down tracks of all routes can be electrically insulated from each other, and all routes are as far as possible separately fed. At extensive junctions the overhead wires of a number of tracks are connected together, and treated as one section, and are usually tensioned at both ends. An air section insulator is employed between track sections where the speed of trains exceeds 25 M.P.H. Over cross-overs and leading-in tracks to sidings where train speed is restricted, the tracks are electrically insulated from each other by means of section insulators in the catenary and contact wires.

Sectioning points are located with reference to traffic requirements and the position of cross-overs, being on the out-lying lines from 2 to 3 miles apart. The system as a whole is divided into sections which extend beyond sub-stations, and which are divided into sub-sections, while sidings and terminal tracks leading from the sub-sections are divided into branch sections. There is a very complete system of track-circuiting and electric signalling. On the ends of the sleepers opposite "stop" signals are installed automatic train stops (fig. 18) operated through gearing by small induction motors.

Sub-Stations.—The positions of the sub-stations are shown in fig. 19. Fifteen railway traction sub-stations are being provided, and there are in addition two tramway sub-stations, one at Elwoad for supplying the St. Kilda-Brighton tramways, and the other at Sandringham for supplying the Sandringham-Blackrock tramway. At Spencer Street a sub-station is also being built to take over a supply of lighting, as well as to supply the State Government offices and power to the railway workshops. There are two static sub-stations, one at Newport workshops, and one at Jolimont workshops.

Special attention has been paid to sub-station ventilation, numerous large screened openings being provided in the basement, and vertical louvres above the roof level. Each traction sub-station consists of two or more bays for the rotaries, with an unloading bay, and the larger sub-stations have a bay for signalling equipment, the switch house and operating gallery being in an annexe to the main building. Each rotary is installed in a separate compartment, so that during the starting up and operation of any particular rotary, the chamber is screened off, the locking gear on the entrance gate being inter-connected with the 20,000-volt switches controlling the supply to the rotary static transformers, and also with the operating levers controlling the 1,500-volt D.C. gear, so that it is impossible for an operator to come into contact with live metal.

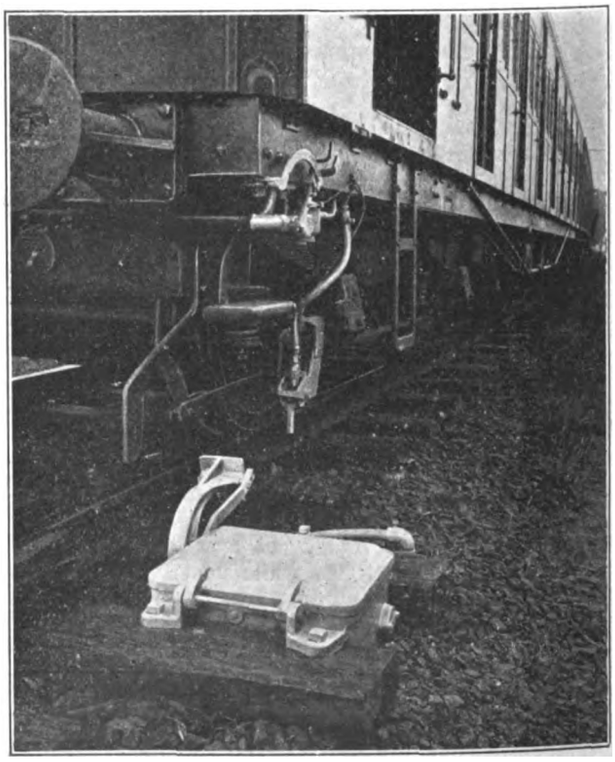


FIG. 18.—AUTOMATIC TRAIN STOP.

H.T. Switchgear.—The 20,000-volt switchgear is of the cellular type; the cell doors are completely interlocked

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with the main oil switches and isolating switches, so that access cannot be obtained to live conductors. The switchgear is arranged on three floors. On the ground floor are

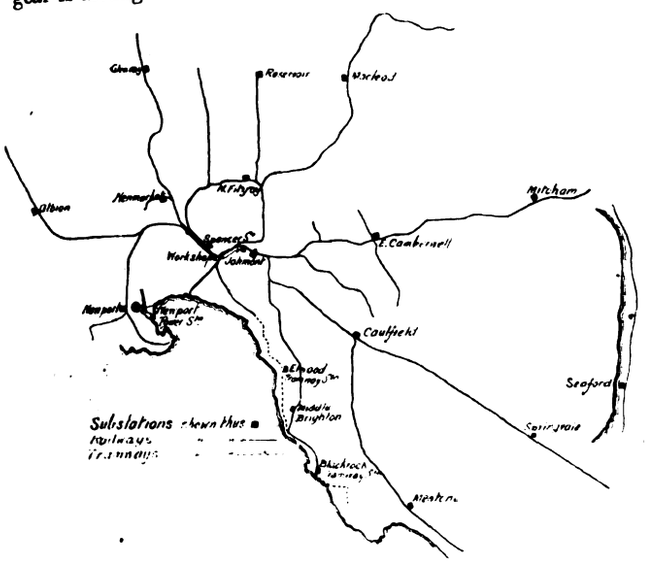

FIG. 19.—MAP OF MELBOURNE SUBURBAN RAILWAY SYSTEM.

installed the cable terminal boxes, earthing and isolating switches, and instrument transformers; on the first floor are installed the oil switches, which are of large breaking

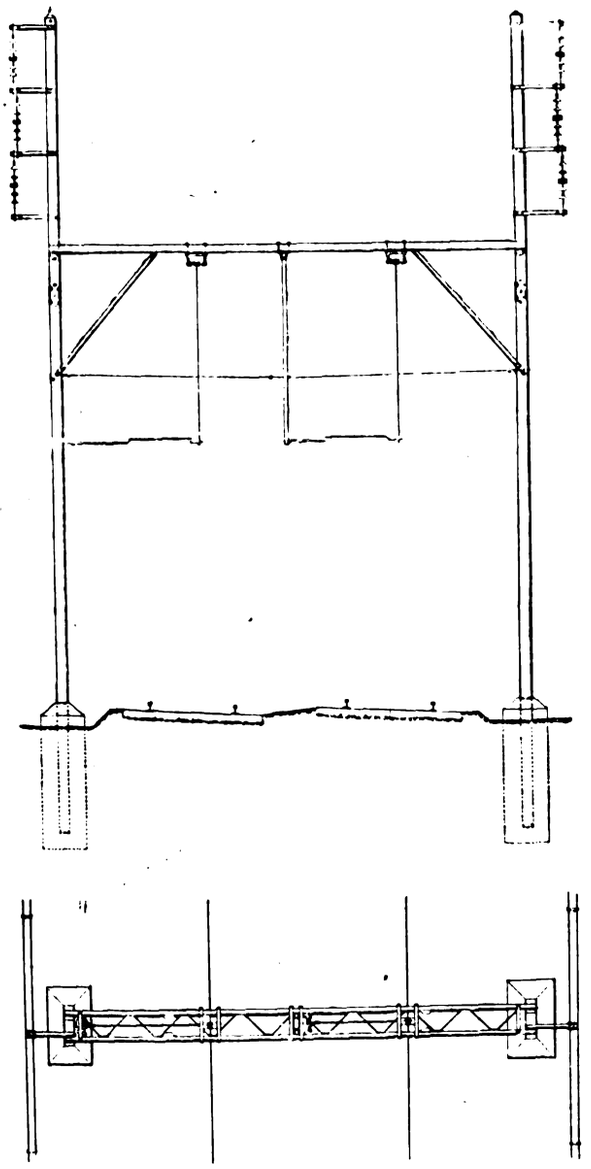

FIG. 20.—OVERHEAD TRANSMISSION LINE STRUCTURE.

capacity, each unit consisting of three single-phase switches in strong steel tanks. The whole connections in the oil-switch cell are insulated, and the doors to the cell are dust tight. The gallery giving access to the switch cells is open to the outer air, so that in the event of a fire occurring in one-switch cell, it can be dealt with from the outside. The oil-switch tanks are provided with vent pipes which discharge the gases into the open gallery; on the second floor are the busbars and busbar isolating switches. The busbars are split by means of a section switch, so that maintenance work and repairs can be carried out without shutting down the whole of the substation. The operating gear for the 20,000-volt and isolating switches is on the operating gallery, fig. 21, in front of the oil-switch cells.

D. C. Traction Switchgear.—The 1,500-volt D.C. switchgear and the positive busbar are installed on the ground floor below the operating gallery, and all isolating switches and circuit-breakers are operated by signal levers from the operating gallery above. The switchgear is mounted in cells with the automatic circuit-breakers on the top. The chamber containing the switchgear and circuit-breakers is specially ventilated. The negative and equaliser busbars are run in the basement below the rotary converters.

Signalling Switchgear.—The 2,200-volt, single-phase signalling switchgear is of the Reyrolle armour-clad type, specially developed for the purpose. It is installed on the operating gallery.

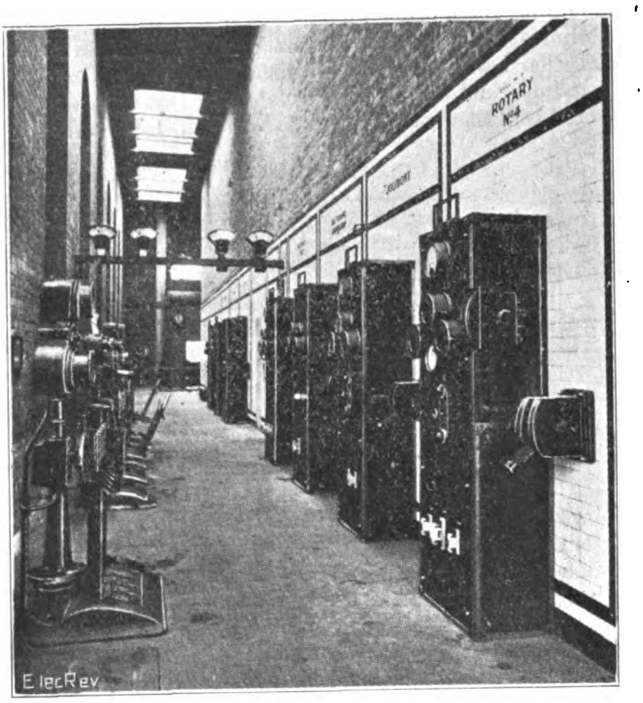

FIG. 21.—SUBSTATION OPERATING GALLERY.

Auxiliary Switchgear.—The 440-volt switchgear for controlling the auxiliary and signalling supplies is of the Metropolitan-Vickers ironclad type, and is mounted on the gallery above the auxiliary transformers, in one bay of the main building. The 110-volt D.C. switchgear for controlling the lighting motor-generators, the tripping and operating battery, &c., is of the usual slate-panel type, and is mounted on the operating gallery.

Rotary Converters.—Four sizes of rotary converter are at present being built by Siemens Bros. Dynamo Works, Ltd., Metropolitan-Vickers Electrical Co., Ltd., and by the General Electric Co. (of New York), the two-hour ratings being 3,000 KW., 2,250 KW., 1,500 KW., and 750 KW. The 750-KW. machines being destined for installation in outlying sub-stations, with a comparatively infrequent train service, have been specially designed with a drooping characteristic, since the overloads are relatively more severe, and the regulation of less importance. The conditions laid down were the conversion of three-phase energy at 19,000 volts, 25 cycles to direct current at 1,500 volts, with a leading power factor of 0·95 at normal load. A compound winding on the larger machines compensates for a drop in pressure of 10 per cent. at double full load. The machines are six-phase with 12, 6, or 4 poles, and are arranged for self-synchronising. The 3,000-KW. machines are designed to

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carry 6,000 KW. for short periods, and *pro rata* in the case of the other sizes, except in that of the 750-KW. machines, which are designed to carry 2,000 KW. for short periods.

H.T. Distribution System.—Thirteen 20,000-volt feeders radiating from the Newport power house to the sub-stations in the central area are included in the present scheme, nine being of 0·15 sq. in. and four of 1 sq. in. C.S.A. Paper-insulated, lead-covered, wire-armoured cables are employed, all of the split-conductor type. The cables are mainly laid in trenches in the streets, owing to the very limited space available alongside the railway lines. The trench averages 4 ft. in depth, and the cables are 1 ft. 9 in. between centres, covered by boards; special precautions are taken in the cast-iron joint boxes (fig. 22) to prevent air pockets being formed when being filled with compound.

In the outlying districts the supply to the sub-stations is provided by overhead transmission on the track equipment structures. The overhead transmission lines are carried on brackets (fig. 20) extending from the sides of the masts away from the tracks, the three phases, each of two separate wires of 0·035 sq. in. C.S.A., being placed directly above one another, and supported on chain-type insulators. This enables the split-conductor protection system to be employed throughout the E.H.T. transmission system. Telephone cables are laid along the route of the 20,000-volt transmission line, there being an automatic telephone exchange at Jolimont sub-station for 50 lines. This provides communication between the control room, all sub-stations, and certain important signal boxes from which switching of the overhead contact wires is regulated. Such 1,500-volt D.C. feeders as are employed are paper insulated, lead covered, and for the most part wire armoured, being of 0·75 sq. in., and in a few cases 0·5 sq. in. sectional area.

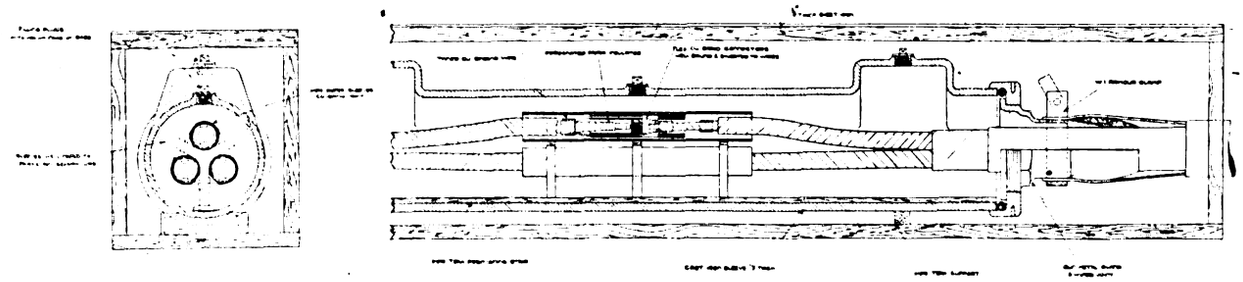

FIG. 22.—CABLE JOINT, 20,000-VOLT, SPLIT CONDUCTOR.

The whole of the electrification, including the power station, has been carried out to the plans and specifications of Messrs. Merz & McLellan, consulting engineers, of London, under the direct supervision of their local representative, Mr. E. P. Grove, at their Melbourne offices, in conjunction with the Electrification Committee of the Railways Department. The excavations, foundations, plaster walls, and brick buildings, were carried out by the Victorian Railways staff.

For some of our illustrations we are indebted to *The Commonwealth Engineer*.

We are informed by our Australian correspondent that Mr. C. H. Merz visited Melbourne in October last, having gone on from South Africa. He was to inspect the electrification work and advise the Railway Department if the undertaking could be expedited.

Fuse Size for Mercury-Arc Rectifiers.—On account of the high starting current required by mercury-arc rectifiers, some trouble is occasionally experienced in determining the correct size of fuse to use. If the rating is too high, the tube will not be adequately protected against overloads and its life will consequently be shortened. On the other hand, if the fuse is rated too low, there will be a tendency to blow if the tube is cold and requires a greater amount of current. Mr. H. E. Weightman, writing to the *Electrical World*, states that he has found that if the fuse is rated at the value obtained by the use of the following formula, proper protection will be afforded :—

$$I = (1{\cdot}5 \times W) / E \times A \times B,$$

where I = ampere rating of fuse; W = D.C. output of rectifier in watts; A = rectifier efficiency expressed as a decimal; B = power factor of outfit; and E = A.C. voltage. The rectifier efficiency is usually between 0·40 and 0·50 and the power factor is 0·90 in most cases. Where high reactance is used to smooth out pulsations, however, the power factor will be about 0·57.

METHODS OF BALANCING MACHINES.

BY A. B. EASON, M.A., A.M.I.E.E.

THIS article deals with various types of balancing machines on the market and with the principles upon which such machines work. There is no need to discuss the mathematical portion of the subject fully, as this is dealt with in articles mentioned later, and in those of Andrews (*Mechanical World*, Vol. 62, page 90, 1917), Heidebroek (*Zeit. Ver. Deut. Ingr.*, Vol. 60, page 11, 1916, and *Journal*, American Society of Mechanical Engineers, Vol. 38, page 268, 1916), Hymans (*Auto. Engineer*, Vol. 7, page 79, 1917). One need only explain the terms "static" and "dynamic" balance. Consider fig. 1, which represents symbolically the conditions of a body rotating round the axis X Y: (*a*) represents a homogeneous cylindrical shaft with two equal weights M, in the same axial plane at equal and opposite distances from the axis. This system is in static balance, and, if rotated, there is no unbalanced force or couple; the system is thus also in dynamic balance; (*b*) represents the same shaft with the equal weights displaced along the shaft; this system is still in static balance, as there is no unbalanced force tending to turn the body round its axis X Y. But when rotated with regular velocity ω, there will exist equal and opposite centrifugal forces $M r \omega^2$, causing an unbalance couple $M r \omega^2 l$, which will tend to turn the whole shaft in the axial plane through the bearings. The force on the bearing at X will vary above and below the static force due to the weight by $M r \omega^2 (l/L)$, according as the left-hand weight is below or above the axis of rotation; (*c*) represents the same shaft with unequal weights at opposite sides of the axis; this system is in both static and dynamic unbalance. When rotated, the external forces exerted on the bearings are a couple $M r \omega^2$ plus an unbalance force $= m r \omega^2$. The plane in which these forces act is continually rotating round the axis, as the body rotates.

When a body is in absolute static balance, there is no force tending to rotate the body round the axis X Y. In absolute dynamic balance there is no couple tending to turn the axis X Y either about X or Y. No rotating body

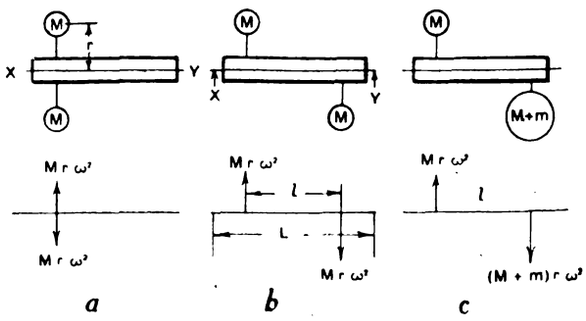

FIG. 1.

is perfectly balanced; the amount of unbalance may be inappreciable, and in well-designed machines is always made innocuous. To reduce the unbalance to negligible proportions is the object of all balancing arrangements.

STATIC BALANCE.

Consider the method of getting static balance by placing the body on parallel ways; the journals of the body rest on two smooth horizontal surfaces, upon which they are

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free to rotate in either direction. If the vertical plane in which the centre of gravity lies does not pass through the points or lines at which the journals touch the ways, there will be a couple tending to turn the body (see fig. 2). Whether the body turns or not depends upon the magnitude of the couple as compared with the frictional moment resisting motion. The limiting load allowable on parallel ways is about 750 d lb. per inch width, where d is the diameter of the journal in inches. If the ways are $1\frac{1}{2}$ in. wide and $d = 10$ in., then each side might bear a load of 11,250 lb. It is obvious that the line of contact between the journal and the ways cannot be a true line, but must have some width, say t. Suppose $t = 0{\cdot}005$ in., and that the centre of gravity of the body is directly above the mid-point of this width; let a weight be added to the body to unbalance it; until the centre of gravity of the body has been displaced by more than 0·0025 in., there will be no turning moment apparent, as the downward force due to the weight of the body will still act within the area of support (fig. 2).

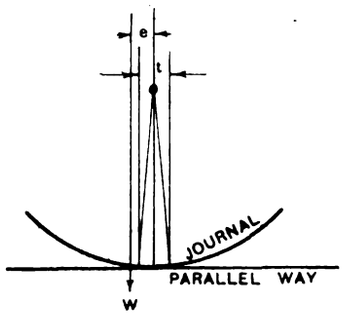

FIG. 2.

The turning moment W e (e being ft.), which will just begin to rotate the body, we shall denote by 16 W f in oz.-in., where W is in lb., and f is in inches. Akimoff (*American Mach.*, Vol. 47, page 1,121, 1917) states that Resal's formula for the residual unbalance not perceptible by parallel-way balancing, is—

Shaft, diam., inches.	Weight, lb.	Unbalance, oz.-in.	Kg.-cm.	Value of f, inches.
1	10,000	500	36	0·0031
2	10,000	700	50	0·0044
6	5,000	600	43	0·0075
12	5,000	800	58	0·0100

The unbalance being W f, f gives the possible eccentricity of the centre of gravity. Hertz says that the residual unbalance $= 465\ (10)^{-6}\ p\ (p d)^{1/2}$ oz.-in., where p is the pressure per inch width of the ways. Heidebroek says that when balancing on parallel ways the eccentricity of the centre of gravity which is not revealed is 0·02 in. (0·5 mm.); but if the journals are placed on four rollers, eccentricities as low as 0·003 in. (0·07 mm.) are recognisable. No mention is made of the weight of the body to which these figures refer; but rollers would naturally reveal a greater residual unbalance than parallel ways in any case. Hering (*Electrical World*, Vol. 72, page 389, 1918) speaking with Akimoff's approval, mentions that 0·4 oz.-in. (29 gm.-cm.) is a reasonable amount of static unbalance to allow in a 200-lb. (90 kg.), armature rotating at 1,000 R.P.M. No amounts for other sizes are stated.

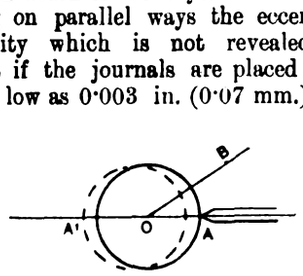

FIG. 3.

MODERN METHODS OF STATIC BALANCING.

The up-to-date method of balancing consists in supporting the body upon a spring suspension of some sort; the body can then oscillate to and fro when moved from the position of equilibrium. When set in rotation at such a speed that the period of action of the unbalance forces coincides with the natural period of oscillation of the suspended body, the amplitude of the vibrations will become perceptible, even though the amount or unbalance is very small. Having found the existence of unbalance, one has to find the axial plane in which the unbalance is situated, so as to either remove excess weight or to add additional weight. The old-fashioned method is to allow a pencil or chalk to touch the rotating body; suppose the body is an armature, and is on bearings free to slide horizontally under spring control; at each revolution a point (see fig. 3), A, say, will be the extreme point on the line of oscillation. The chalk mark would appear, therefore, on a particular commutator bar. The plane of unbalance is not the plane passing through O and A, but is displaced by an angle whose value depends upon how near resonance the revolutions of the armature may be. Heidebroek (*loc. cit.*) gives figures for this angular displacement in a particular case, viz.:—

Angular displacement ...	8	10	70	90	165	172
Revs. per min.	630	640	650	652	660	670

This shows that the relative position of the plane of maximum displacement and of the unbalance plane varies rapidly at the point of resonance. Below resonance the unbalance plane is slightly in advance of the plane of maximum displacement; at resonance it is 90° in advance; above resonance the advance increases to 180°. From the above figures it is seen that the position of the chalk mark (assuming it to be only a point) would lie in an arc between 70° and 165°, while the revolutions only varied from 650 to 660 R.P.M.; in order to get reasonable accuracy, one must rotate the body at resonant speed, and must then keep the speed constant at this point. The resonant point is chosen because the maximum displacement will occur then; as the chalk mark will cover more than a point, the body is rotated first one way and then the other, and then the point midway between the chalk lines is taken as being the unbalance plane. Having found the *plane* of unbalance, one finds by trial and error the most suitable weights to improve balance until it is within tolerable limits.

Akimoff (*American Mach.*, Vol. 47, page 1,121, 1917) finds the *amount* of static unbalance by Lavatzeck's method; the body to be balanced is suspended in a frame which can oscillate as a pendulum, and is then rotated at a speed to coincide with the natural period of oscillation of the frame and body.

DYNAMIC BALANCING.

When dynamic unbalance exists, the couple tends to make the axis vibrate angularly round a point O (fig. 4), in contrast to the tendency to make it move parallel with itself, viz., X X, Y Y, as with static unbalance. To balance this couple, one must add two equal weights M′ (or their equivalent) in one axial plane at opposite sides of the axis, and separated along the axis by L′, so that $M' L' r \omega^2 = M r \omega^2 l$. Obviously balancing done at any one speed will be satisfactory at any other speed, except in so far as (*a*) imperceptible unbalance at, say, 400 R.P.M., may become perceptible at 3,000 R.P.M., as its magnitude will have increased by $(30/4)^2 = 56$ times; (*b*) the unbalance is due to electrical sources, which may vary with the speed. Hering (*loc. cit.*) states that a dynamic unbalance of 2,190 cm.-gm.-cm. (12 in.-oz.-in.) for a 90 kg. (200 lb.) armature, running at 1,000 R.P.M. is permissible.

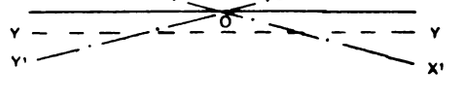

FIG. 4.

Unfortunately, no other speeds or weights are mentioned; but assuming the same percentage unbalance is allowable in other cases, then one might say—

Permissible unbalance $= 2{\cdot}44\ (10)^{-8}\ n^2$ W, cm.-gm.-cm.
$= 0{\cdot}54\ (10)^{-10}\ n^2$ W′, in.-oz.-in.

W being in kilograms; W′ in lb.; n = R.P.M.

In *Engineering*, Vol. 97, page 349, 1914, there is a description of a machine for balancing fly-wheels. The fly-wheel is first balanced statically when placed horizontally upon a needle point. It can then be rotated upon the

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needle point, and will tilt if it is out of balance; a chalk pencil is allowed to touch the high spot on the upper surface; the presence and absence of chalk will show where the unbalance exists. Lumps of clay are then added until a balance is found; holes are then drilled opposite to where the clay lumps are.

This is obviously a relatively rough method of getting balance, as the weights and centres of gravity of the lumps of clay will not be accurately known. To get balance equal lumps must be added at opposite sides of the central plane. In the American *Electrical Review*, Vol. 72, page 571, 1918, will be found charts giving the weight of metal removed when holes of various sizes are drilled. Akimoff (*Transactions* American Society of Mechanical Engineers, Vol. 38, page 867, 1916) describes his machine with rods and disks for balancing bodies. In his remarks he depreciates the value of the chalk mark method of balancing by noting the position of "high spots"; he emphasises the necessity of balancing statically before proceeding to balance dynamically. This machine of Akimoff's, and also the Norton balancing machine, are described by Hymans in the *Auto. Engineer*, Vol. 7, page 79, 1917. The principle of Akimoff's machine is shown in fig. 5. The machine to be balanced is placed upon a beam, one end of which is hinged, and the other end of which rests upon a spring. Underneath the beam is fixed a driving motor M, and the balancing arrangement, consisting of two disks, with six sliding rods placed parallel to the axis. This system is in perfect balance. The body to be balanced is rotated at

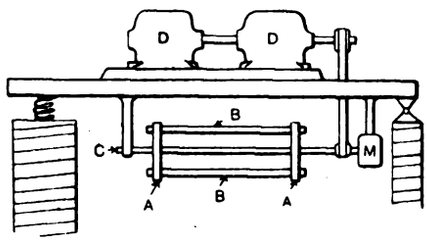

FIG. 5.

such a speed that any vibrations existing shall be in resonance with the oscillations of the beam and its load on the spring. The rods B can be moved parallel to the axis C while in motion, so that a couple can be exerted to equalise the unbalance couple of the body D; the amount of the couple exerted by B depends upon how far the rods are displaced in the disks A; the plane of the two rods shown is also adjustable about the axis C, so that the couple can be introduced in the plane parallel to the unbalance plane of body D. The rods are adjusted until the system, as a whole, ceases to vibrate. The amount of unbalance can then be read off upon a scale marked on the balancing system. Actually in the machine six rods are used, but only two are shown in fig. 5. Akimoff (*Amer. Mach.*, Vol. 47, page 1,121, 1917), mentions an improvement he has made in the above machine by replacing the disks and rods by two disks, each with a single pin projecting from its surface; there are corresponding holes in the other disk, so that when the disks are placed close together they are perfectly balanced. Unbalance is brought about by separating them.

Other references to methods of balancing may be mentioned here. Wheeler and Southwell (*Engineering*, Vol. 99, page 64, 1915) describe the balancing of large turbine rotors, using mirrors and a beam of light to reveal unbalance. Commander Cleary (*Journal* American Society of Naval Engineers, Vol. 30, page 1, 1918) describes the same method, used in America. Heidebroek (*Zeit. Ver. Deut. Ingr.*, Vol. 60, page 11, 1916) describes Lavaczzeck's method of balancing, where the rotating body is supported on bearings, one of which moves in the arc of a circle, whose centre is the other bearing, under the control of springs. In an example quoted, a 100-kg. rotor was run at resonant speed, and a weight of 0·5 gm. placed at a distance of 300 mm. from the centre of gravity of the body, produced an amplitude of vibration of 0·035 mm.; this means that a displacement of the centre of gravity by 0·001 mm. was revealed by the machine.

Törbet (*Journal* American Society of Naval Engineers, Vol. 30, page 518, 1918) discusses balancing of machines and the vibrations of the foundations from a mathematical point of view, and suggests how to determine the unbalance from the forces acting on the bearings. Brinton (*Electric Journal*, Vol. 15, page 349, 1918) describes the Carl Wenstrom balancing machine, which is based on Lavatzeck's idea. This article is reproduced in the *Electrician*, Vol. 82, page 128, January 24th, 1919. The machine is also described in *Aerial Age Weekly*, April 29th, 1918. *Machinery* (New York), in Vol. 25, page 285, December, 1918, and page 422, January, 1919, describes all the existing types of machines. Jeffcott (*Phil. Mag.*, Vol. 37, page 304, 1919) discusses the question of balance from a mathematical point of view. Heyman (*Electrotech. Zeit.*, Vol. 44, page 234, &c., May 22nd and 29th, 1919) describes the whole matter in a very well illustrated and complete article.

The conclusions to be drawn may be summed up thus:—

1. Very accurate balancing is possible if proper balancing machines are used.

2. The balance obtainable by using "chalk mark" and "high spot" methods is only relatively good.

3. Static balance obtainable by the use of parallel ways is relatively poor.

4. Definite information to cover all cases is required, as to the unbalance which is permissible or tolerable.

5. Where the natural period of oscillation of the supports is being utilised, the deflection of the spring for the superincumbent load should be about $3{,}520/n^2$ in., where n is the speed of the machine in R.P.M.

Time of swing $= 2\pi$ (deflection/g).

WAGES IN THE LONDON DISTRICT.

THE Industrial Court has issued an award relating to electricity undertakings in London and the adjoining district (war-wage advance), dated December 19th, 1919.

The parties were on the one hand, the Electrical Trades Union, the National Amalgamated Society of Enginemen, Firemen, Mechanics, Motormen, and Electrical Workers, the National Union of General Workers, and the Workers' Union; and on the other, the London County Council, the local authorities of Leyton, Epsom, Ilford, Barking, Barnes, Beckenham, Erith, Walthamstow, Watford, Willesden, Battersea, Bermondsey, Fulham, Hackney, Hammersmith, Hampstead, Islington, Poplar, St. Pancras, St. Marylebone, Shoreditch, Southwark, Stepney, Stoke Newington, West Ham, Woolwich, Croydon, Ealing, East Ham, Kingston-on-Thames, and Wimbledon, the London electricity supply and tramway companies, the North Metropolitan Electric Power Supply and Distribution Companies, and the companies supplying Hendon, Twickenham and Teddington, Uxbridge and district, and Richmond (Surrey).

The terms of reference were a claim on behalf of the workpeople concerned in the employ of the undertakings for a further war-wage advance of 15s. per week.

1. The matter was referred under the Industrial Courts Act, 1919, by the Ministry of Labour to the Industrial Court for settlement, and representatives of the parties were heard on December 19th, 1919, in London. The Richmond (Surrey) Electric Light and Power Co., Ltd., was not represented.

2. The men concerned, aged 18 years and over, have received war advances not exceeding 28s. 6d. a week; in addition, those 21 years of age and over have received a bonus on earnings of 12½ per cent. in the case of timeworkers, and 7½ per cent. in the case of pieceworkers.

The decision of the Court was as follows:—

3. The men concerned, aged 18 years and over, shall receive an advance of 5s. a full ordinary week.

4. The amount hereby awarded is to be taken into account in the calculation of payment for overtime and night duty, and for work on Sundays and holidays, and will form part of the total earnings of time and pieceworkers upon which the bonuses of 12½ per cent. and 7½ per cent. respectively, are to be calculated; but it is not otherwise to apply to or affect present time rates, premium bonus rates, or piecework prices, and is not to be taken into account as part of the time rates for the purpose of fixing new piecework prices or bonus rates.

5. The Court's decision shall take effect from the pay-day immediately following December 1st, 1919, in respect of the pay period for which payment was made on that pay-day.

WILLIAM W. MACKENZIE,
J. MCKIE BRYCE,
D. C. CUMMINGS.

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A similar award relates to electrical workers on railways, and bears the same date. The parties were, on the one hand, the Trade Unions above-named, and on the other, the Railway Executive Committee, representing the railways operating in the London district. The terms of reference were a claim for an advance of 15s. per week.

The matter was referred under the Wages (Temporary Regulation) Acts, 1918 and 1919, by the Ministry of Labour to the Interim Court of Arbitration for settlement, and not having been settled by that Court before the passing of the Industrial Courts Act, transferred to the Industrial Court, and this award has effect as if it were an award of the Interim Court of Arbitration made under the Wages (Temporary Regulation) Act, 1918. Representatives of the parties were heard by the Industrial Court in London on December 19th, 1919.

The decision of the Court was, in effect, identical with the foregoing, with the following additions :—

This decision shall not apply to men who in respect to wages are at present on the same footing as men of a class other than electrical workers employed on railways.

The rates fixed in accordance with this decision shall be the substituted rates of the workpeople concerned for the purposes of the Wages (Temporary Regulation) Acts, 1918 and 1919, as modified by the Industrial Courts Act, 1919.

THE COAL REBATE.

UNDER Clause 5 of the Coal (Pit's Mouth) Prices Order and Direction, 1919, dated November 29th, 1919. the following prescription has been issued by the Controller of Coal Mines to Electricity Undertakings :—

Whereas under the provisions of Clause 5 of the above-mentioned order and direction it is provided (amongst other things) that where coal is delivered to an electricity undertaking the owners or secretary or manager may when paying therefor give a certificate either to the colliery owner or to the factor dealer or merchant from whom they bought that a proportion of the said coal has been or will be used by them for making electricity for domestic or household purposes, and shall in that case be entitled to deduct 10s. per ton from the price in respect of such proportion and that the Controller may prescribe the amount of coal in respect of which such deduction may be made as he in his absolute discretion thinks fit.

Now therefore the Controller hereby prescribes as follows :—

(*a*) In the case of coal delivered during the month of December, 1919, the amount of coal in respect of which the said deduction of 10s. per ton may be made shall be ascertained by reference to the proportion that the quantity of electricity supplied for domestic or household purposes during the third quarter of 1919 bears to the total quantity of electricity supplied during the same period and shall be determined and certified accordingly.

(*b*) In the case of coal delivered between January 1st, 1920, and March 31st, 1920, the amount of coal in respect of which the said deduction of 10s. per ton may be made shall be ascertained by reference to the proportion that the quantity of electricity supplied for domestic or household purposes during the fourth quarter of 1919 bears to the total quantity of electricity supplied during the same period and shall be determined and certified accordingly.

(*c*) In any subsequent quarter the amount of coal in respect of which the said deduction of 10s. per ton may be made shall be ascertained by reference to the proportion that the quantity of electricity supplied for domestic or household purposes during the corresponding quarter of the previous year bears to the total quantity of electricity supplied during the same period and shall be determined and certified accordingly.

Provided always that in respect of sums so deducted an allowance shall be made to each domestic or household consumer at the end of each quarter which shall be at that rate per unit which results from dividing the total weight of coal (in tons) used in the previous quarter by the total units supplied in such previous quarter, multiplying the quotient by 120 (the result being in pence) less such percentage in respect of expenses as may from time to time be approved by the Controller of Coal Mines.

The first allowance shall be given to the consumers at the end of the first quarter of 1920, and shall take account of deductions then actually made from the price of coal delivered between December 1st, 1919, and March 31st, 1920. Any surplus or deficiency shall be carried forward to the next quarter.

(Signed) A. R. DUNCAN,
Controller of Coal Mines.

Dated December 30th, 1919.

An Explanatory Memorandum on the Prescription (approved by the Controller of Coal Mines) has been prepared by a Committee consisting of :—

Mr. Roger T. Smith, President I.E.E. (Chairman), and representatives of

The Incorporated Municipal Electrical Association,

The Incorporated Association of Electric Power Companies,

The Conference of Chief Officials of London Electric Supply Companies,

The Provincial Electric Supply Committee of the United Kingdom, and

The Associated Municipal Electrical Engineers of Greater London.

The memorandum states that to obtain the rebate of 10s. per ton on the coal used for electricity supply for domestic or household purposes for December, 1919—

$$\text{Let } R_1 = \frac{\text{Electricity sold for domestic or household purposes during third quarter, 1919.}}{\text{Electricity sold for all purposes during third quarter, 1919.}}$$

The rebate at 10s. per ton on coal delivered during December will be—

Rebate in £ sterling = R_1 × total coal delivered during December × 10/20.

For January, February, and March, 1920, the fourth quarter of 1919 is taken, and a similar formula is given for the rebate on the total coal delivered during each month. For subsequent quarters the corresponding quarter of 1919 is taken.

Certificates are to be issued only at the end of each month after coal is delivered, and not when it is ordered. The total quantity of coal certified is to be divided between the different suppliers in proportion to the quantities delivered by each. Coal burnt from stock receives no rebate.

To pass on the rebate on the coal obtained (less 5 per cent. for expenses) to the consumer for domestic or household purposes, for the March quarter, 1920—

$$\text{Let } T_1 = \frac{\text{Tons of coal used in fourth quarter, 1919.}}{\text{Total units of electricity sold in fourth quarter, 1919.}}$$

The rate of the rebate to be passed on to the consumer for domestic or household supplies is 120 pence per ton, less 5 per cent., or 114 pence per ton.

For the three months January, February, and March, 1920, each unit of electricity sold for domestic or household purposes will receive a rebate in pence = T_1 × 114 pence. The rebate itself is to be given as a lump sum, to be deducted from the account.

For any subsequent quarter in 1920 a similar rule holds good.

The rebate actually passed on is to be compared with the actual electricity sold and the actual coal used for domestic or household purposes, the coal used being calculated as provided for in the order as if every unit (whether for industrial or domestic supply) required the same amount of coal.

Any deficiency or surplus in the rebate passed on is to be carried on to the next quarter, it being the intention of the order that only the rebate actually received for the coal, less 5 per cent. for expenses, should in the aggregate be passed on.

LEGAL.

WORKMEN'S COMPENSATION CASES.

IN the Bow County Court, on Monday, before Judge Graham, K.C., in a case under the Workmen's Compensation Act, Edward Hanxwell, of Stratford, was the applicant, and the Charing Cross, West End and City Electric Supply Co., were the respondents. Mr. Shakespeare appeared for the applicant, and Mr. Rowlands for the respondents. It appeared that the applicant was employed as an assistant engine driver at the power station at Marsh Lane, and on December 1st, 1918, a ladder fell, causing him to fall into the pit, and his right wrist was broken. At that time he was earning £4 13s. 2d. a week. He went back at the end of March, and was found light work at £3 6s. 8d. a week, and his compensation was lowered from 25s. to 10s. a week, for eight weeks. Then he was put back on his old work for a time, but found himself incapable of doing it. The respondents discharged him, but the Trade Unionists took the matter up, with the result that three days later applicant was taken back as an assistant box cleaner at £3 10s. a week. He claimed that since July he had been at a loss of the difference between the £3 10s. a week and the £4 13s. 2d. he had originally earned. On the other hand, the respondents contended that the high wage earned by the man was only caused by his temporarily doing some very long overtime, but it was of such short duration that it would not be fair to include it in an average for compensation. Again they suggested that the man had recovered sufficiently to do his old work, and that the reason for his discharge was because he absented himself for days without letting them know why, and it would be impossible to carry on a great power plant if that was to go on. They agreed to take him back on the representations of his Union, but they could not then give him his old job, as a number of their old employés, who had been in the Army, had been demobilised, and they had to carry out their promise to find them jobs. The applicant had only been taken on during the war, and was not entitled to the same consideration as the demobilised men.

Judge Graham reserved judgment.

SHERIFF-SUBSTITUTE GUY gave his decision at Edinburgh on Saturday in a case in which a Portobello woman sought compensation for herself and two children from the Niddrie and Benhar Coal Co. Pursuer sued for £300 in respect of the death of her husband while working an electrically-driven coal-cutting machine in the Woolmet Pit, Niddrie. The Sheriff held that the cause of death was electrocution. It had been agreed between the parties that in the event of the pursuer succeeding in the action, the compensation should be fixed at £300, and he granted a decree accordingly, finding the defenders also liable in expenses.

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Hodges v. Webb.

On Monday last, in the Chancery Division, Mr. Justice Peterson commenced the hearing of this case, in which plaintiff, a foreman electrician, a former member of the E.T.U., from which he resigned (he joined the National Association of Supervising Electricians), asked that the defendant, Secretary of the E.T.U., should be restrained from wrongfully interfering with, or attempting to interfere with, his employment and his right to dispose of his labour as he willed. Hodges complained that Webb coerced his employers (Messrs. Tyler & Freeman), while doing work at Watford for the Watford Manufacturing Co., into dismissing him, by calling out on strike the 12 men who were working under him. Correspondence was read which showed that Messrs. Tyler & Freeman received a letter from Mr. Wyatt, Assistant London District Secretary, in which he said that the men were not called off, but that the whole of the men, members and non-members of the E.T.U., came out together owing to the fact that the foreman was a member of the N.A.S.E., and also because of the arrogant attitude adopted by Mr. Hodges toward Mr. Webb when the latter approached him. In the course of the hearing plaintiff said that in October last Mr. Webb had told him that unless he joined the E.T.U. he would lose his livelihood. This he refused to do. At the end of November last plaintiff had to go, and he had been out of employment until the hearing of the motion in this action. Messrs. Tyler and Freeman took him into their employ again in December. Mr. Tyler gave evidence on Monday. He referred to the relations of his firm with the E.T.U., and said that the firm dismissed plaintiff because the Watford Manufacturing Co. ordered them to push on with the work. They were sorry to lose him, but they had no option but to dismiss him. Under cross-examination, he said that the E.T.U. had been in antagonism with the N.A.S.E. regarding whether E.T.U. members should work with N.A.S.E. members. The latter Association had been refused federation by the Trade Union Congress owing to the blackball of the London District. Mr. Tyler denied that the N.A.S.E. was formed at the instigation of the National Federated Electrical Association.

The hearing was resumed on Tuesday when Mr. Tyler was further cross-examined. Evidence was also given by Mr. Banister, hon. secretary of the N.A.S.E., and others. The defendant's case was then opened and he was giving evidence when the Court again adjourned.

(To be continued.)

Direct United States Cable Co., Ltd. v. Western Union Telegraph Co.

This case was mentioned on an adjourned summons in the Chancery Division, before Mr. Justice Peterson, on Monday.

Mr. Maugham, K.C., said that the position at the moment was that the witnesses from America had not yet arrived. They were expected to arrive on or about January 26th, and he asked his Lordship to fix a date for the hearing of the action shortly after that date. He suggested Monday, February 2nd.

Mr. Whinney, appearing on the other side, said he would like to see the documents before the case came on again.

Mr. Maugham said that copies of all the documents were here now, and Mr. Whinney could see them.

His Lordship fixed February 2nd provisionally for the hearing of the case.

A STERLING WORKS VISIT.

The Sterling Telephone & Electric Co.'s business was established in 1900, and was registered as a limited liability company in 1909. The company manufactures telephones, wireless telegraph instruments, mine signalling apparatus, including shaft signalling systems, mine exploders (blasting machines), electric bells and indicators of every variety. The head office of the company is situated in London, and comprises a handsome suite of offices, also a selling organisation, stores, showrooms, and other departments. Here may be seen samples of the company's various manufactures, the outstanding feature of which is the large variety of articles which form part of the telephone and signalling industry, due to the fact that the instruments are required to work under such varied conditions.

Early in 1909 the company secured valuable freehold works situated on the eastern outskirts of London at Dagenham, in Essex. The ground area is approximately 35 acres; the buildings and plant cover an area of six acres; sports ground five acres; for the benefit of the workpeople 18 acres have been reserved for a housing society, and the balance is available for future extensions. Building operations in the housing scheme are, we understand, to be commenced in the near future.

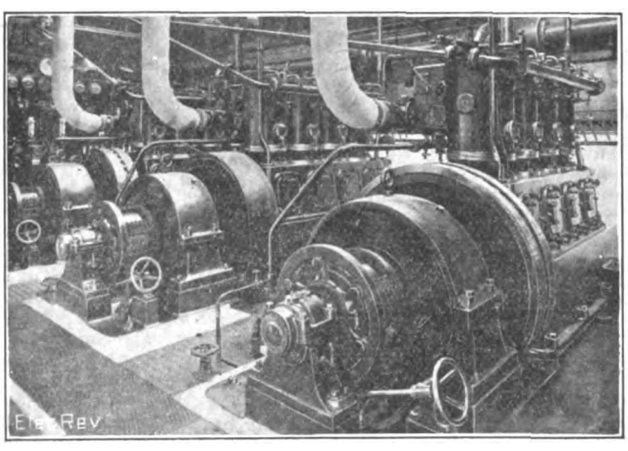

Fig. 1.—Generating Station at the Sterling Works.

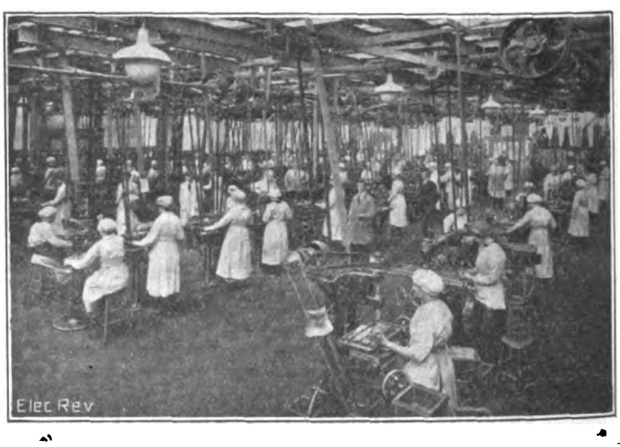

Fig. 2.—Telephone Machine Shop.

The works, primarily intended for the manufacture of all kinds of telephones and kindred apparatus, are capable of producing on mass production lines all kinds of small engineering parts. They are up to date, the equipment comprising high-class modern machinery, all of which is guarded to prevent accidents to the operators. A feature is the use of special jigs and tools which economise time and labour and ensure a high degree of accuracy in the work. The employés work in hygienic conditions, the various shops being well lighted and ventilated, as well as being more spacious than is usually the case.

Important work was carried out for the Ministry of Munitions during the war period, when the total number of employés exceeded 2,500. The number of pieces manufactured for munitions contracts would approximate 135 millions, representing a large variety of parts each requiring many operations and all manufactured to very fine limits. During the early stages of the war great progress was made with the company's wireless telegraph instrument works, which are situated in London. These works were considered of such importance that in the middle of 1915 they were, with the entire staff, taken over by the War Department and carried on by it.

Much attention has been given to the welfare, athletic, and social side of the organisation. The works' canteen is excellently equipped; hot and cold meals are prepared on the premises, the kitchen plant being sufficient to enable several thousand workers to be catered for. A commodious recreation room has been erected adjoining the canteen, and has proved a boon to the employés and the members of the Athletic and Social Club. Concerts and dances are held during meal hours and in the evenings, the talent for which is drawn exclusively from the workers. The company has also provided a very fine recreation ground, where cricket, tennis, football and bowls are enjoyed, and some excellent records have been set up. A double rifle range is attached to the works, which is largely patronised, and there is also a very successful cycling club connected with the sports section. A well-equipped first-aid hospital is situated in the heart of the works, where numerous cases of minor accidents and some more serious have received attention at the hands of qualified nurses.

The works are heated by means of a system of hot-water pipes, and they are electrically driven, and electric lighting is installed throughout. The company has its own generating station, an interior view of which is shown in fig. 1, the plant comprising 5 high-speed, four-cylinder, vertical gas engines, direct coupled to 100-kw. generators, the capacity of which is 650 h.p. and the output 450 kw. The gas is supplied by five producers using anthracite coal. The machine tools are belt-driven by means of lines of shafting, which in turn

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are motor-driven by enclosed silent chains, the motors all being placed overhead. In the main machine shop the automatic turret section can produce over 600,000 small engineering parts weekly; the machines in the capstan lathe section are operated largely by women, who handle them with great dexterity. Most of the parts produced in the machine shops

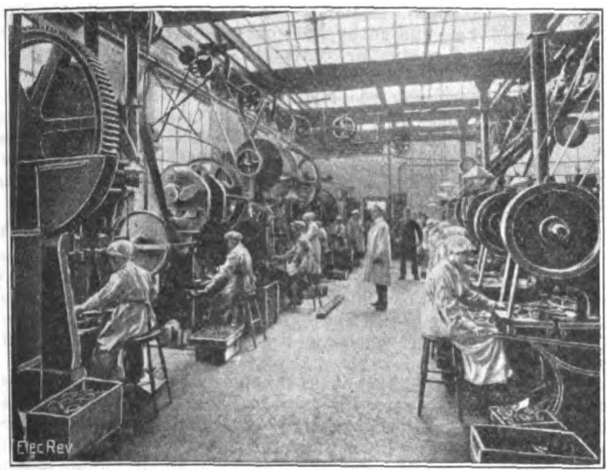

FIG. 3.—PART OF POWER PRESS SHOP.

pass through the high-speed sensitive drill section, where women are almost exclusively employed. The telephone machine shop is more particularly engaged in the production of telephone parts as distinct from other products. Fig. 2 is a view of this shop, in which a large assortment of high-class machine tools is employed. The view also indicates the nature of the lighting system and the commodiousness of the shops. In other instances individual machines are lighted locally. Fig. 3 shows a section of the power press shop, in which the success of the operations depends largely upon the efficiency of special press tools which are designed and produced in the works' toolroom, which may be regarded as the mainstay of the works.

Brass and steel turnings (swarf) are removed from the various machine shops and treated by hydro-extractors and oil filtration plant. The oil is extracted by centrifugal force and filtered by a special process. In the annealing shop all the tools as well as the magnets required in the manufacture of telephones are hardened. In the grinding and polishing shop small components are prepared for electro-plating. The air is kept free from dust by a hurricane extractor fitted at each operator's position. Hoods are fitted above the vats in the electro-plating shop, where components are zinced, tinned, coppered, or nickel-plated, by means of which the fumes are drawn out of the building by a powerful fan. In the enamel shop care is exercised to keep the air dust free while articles are being dipped or sprayed, and precautions are taken against fire in the gas-heated baking ovens which adjoin.

In the coil-winding department coils are wound to specific resistance, and must pass a severe test; the delicate work, demanding patience and skill, is handled exclusively by girls. The whole of the printing required in connection with the works is done on the premises; this department was greatly appreciated during the war, when constantly changing conditions had to be met without delay. In the general office buildings, drawing offices for tool and instrument design, a planning department, and a laboratory are included.

In concluding this survey of the Sterling Telephone Co.'s works we have to thank Mr. Guy Burney, managing director, and Mr. A. Anderson, works manager, for the courteous and hospitable manner in which we were received and conducted over the works at the time of our visit, and also for supplying photographs from which the above illustrations were reproduced.

BUSINESS NOTES.

Municipal Finance.—We read in the financial notes in the *Times* that several municipalities are favouring the idea of the establishment of a municipal bank. The Manchester City Council has agreed to appoint a special committee "to consider the desirability of establishing and carrying on a national bank, with municipal branches in all large centres of industry and commerce, to enable, amongst other things, municipal corporations and other bodies to utilise their surplus assets to finance house building and other public undertakings, thereby saving interest on borrowed moneys, the repayment of which under the present system entails a total expenditure equal to twice or thereabouts of the original capital expenditure."

Exhibitions at São Paulo.—The British Chamber of Commerce at São Paulo and Southern Brazil is organising a series of exhibitions of British products. The first, devoted to hardware of every description, is being held from January 1st to March 1st, 1920. The second from April 1st to June 30th, will deal with fancy goods, including electrical batteries, pocket lamps and fancy articles. From October 1st to December 31st the exhibition will be devoted to glass, china and earthenware, including electric bulbs, laboratory and lighting glass, insulating materials and laboratory porcelain. From January 1st to March 30th, 1922 (two years hence be it noted), electrical goods will have the floor to themselves, and electrical manufactures of very many kinds coming in an alphabetical list from A (accumulators), to T (trolley wheels) will be displayed. Some further particulars may be found in the *Board of Trade Journal*.

Swedish Company's Reconstruction.—According to Reuter, the Volta Electric Co., Ltd., Stockholm, is to be liquidated, and a resolution for reconstruction had been provisionally accepted. The business will be taken over by a new company with a capital of Kr. 6,500,000, of which Kr. 3,500,000 will be issued in founders' shares, and Kr. 3,000,000 in preference shares. Of the founders' shares, Kr. 2,500,000, or 50 per cent. of the present capital, would go to present shareholders.

Italy.—ELECTRICAL UNDERTAKINGS.—Numerous companies are being formed in Italy for the purpose of the generation and distribution of electrical power. Many of these, such as the Società Anonima Forze Idroelettrica Meridionali and the Società Ligure-Toscana di Elettricità, have as their object the harnessing of Italy's water power. The majority of the remainder are relying on lignite and other low-grade fuels, which abound in the valley of the Arno, for the production of energy.

Empty Cases.—Owing to the increased railway rates and other transport considerations, the GENERAL ELECTRIC CO., LTD., will in future only make a nominal charge for packing cases, so that clients may retain them or dispose of them locally, instead of returning them. Cases returned "carriage paid," in good condition, will be credited in full as before.

Armstrong-Whitworth Diesel Engines.—Realising the great future of the Diesel engine for ship propulsion, MESSRS. ARMSTRONG-WHITWORTH & CO. have entered into an agreement with the well-known Swiss firm of Sulzer Bros., whereby they acquire a licence to manufacture and sell, in Great Britain and the Colonies, two-cycle marine engines embodying the best features of the Sulzer system. It has been decided to adopt the two-cycle principle on account of the proved reliability and efficiency of this type of engine, its high ratio of horse-power to size and weight, and its ability to work continuously on Californian or Mexican crude oils of high sulphur and asphalt content, which are the cheapest fuels at present on the market. Engines aggregating over 600,000 B.H.P. have now been built by Sulzer Bros. on the two-cycle principle, and the experience they have gained in regard to both design and manufacture will be placed at the disposal of Armstrongs in the production of the new engine.—*Financial Times*.

Foreign Trade.—DECEMBER FIGURES.—The following are the values given of electrical goods and machinery in the official returns of imports and exports for December :—

	December, 1919.	*Inc. or dec.*	12 *months*, 1919. *Inc. or dec.*
IMPORTS.	£	£	£
Electrical goods, &c. ...	141,822	+ 82,700	+ 156,693
Machinery	1,714,943	+ 922,051	+ 4,362,299
EXPORTS.			
Electrical goods, &c. ...	646,155	+ 401,776	+ 3,424,612
Machinery	3,884,429	+2,710,109	+16,618,006

Preference to Australian Manufactures.—The South Australian Chamber of Manufactures has decided to use efforts to get both branches of the State Parliament to pass a resolution similar to that carried some years ago by the Victorian legislature as follows :—" That in obtaining machinery, goods or material for the service of the State, the Government shall, with a view to the encouragement of our own manufacturers and producers, give substantial and effective preference to those manufactured or produced in the Commonwealth ; and further, that the prices and tenders for all machinery, goods or material so obtained, which are manufactured or produced outside the Commonwealth, shall be laid on the table of the House at the end of each financial year, or as soon thereafter as Parliament meets." The meeting also discussed the disadvantages under which contractors tendering for Government work are placed through awards of higher wages being made after their contracts have been accepted. It was resolved :—" That in view of the uncertainty of the labour position, and the fact that wages are fixed by a Government tribunal, the Chamber approach the Government with the object of having included in the conditions of Government contract a rise and fall clause in regard to wages."—*Tenders*.

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Germany and her Foreign Markets.—It is generally assumed in the German Press that, apart from the danger of an "economic war" on Germany, there is also what is termed a "psychological epidemic" with which entire nations are afflicted. This is resolving itself into an aversion for everything German, which will continue for some time to lead to a situation in all economic life similar to a state of war. To overcome this prejudice many suggestions have been made, some of which have been carried out. The first was the idea of selling German merchandise under the trade-marks of neutral countries. This, it is stated, has necessarily been abandoned. Another project is the establishment of branch factories in neutral countries. But here again, Switzerland, for example, has taken measures to prevent articles produced by such branch plants from bearing marks indicating Swiss manufacture. Such articles are not admitted to the Sample Fair at Basle, and it is anticipated that there will be future legislation, at least in France and England, to prevent entrance of these pseudo-Swiss products. It is hoped, however, that it may be possible to overcome these difficulties by founding in neutral countries local (national) firms under the control of dummy directors. For the period immediately following the war, at least, it is urged that everything points to the neutral as the proper representative of German firms. He can enter France and England without difficulty, and can sell his customers German goods, which naturally speak for themselves.—*Board of Trade Journal.*

Forthcoming Congress of Manufacturers.—*The Times* reports that the Federation of British Industries is organising a congress, to which the various manufacturers and trade organisations of the country will be invited to send representatives, in London early in February.

The Situation in France.—It has been the practice at the annual meetings of the Compagnie Générale d'Electricité, in Paris, for M. Azaria, deputy manager, to submit a forecast of the possible course of business, not only in the new financial year, but also for subsequent years. At the recent general meeting, however, the customary resolutions were adopted without any statement being made by the deputy manager, and it seemed at first as if the shareholders would disperse without any information being given on the question. Nevertheless, the earnest request of the shareholders induced M. Azaria, who appeared to be desirous of discontinuing the tradition, to rise to the occasion, although he remarked that any prevision at the present time is absolutely impossible owing to the very difficult conditions of working which prevail. The deputy manager stated that it happened frequently, too frequently for their liking, that their works were brought to a standstill—stopped when they were in the environs of Paris, as those at Ivry and Vitry, owing to the lack of current through the works which supplied them having no coal; and stopped when the question concerned works which were supplied by the Compagnie Générale as a consequence of the failure in the delivery of raw materials to the latter, particularly coal. Under the circumstances, what forecast could be made? If, however, the coal and transport crisis were to come to an end—which was a question of time—or if the situation in this respect were to be mitigated, even slightly, the requirements of consumers in the manufactures produced by the company, as well as in all those made by industry in general, were such that industrial prosperity could not fail to become very considerable; and the company would derive advantage therefrom as well as others, neither more nor less. Coming to consider the problem of supply works and distributing companies, the deputy manager remarked that the companies were gripped as in a vice by the specifications or conditions of concession, which hindered them from increasing their sale prices for the supply of energy, but which did not prevent them from experiencing the immense repercussions caused by the growth in the prices of the raw materials they used, especially coal. Thus the price of coal, which was quite normal before the war, at 18, 20 or 25 francs per ton—and when it advanced to 30 or 35 francs, the rate was considered to be fantastic—had risen to 200, 300 and 500 francs per ton. As the sale prices under the terms of the concessions could not be increased without official sanction, the question arose as to how to obtain compensation for the excess of expenses over receipts, which amounted to millions of francs. The attention of the public authorities had frequently been drawn to the situation of affairs, but many other matters had to be considered on account of the war. The war, however, was over; the public authorities and the municipalities now understood that the companies could not continue to sell at the pre-war price a product which at present cost them two, three and four times more; and the speaker foreshadowed the impending issue by the Ministres des Travaux Publics et de l'Interieur of an instruction to the municipal and other competent authorities, authorising an increase in the charges for supply. Under these circumstances, the deputy manager expressed the opinion that the supply business would first gradually recover financial equilibrium, and subsequently the prosperity which it enjoyed prior to the war.

South American Trade.—Speaking at a luncheon of the British and Latin-American Chamber of Commerce, Sir James Kemnal, the president, said that a great amount of work was being done by the chamber in bringing firms in South America into close contact with British manufacturers. During the past year 1,250 inquiries were received by the chamber from South America, and 3,000 inquiries were received regarding South America and trade openings. During the same period the agencies of 200 British firms were placed in the hands of reliable South American representatives, and those agencies were working successfully.

Shanghai Electrical Undertaking.—The Special Correspondent at Shanghai of the *Times Trade Supplement* says that some very good contracts for engineering material have been secured recently by British firms. Engineering firms generally are very optimistic as to the future in China. In his presidental address at the meeting of the Engineering Society, the President, as an instance of the growth of industrial enterprises, cited the Municipal Electricity Department. With the additions now in course of erection, the power station would be able to handle a load of 77,000 KW. Yet, the anticipated demand for power from mills now in course of erection or contemplated in the neighbourhood of Shanghai was such that the engineer-in-chief expects to have to go home in the coming year to place orders for additional plant. "It would pay some of the big electrical companies, which have been formed since the signing of the Armistice, to send out experts to study the electrical question on the spot, and establish their own offices here. There would be ample scope for their activities in China."

The Engineering Strike in Sweden.—A Reuter dispatch dated January 9th, stated that the situation in the dispute with the Swedish engineering industry was becoming more critical. A lock-out was probably to be declared by all the factories belonging to the Swedish Mechanical Works Association (Sveriges Verkstadsfoerening) in support of those firms where a strike had been declared.

The Times correspondent at Stockholm says that the cause of the strike, besides a demand for increased wages in some cases, is a dispute as to the regulation of the hours of labour to meet the provisions of the new law for an eight-hour day, which was voted last summer and which entered into force at the beginning of this year. The employers claim the right to apportion the eight hours during the day so as to suit the character of the work, while the workmen contend that they may complete their eight hours when and as they like.

Sydney Tendering Conditions.—The Sydney (N.S.W.) Municipal Council has decided that with regard to specifications and general conditions of tenders for the electric lighting department, in respect of which a conference has been held between representatives of the Council and representatives of the B.E.A.M.A., in Sydney, amendment of the Council's specification and general conditions, so far as the electric lighting department is concerned, be approved and adopted, to provide for the following:—

1. "Specifications" in future to be in such a form that while each tenderer must submit one formal tender precisely in accordance with the "specification" and general conditions, each tenderer shall be at liberty also, if he so wishes, to submit at least one alternative tender, this alternative tender to be for plant or apparatus, if the tenderer so wishes, differing from the "specification."
2. In "specifications" issued during the next 12 months, the penalty for late completion of contracts to be not more than ¼ of 1 per cent. of the value of the contract per week, with a maximum of 5 per cent. of the value of the contract.
3. "Specifications" issued in future to set out standard rates on which the amounts of tenders are based for:—
   (*a*) Freight rate per ton from Great Britain to Sydney.
   (*b*) Freight rate per ton from United States of America to Sydney.
   (*c*) Rate of exchange between Sydney and London.
   (*d*) Rate of exchange between Australia and the United States of America.
   (*e*) Price per ton for electrolytic copper on London market.
   (*f*) Price per ton for lead on London market.
   (*g*) Price per ton for tin on London market.
4. "Specifications" issued in future to provide for Council paying any extra amount which the contractor has to pay for labour in Australia as the result of an Award of a Wages Board or a Judgment of an Arbitration Court taking effect between the date of the sending in of the tender and the date of the completion of the contract.

Also that payments under future contracts be made in Australia as laid down under resolution of Council and agreed to by conference. By consent, the following clause was added:—

(*h*) Price per ton for tin, copper and lead on Sydney market for Australian manufactured goods.

Trade Union Methods.—In a letter to *The Times*, Mr. P. M. Brooke-Hitching states that in a large building, which is now nearing completion, flats are let to people who wish to obtain possession as early as possible. The builder is doing all that he can to expedite the work. A number of electricians are employed carrying out wiring for electric light. In order to meet the demand for telephones, the Post Office arranged to bring in the necessary cables. After this work had been going on for several days, an organiser of the Electrical Trades Union came to the buildings and informed the electricians working there that he would not allow the Post Office officials to continue their work, and that, if the Goverment men did not leave, he would call out every electrician immediately. As the completion of the electric light wiring was a more urgent matter than the installation of telephones, the builder had no option but to obey the dictates of the Electrical Trades Union organiser. This interference has apparently been accepted without demur by the Post Office.

What occasioned the action of the Union is not clear to us; is this the beginning of an attempt to force the Post Office electricians into the E.T.U.?

Patent Restoration.—An order has been made restoring Patent No. 23,082, of 1912, granted to ROBT. F. VENNER, for "Improvements in electric heating and cooking apparatus."

Auction Sale.—By direction of the Disposal Board, Ministry of Munitions, Messrs. Harris & Gillow will sell by auction, at Shoreham Camp, Sussex, on January 21st, 22nd, and 23rd, a quantity of building material, huts, camp equipment, and electrical appliances, comprising batten-holders, switches, wall-plugs, pendants, &c. For full particulars, see our advertisement pages to-day.

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A French Undertaking.—The directors of Les Exploitations Electriques, S.A., of Paris, reporting on the year 1918-19, state that the difficulties experienced by the tramway and lighting undertakings managed by the company continued great. If labour had become less scarce through the progressive demobilisation which had rendered possible the return of a portion of the workmen, the prices of all raw materials, and coal in particular, had remained on a high level. On the other hand, wages had largely increased both in the case of the company and in that of its subsidiary companies. These conditions involved a heavy charge upon the subsidiary companies, and the directors had, therefore, applied to the concessioning authorities for permission to raise fares and charges for supply to a further extent than that previously granted. In most instances the municipalities and the departments had acceded to the request, but only after long and tedious negotiations. The company had taken an important part in the formation of Les Constructions Electriques du Rhône (Procédés Dick-Kerr), which was constituted in November, 1918. The object of the latter was the construction and maintenance of tramway rolling stock, motors and accessory tramway equipment, and works for this purpose were being built in the suburbs of Lyons. The participation of the Exploitations Electriques in the new undertaking would assure the former a supply of plant necessary for its subsidiaries. As net profits and balance forward the accounts of the parent company show the amount of 1,140,000 fr., permitting of the payment of a dividend of 16·25 fr. per ordinary share on a capital of 12,500,000 fr.

The A.E.G. and Austrian Water Powers.—With reference to the statement that the Berlin A.E.G. had been endeavouring to secure possession of the water powers in the Vorarlberg by means of direct purchase, it is reported that after preliminary negotiations the Government declined, on principle, to dispose of the water powers to another country, but expressed its readiness to enter into further negotiations on a different basis—namely, by the formation of a joint company in Vorarlberg, the State of which would possess 51 per cent. of the share capital, leaving 49 per cent. to be taken up by the A.E.G.

Book Notices.—"Lockwood's Builder's and Contractor's Price Book" for 1920. London: Crosby Lockwood & Son. 4s. net.—This is quite an old friend, and, in view of coming building activity, it will be much in demand, though, while giving prices "down to date," the editor recognises that owing to the fluctuating conditions to compile a definite set of prices for building work during 1920 is an impossibility. Sections relating to electric lighting and electric bells, prepared by Mr. A. P. Haslam, have been revised and enlarged. Prices of electric lighting, heating and domestic appliances, conduits, dynamos, motors, batteries, bells, and telephones are quoted from various manufacturers' lists. There are wages tables, legal notes, &c., and in the supplement the London Building Act of 1894 and other Acts, by-laws, and regulations affecting building operations occupy a great deal of space.

The *Chamber of Commerce Journal*, which is the official organ of the London Chamber of Commerce, is now published weekly (6d.), instead of monthly. Always a very useful paper for business men—employers and employed alike—it should be more so, owing to the prompter publication of many matters which is possible under the new arrangement.

"Science Abstracts" (A and B). Part 12. No. 264. Vol. XXII. December 30th, 1919. London: E. & F. N. Spon, Ltd. Price 1s. 6d. each net.

"Electrical Engineer's Diary for 1920." London: S. Davis and Co. Price 7s. 6d.

"The Dyeing Industry." By S. H. Higgins. Pp. viii + 189. London: Longmans, Green & Co. Price 8s. 6d. net.

Scientific Paper No. 349 of the Bureau of Standards, "Photo-electric Spectrophotometry by the Mill Method." Price 5 cents. Scientific Paper No. 334, "New Forms of Instruments for Showing the Presence and Amount of Combustible Gas in the Air." Price 15 cents. Washington: Government Printing Office.

Lead.—In their report, dated January 10th, MESSRS. G. CAWSON & Co. state:—

> The closing figures yesterday, £47 15s. prompt and January, and £48 5s. to £48 10s. March and April, are record prices, and they are not justified by the position of the metal. . . .
>
> There is a large supply of lead in the country, and it is a real hardship on consumers that they should be compelled to pay such tremendous prices, owing to speculation. Lead is coming forward quite freely, as shown by the arrivals last month of 12,496 tons. This month they promise to be quite as heavy. . . .
>
> The outlook is more confused than ever; should speculators continue their operations, the price may be driven still higher, although the eventual crash is bound to come sooner or later; it may even come sooner than anticipated.

Italian Engineering Combine for Near Eastern Trade.—The Agenzia Economica says that the following companies: "Breda," "Terni," "Officine Meccaniche gia' Mianie Silvestri," "Meccanica Lombarda," and "Moto-Aratruce," have come to an agreement, under the auspices of the Credito Italiano, to form the "Societa Italo-Orientale," which has as its object to concentrate into a single channel the exporting activities of the above industries in the Balkans and the Near East. The new company is beginning with a capital of 2,500,000 Italian lire, and has its head offices in Milan. In order to put into practice a plan for the co-operation of the countries with which the new company intends to trade; financial groups in these countries will be asked to contribute to the capital of the new company, places being reserved for their representatives on the board of directors.—*Reuter's Trade Service.*

Catalogues and Lists.—BRITISH THOMSON-HOUSTON CO., LTD., 77, Upper Thames Street, London, E.C. 4.—Descriptive List No. 10,952, dealing with thermostatic metal developed for use on thermostatically operated devices. The action of this metal may be summed up by saying that "it bends with the heat."

MESSRS. SIEMENS BROS. & Co., LTD., Palace Place Mansions, Kensington Court, W. 8.—Catalogue P 535 gives a two-page illustrated description of the Siemens ringing vibrator (pole-changer).

SIMPLEX CONDUITS, LTD., Garrison Lane, Birmingham.—Card illustrating the "Plexsim" one-bar fire.

MESSRS. JOHNSON & PHILLIPS, Charlton, S.E. 7.—Descriptive illustrated list dealing with unit type ironclad switchgear (8 pp).

CRYSELCO, LTD., Kempston Works, Bedford.—A pamphlet with seven humorous illustrations purporting to show some of the tests undergone by "Cryselco" lamps before leaving the factory.

MESSRS. MATTHEWS & YATES, LTD., Swinton, Manchester.—List No. 22/11, "Cyclone" D.C. motor, priced and illustrated specification.

MESSRS. DRAKE & GORHAM WHOLESALE, LTD., 67, Long Acre, W.C. 2.—Pamphlet No. 274 (42 pp.), "Artistic Fittings." An illustrated and priced catalogue of electric light fittings and accessories.

MESSRS. JOHNSON & PHILLIPS, LTD., Charlton, S.E. 7.—A 16-page list of arc lamps and accessories, with prices and illustrations, and a folder dealing with lighting costs.

Calendars.—MESSRS. S. G. LEACH & Co., LTD., 26-30, Artillery Lane, London, E.C., have hit upon a calendar novelty in the shape of an electric fan through one of the blades of which, by means of revolving card disks, the day and date can be shown as long as the calendar lasts.

MESSRS. S. WOLF & Co., LTD., 115, Southwark Street, London, S.E., 1, have issued a serviceable wall calendar for 1920. Clearly printed monthly date sheets have a column of blank space set apart for daily memoranda.

From MESSRS. SMITH & Co., of 17, West Tower Street, Carlisle, we have received a wall calendar with a coloured picture in which King George appears, his attention being centred upon a crucifix that lies among the ruins in France, with a broken sword laid upon it—"Cross" and "Crown."

MESSRS. GABRIEL, WADE & ENGLISH, LTD., timber merchants, of Hull, have issued a calendar with daily cards for changing.

Whitley Councils.—At a meeting held in Edinburgh between representatives of the Corporation electrical undertakings, power companies, and employés, it was agreed to form an Industrial Council for Scotland under the Whitley scheme. The employers and the employés will each be represented by 10 members. Councillor Bruce Lindsay, Edinburgh, was appointed chairman of the Council.—*Glasgow Herald.*

Australian Exhibition.—The *Industrial Australian and Mining Standard* says that the All-Australian Peace Exhibition of Manufactures, Arts and Industries, to be held in Adelaide from March 26th to May 22nd, 1920, promises to be successful. Practically all the available floorage has been let. The exhibition will be held in the Jubilee Exhibition building and annexes, and it has been decided to erect two additional annexes. One will be allocated to the Repatriation Department, which intends making an extensive display of work by men undergoing vocational training, and the other will be utilised for general exhibits.

Clearing Office for Enemy Debts.—The Clearing Office for enemy debts provided for in the Treaty of Peace with Germany has now been established, and Mr. Egerton Spenser Grey, Senior Official Receiver in Bankruptcy, has been appointed Controller. All communications should be addressed to:—The Controller of the Clearing Office, Cornwall House, Stamford Street, S.E. 1. Notices giving instructions as to the steps to be taken for proving their claims have been sent to creditors in the United Kingdom who have registered with the Public Trustee as custodian, claims against German nationals. Notices requesting payment of their debts to the Controller have also been sent to debtors in the United Kingdom who have registered with the Public Trustee as custodian, debts owing to German nationals. Any creditor or debtor who does not receive a notice should communicate with the Controller of the Clearing Office.

Amalgamations.—It is stated that MESSRS. BRUNNER, MOND & Co., LTD., have made a proposal to the Castner-Kellner Alkali Co., for amalgamation of interests; also that a provisional agreement has been entered into between the Vulcan Boiler and General Insurance Co., whereunder that company will be acquired by the London Assurance Corporation. Messrs. Guest, Keen and Nettlefolds, Ltd., are reported to be acquiring a controlling interest in John Lysaght, Ltd.

The Cassirer Cable Works.—It is announced that the cable and rubber works of Dr. Cassirer & Co., of Berlin-Charlottenburg, have been transformed into a joint-stock company, with a share capital of 6,000,000 marks. The transaction has been carried into effect with the co-operation of the Dresden Bank and a private banking firm, each of which has a representative on the board of the new company.

Carels Fréres Developments.—The engineering firm of Carels Fréres, of Ghent, is changing its title to La Compagnie Générale d'Electricité et de Mecaniques (Procédés Thomson-Houston et Carels), and is altering its articles of association to enable it to engage in all branches of the electrical engineering industry.

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Trade Announcements.—THE IVOR ELECTRICAL CO., Ltd., of 10, Kirby Street, Hatton Garden, E.C. 1, are now in a position to undertake repairs to electric motors, armatures, magnetos, &c.

MR. W. M. WILLIAMSON has removed from No. 104 to No. 184, Peckham Rye, S.E, 22, where he has larger premises.

MESSRS. HARRISON & HORSFALL have commenced business as electrical engineers and contractors at Waltham Street, Doncaster Road, Barnsley.

MESSRS. BROTHERTON TUBES & CONDUITS., LTD., have removed their Manchester office to No. 314, Corn and Produce Exchange, Cathedral Street, Manchester. The branch will be under the management of Mr. T. A. Nunwick, as formerly. Telephone number and telegraphic address unaltered.

MESSRS. SPENCER, ABBOTT & CO., LTD, coal contractors (manufacturing fuel by rail or by water), have opened offices at 8, Arthur Street, London Bridge, E.C. 4.

MR. WILLIAM GLASS, who has opened business as a mechanical and electrical engineer at Allness, Ross-shire, N.B., desires to receive catalogues of electric wiring and accessories.

Control of Electricity Prices in N.S.W.—A Bill to control the price of necessary commodities and prevent profiteering was introduced by the Government in the N.S.W. Legislative Assembly recently. In addition to fuels, electricity for lighting, heating, or industrial purposes, is included in the necessary commodities specified in the Bill.—*Tenders.*

Generating Plant for Sale.—St. James' and Pall Mall Electric Light Co., Ltd., has for disposal two Willans compound engines, coupled to two 310-KW. Siemens dynamos. For full particulars see our advertisement pages to-day.

Dissolutions and Liquidations.—H. COLTMAN & SONS, boilermakers, Meadow Lane, Loughborough.—Messrs. J. C. and E. E. Coltman have dissolved partnership.

HOLME ELECTRIC CO., LTD.—Winding up voluntarily. Liquidator, Mr. J. Alderson, of Holme. Meeting of creditors at 1, Westgate, Huddersfield, January 19th.

ARMATURE REPAIR CO., 5, Hirst Street, Liverpool.—Messrs J. Copland, W. A. McGuire, and T. Murphy have dissolved partnership. Messrs. J. Copland and W. A. McGuire will attend to debts and continue the business.

BLACKPOOL AND FLEETWOOD TRAMROAD CO.—Claims to be sent by January 31st, to Mr. J. Cameron, 75, Red Bank Road, Bispham-with-Norbeck, Blackpool.

GELL TELEGRAPHIC APPLIANCES SYNDICATE, LTD.—A meeting is called for February 19th at Sardinia House, Sardinia Street, Kingsway, W.C., to hear an account of the winding-up from the liquidator, Mr. A. F. Dickin.

GRAPHITE PLUMBAGO CRUCIBLE CO., LTD. — Winding up voluntarily. Liquidator, Mr. E. Phillips, Tanner's Hill, Deptford, S.E. 8. Meeting of creditors, January 27th.

Bankruptcy Proceedings.—F. J. HORNETT (Earle), electrician, Truro.—Trustee (Mr. G. C. Hancock, official receiver), released January 2nd.

C. HELLYAR (A. Parker & Co.), electrical engineer and contractor, 130, Upper Richmond Road, East Sheen.—Last day for proofs for dividend, January 26th. Trustee, Mr. T. Gourlay, 132, York Road, S.E. 1.

W. H. MELLON (H. B. Wallis & Co.), electrical engineer, 37, Elliott Road, Chiswick, late of 43, Turnham Green Terrace.—Receiving order made January 10th on debtor's own petition.

LIGHTING AND POWER NOTES.

Ascot.—PRICE INCREASE.—The Electricity Co. has received from the Board of Trade authority to advance the price of electricity from 9d. to 10d. per unit.

Australia.—SYDNEY.—The City Electrical Engineer calculates that by the end of the present year a further capital expenditure of £121,368 will have been made, bringing the total capital charges up to a total of nearly £4,000,000. The net profit of the Sydney undertakings for the three months, July to September, 1919, was £17,588.

TASMANIA.—The Minister of Works states that plant capable of developing 50,000 H.P. has been ordered for the Great Lake hydro-electric scheme, involving an outlay of £2,500,000, of which £1,300,000 is for the power station, £573,000 for sub-stations and transmission lines, and £200,000 for the Hobart installation. It is anticipated that the following yearly revenue will be assured :—Electrolytic Zinc Co., £60,000 ; Carbide Co., at Electrona, £30,000 ; and Hobart district, £60,000.

Bath.—LOAN.—The Ministry of Health regards the proposals contained in the Council's application to borrow £30,405 as generally satisfactory, but awaits a revised estimate based on provisionally accepted tenders.

Buxton. — LOAN. — The Town Council has decided to apply for sanction to borrow £24,379 for various improvements. These include the replacement of the existing steam plant by gas-driven machinery, at an estimated cost of £15,775.

Chesterfield.—PRICE INCREASE.—The Town Council has increased the charge for electricity for private and public lighting by an amount equivalent to 75 per cent. on pre-war prices from the last meter readings in November.

Crewe.—EXTENSION OF SUPPLY.—The Town Council has applied to the Board of Trade for an order to supply electricity to the township of Shavington.

Darwen.—LOAN.—Application has been made for sanction to borrow £27,695 for electricity extensions.

Derby.—JOINT SUPPLY SCHEME.—The Town Council had before it, at the meeting held on January 7th, the report of Messrs. J. H. Rider and C. H. Wordingham upon the proposed Midland joint supply scheme. It was found that while most of the towns would benefit by the suggested arrangements, Derby would have to pay more for energy than at present, owing to the cost of distribution. In view of this, the Joint Committee appointed to deal with the arrangements has not yet agreed to the adoption of the scheme in its entirety, but has arranged for the electrical engineers of the undertakings involved to meet and form an alternative scheme for the Committee's consideration.

Dewsbury. — BULK SUPPLY. — To meet the present shortage of electricity, the Corporation has decided to enter into arrangements with the Yorkshire Electric Power Co. for a bulk supply, and application is to be made for power to borrow £8,500 for distributive plant.

Dover.—PRICE INCREASE. — The Board of Trade has approved the Council's proposal to advance the price of electricity to 8½d. per unit from October last. The Town Council has decided to abandon free wiring as unremunerative. Prepayment meters have also proved too expensive in maintenance, and it has been decided not to install them in future.

LOAN.—The Town Council is applying for powers to borrow £20,000 for extensions and additional plant.

Dysart.—STREET LIGHTING.—The Town Council has invited offers from the Gas Co. and the Fife Electric Power Co. for the lighting of the town. The Power Co. states that it has recently laid main transmission cables through Dysart, but it will be necessary to erect a sub-station and lay distribution cables.

Glasgow.—DALMARNOCK STATION.—It was hoped to have the new power station at Dalmarnock partly in commission by the beginning of this year, but the moulders' strike has caused delay, and it is expected that three months will elapse before a start can be made.

LOAN.—The Secretary for Scotland has signified his approval of the Council's request for powers to borrow a further amount of £1,000,000 for electrical extensions. This brings the total authorised by the Secretary to £5,071,478.

It has been decided by the Council not to reduce charges for energy, upon the reduction of the price of coal, as no increase was made when coal was raised by 6s. per ton.

Hastings.—EXTENSIONS.—The Council has sanctioned several mains extensions, including one to Ore Rectory. Application has been made for a loan of £3,000—the cost of installing meters.

Isle of Wight.—PRICES.—The Electric Light and Power Co. has fixed the price for energy supplied for heating at 4d. per unit for the first 300 units per quarter, and 3d. per unit beyond.

Leith.—NEW PLANT.—The Leith Dock Commission has decided to install a 1,500-KW. turbo-generator to replace the present gas-driven plant. The cost, including the foundations and structural alterations, is estimated at £40,000.

Lewes. — PUBLIC LIGHTING. — The Town Council has sealed an agreement for public lighting with the Lewes and District Electric Supply Co.

Liverpool.—EXTENSIONS.—The Corporation proposes to apply to the Ministry of Health for sanction to the borrowing by the Council of £200,000 for the provision of additional generating plant, boilers, cooling towers, &c., in connection with the reconstruction of the Lister Drive power station.

London.—POPLAR.—New plant is needed to meet the increased demands for power. The Port of London Authority intends to erect a 3,000-KW. sub-station shortly, which the Council is being asked to supply from its mains. Although a certain amount of assistance is available from "linked-up" neighbouring supplies, an immediate expenditure of £68,080 is necessary.

Loughborough. — YEAR'S WORKING. — It is stated that the gross profit of £613 for the last year of the electricity undertaking's working is not sufficient to pay expenses. Even last year's gross profit of £2,112 was inadequate to meet the liabilities. The increases in prices which came into force recently are not considered large enough and a further 15 per cent. advance is projected.

Nelson.—NEW PLANT.—The Town Council has decided to install additional plant, at an estimated cost of £47,600. Applications have been received from cotton manufacturers for the supply of power to 1,800 looms.

New Zealand.—LAKE COLERIDGE UNDERTAKING.—The report on the fourth year's operation of the Lake Coleridge supply states that 23,387,546 units were sold to wholesale consumers at an average cost, allowing for loss in distribution, of 1·125d. per unit, compared with 1,260,725 units sold at an average price of 3·74d. per unit in 1914, the last complete year of operation of the

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Christchurch City Council's steam-generating plant. The connected load has increased to 23,189 KW. This has been supplied without exceeding a maximum load on the Addington sub-station of 5,340 KW., indicating that with the nature of the load in the Christchurch district the use of energy by consumers at different periods during the 24 hours makes it possible to supply a given amount with a plant capacity of less than one-quarter the aggregate of the load connected. Of the special industrial developments associated with a supply of cheap hydro-electric power which have taken place during the year, the position is as follows :—(*a*) Iron oxide for paint, prepared electrochemically from waste sheet-iron, such as empty tins, &c. This industry has now been established on a commercial basis, and the paint is being successfully marketed. (*b*) The electrolytic production of oxygen has proved a definite commercial success. The oxygen is produced by direct electrolysis from water, the hydrogen so far not being utilised, but processes are under contemplation for using this gas in connection with the recovery of lower-grade oils and in soap manufacture. (*c*) Steel smelting : the ferro-concrete building for the works is nearing completion, and the bulk of the electrical equipment has been delivered. The installation of a six-ton 1,200-KW Heroult steel furnace by a New Zealand company is an enterprise of considerable magnitude and interest, and marks an important step in the country's industrial and electrical development.—*Auckland Weekly News.*

HORAHORA SCHEME.—It is understood that the Horahora hydro-electric power plant, recently purchased by the Government from the Waihi Gold Mining Co., was taken over by the Government early in November. The company's staff will, however, run the plant for the time being, and will probably assist with the installation of additional plant.

Richmond (Yorks.).—LIGHTING PROPOSALS.—The question of installing electric lighting in the borough is under consideration. Application has been made to the Ministry of Health, which has referred the matter to the Board of Trade.

Southend.—SUB-STATIONS.—The position with regard to the two sub-stations which were agreed upon prior to the war, is as follows :—The Leigh station was erected shortly before war broke out, and the Diesel engines were ordered and completed. The Council was urged by the Government to dispose of this plant during the war, as it was considered of greater utility elsewhere. The plant was eventually sent to Russia, where there was a shortage of such equipment. The manufacturers entered into an agreement with the Council to supply further plant upon the cessation of hostilities. This has not yet been delivered, and it is proposed to "carry on" for the time being with the four Diesels taken from enemy submarines. The Thorpe Bay sub-station was not commenced in 1914, but efforts are being made to get it running as soon as possible.

South Shields.—PROPOSED EXTENSIONS.—The Electricity Committee states that additional plant is required to meet the increased demands of consumers. The present capacity is 5,800 KW., the same as it was in 1915, and only a part of this can be considered efficient. Consumers' connections have increased from 8,015 KW. in 1915 to 11,481 KW., and in addition to this there are 110 outstanding applications and also the prospect of the early construction of a light railway in the district.

St. Helens.—LOAN.—The Ministry of Health has sanctioned the borrowing of £28,900 for the purchase of a turbo-generator and condensing plant.

Stockport.—EXTENSIONS.—The Electricity Committee is to expend £75,000 on new plant and extensions to the electricity works.

Stockton-on-Tees.—LOAN.—The Ministry of Health has sanctioned the borrowing by the Corporation of £2,500 for prospective expenditure on mains and plant.

Teignmouth.—OFFER TO COUNCIL.—Dr. Purves, who holds an order for Teignmouth electric lighting, has offered to hand it over to the Council on condition that he is allowed to do the work at a charge of 5 per cent. on cost. The Council has decided to meet Dr. Purves on the subject. Meanwhile the Council gives its support to the Dartmoor hydro-electric scheme, and urges other local bodies to take a similar course.

Torquay.—LOAN.—The Town Council has applied for a loan of £1,617 for installing new plant at Beacon Quay, and has increased the meter rental charge from 1s. 3d. to 1s. 9d. per quarter.

Tunbridge Wells.—LOANS.—The Ministry of Health has sanctioned the borrowing of amounts of £15,518 and £3,761 for electrical purposes. Permission to borrow a further sum for the purchase of plant is being withheld pending the receipt of tenders.

Todmorden.—DEFICIT.—The financial statement for the past year, just issued, shows a deficit of £3,281 on the electricity department's working.

Wigan.—SUB-STATION PLANT.—The Town Council is applying for permission to borrow £12,050 for the purchase of rotary converters, &c., for the Bradford Place and Pemberton sub-stations.

Wolverhampton.—PROPOSED EXTENSIONS.—The Electricity Committee has submitted a list of improvements and additions which, it is estimated, will cost £17,000. The largest item is the provision of transformers at a cost of £7,600, excluding the necessary switchgear and other accessories.

TRAMWAY AND RAILWAY NOTES.

Australia.—TRAMWAY RETURNS.—The revenue of the Prahran and Malvern Tramways Trust for the year ended September 30th, 1919, was £214,728, an advance of £10,036 upon the previous year's figure. The last month of the period produced receipts totalling £19,996, a record figure.

Blackpool.—YEAR'S WORKING.—The annual report of the general manager of the Corporation tramways for the year ended March 31st, 1919, gives the following figures :—Total income, £144,535 ; total expenditure, £93,639, leaving a gross profit of £50,896. Net profit, after deduction of loan interest and taxes, was £37,580, a decrease of £355 on last year's figure. The number of passengers carried was 25,548,753, and the total energy employed was 2,137,716 units.

Further extensions of the tramways have been approved by a majority of ratepayers.

Burnley.—BULK SUPPLY.—The Council has received an application from Nelson Corporation for the supply of power for traction purposes. It has been decided to accede to this request if the Nelson Corporation will replace the coal consumed in generating the energy supplied.

Darlington.—STORM DAMAGE.—During a gale on January 8th, a tree was blown against an electric standard, and both fell across the roadway, breaking the overhead wires. Tramway traffic was suspended for several hours.

Halifax.—The proposal to construct tramway lines in Southgate was deleted from the Corporation Bill at a ratepayers meeting last week. The proposal to extend the tramway system to Elland and Wood Bottom, and thereby join up with the Todmorden 'bus service, was carried, as was also the power to increase the fares from 1d. to 2d. per mile, and to alter the gauge.

Leeds.—WORKMEN'S FARES.—It was stated at the meeting of the Town Council held last week, that a heavy loss was resulting from the running of workmen's cars at cheap fares. The annual loss was at the rate of £44,565. An attempt by one of the Labour members of the Council to extend the cheap fare limit from 7.45 to 8.45 a.m. failed.

London.—UNDERGROUND EXTENSION.—The Central London Railway Co. is applying for power to construct a branch line linking up the system with that of the London and South-Western Railway Co., at a point near the latter's Shepherd's Bush station. The necessary capital is being raised by the issue of £374,000 debenture stock. The Bill imposes upon the company a penalty of £50 a day if the stipulated time for construction is exceeded, to be applied as compensation to landowners and others affected.

EXTENSIONS OPPOSED.—Strong opposition is being offered by London local authorities to the London County Council Tramways and Improvements Bill which is being promoted for next session. Among those who have deposited memorials asking to be heard against the Bill are the City of Westminster, the City Corporation, the Boroughs of Hammersmith, Lewisham, Southwark, Paddington, Holborn, Lambeth, St. Marylebone, St. Pancras and Hampstead, and the Urban District Councils of Beckenham, Willesden, and Penge.

Memorials have been received from the Borough of Hampstead and the Willesden Urban District Council in opposition to the Bill promoted by the Middlesex County Council for proposed tramways and other improvements.

Middlesex.—TRAMWAY EXTENSIONS.—The County Council has deposited a Bill for next session which, if passed, will enable the Council to raise £1,000,000 by the issue of county stock. This sum is to be expended upon the construction of a tramway route along the Kilburn High Road, and also for the provision of motor-omnibuses in the county and metropolitan districts.

Newcastle.—PROTEST AGAINST BILL.—At a meeting of the City Council, on the 7th inst., it was decided to petition against the Tyneside Tramways and Tramroads Co.'s Bill. The company is seeking power, *inter alia*, to run omnibuses from Gosforth Park to Seaton Burn, and on other country roads in Northumberland. The Corporation is also seeking power to run 'buses to Seaton Burn, and claims a prior right to operate this service.

Salford.—YEAR'S WORKING.—The report upon the undertaking for the year ended March 31st, 1919, shows total income, £419,181 ; total expenditure, £294,501 ; leaving a gross profit of £124,680. The deduction of interest on loans, rents, &c., leaves a net profit of £25,000. The total mileage of the system is 74·8, and the number of units used during the year was 10,666,672. One item of expenditure (£23,867), represented the amount paid to employés serving with H.M. Forces.

St. Helens.—TRANSFER OF SYSTEM.—The Tramways Committee is taking over the undertaking and also an existing debt of £5,000, and is expected to produce £1,000 per annum while bearing the whole cost of repairs and maintenance. The charge for energy has been fixed at 1·50d. per unit, subject to an increase or decrease of 0·03d. for each rise or fall of 1s. per ton in the price of coal, at present 30s.

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St. Annes.—TRAMWAY PURCHASE.—The Urban District Council and a public meeting have passed resolutions confirming the proposal to promote a Bill in Parliament for the acquisition of the undertaking of the Blackpool, St. Annes and Lytham Tramways Co., Ltd., in the St. Annes and Lytham area.

Stoke-on-Trent.—TRAMWAY PURCHASE.—The Council proposes to promote a Parliamentary Bill to enable it to acquire and work the district tramways, light railways and omnibuses. The Town Committee, a body comprising the leading citizens, approves of the scheme, but considers the proposed purchase price excessive.

Yorkshire.—FARE INCREASE. — The Dewsbury and Batley Corporations are combining to oppose an application of the Yorkshire (Woollen District) Electric Tramways, Ltd., for an order authorising increased fares.

TELEGRAPH AND TELEPHONE NOTES.

Cable Rates and Censorship.—Telegrams will now be accepted for Hungary at 4d. a word. Telegrams are liable to censorship in Hungary, and can, therefore, be sent at sender's risk only. Deferred telegrams for Kismayu, British East Africa, will now be accepted at the rate of 1s. 7½d. a word. All previous notices as to the abolition of censorship on telegrams to places abroad are cancelled. Telegrams for all places abroad (with certain exceptions, which may be ascertained at any post office), may now be accepted without restriction, in accordance with the general arrangements in force before the war.

Egypt.—Regarding the cable delays, there was, according to the *Egyptian Gazette*, in the middle of December, a waiting list of 18,000 messages at Alexandria, and at Suez a similar collection of 12,000. These were being dispatched as quickly as possible, but the fresh ones sustained the waiting list, as described.

Italy.—A special wireless service between England and Italy for the use of the Press was opened on January 6th, by the Marconi Co. This service, authorised by the Italian Government and the British Post Office, was instituted particularly to assist the Italian Press in obtaining prompt reports of the Italian Prime Minister's visit to London. The Marconi high-powered station at Carnarvon is being used for the purpose, and three hours daily have been allotted for this particular traffic.

Storm Damage.—There was a breakdown of the overland telegraph lines to the Continent, on January 10th, which interrupted the cross-Channel cables. The main interruption of the land lines was reported on Saturday afternoon near Tunbridge Wells, on the London-Dover route, but soon after 9 o'clock communication with France was resumed, and later with Holland, but not with Germany.

Much damage was caused by the week-end storm to telegraph and telephone systems, not only in England, but all over Western Europe. Communication with Ireland and the Continent, on Monday, could only be carried on by roundabout routes and with much delay. Rome, Marseilles, and Zurich were completely isolated from London.

Wireless Meteorological Information.—The *London Gazette*, January 6th, contains an Admiralty Notice to Mariners, No. 8, of 1920, which cancels the former notice, No. 1,393, of 1919, relating to wireless meteorological information to and from ships at sea. It is hoped that all concerned will assist in making this service a success; negotiations are in hand to extend and unify the system of collecting weather data by wireless from ships at sea all over the world, and at the same time to organise the free transmission of weather bulletins to admit of ships being constantly supplied with reliable weather reports and forecasts wherever they may be. The need of ships at sea regarding information about the weather will march hand-in-hand with the requirements of aircraft, and the importance of the service will, therefore, be constantly increasing. The essence of success lies in rapidity in passing on wireless data collected by ships to the coast stations, and thence to the central meteorological office.

Wireless Service Suspended.—The Marconi wireless telegraphic service to the U.S.A. and Newfoundland has been temporarily suspended, says the *Financial Times*, due to a matter affecting an agreement with the Western Union Cable Co.

Wireless Telephony.—According to the daily Press the Marconi Co. is about to demonstrate a use for wireless telephony in aerial navigation by the employment on an airway route of direction-finding stations. The company also has made successful experiments in wireless telephony between Chelmsford and a station 20 miles east of Amsterdam, with portable sets that can be carried on mules.

Wireless Time Signals.—The *London Gazette*, January 6th, contains an Admiralty notice to mariners, No. 7, of 1920, which cancels the former notice No. 1,993, of 1919, giving general information with regard to wireless time signals, also a complete and up-to-date list of all time signals issued by wireless stations throughout the world.

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the ELECTRICAL REVIEW *in which the "Official Notice" appeared.)*

OPEN.

Aberdeen.—January 31st. Electricity Committee. Two water-tube boilers, with superheaters, economisers, steel chimney and accessories. (January 9th.)

Aldershot.—January 20th. Urban District Council. Electricity Department. Renewal of 180 positive sections for batteries. (See this issue.)

Australia.—SYDNEY.—February 18th. One electrically-controlled tower clock and four dials, for Sydney sub-station. Chief Electrical Engineer's Office, 61, Hunter Street, Sydney.

March 1st. Municipal Council. Supply of 2,000-K.V.A., 5,000 to 10,000-v. transformers. Electric Lighting Department, Town Hall.

PERTH, W.A. — February 10th. P.M.G.'s Department. 340 accumulators (schedule W.A.647.) (December 19th.)

MELBOURNE.—February 25th. Victorian Railways. Incandescent electric lamps. Particulars from the Contractor's Room Spencer Street, Melbourne.

March 10th. City Council. Supply of 6,600-v. switchgear for sub-station switch houses, &c., and of six 250-K.V.A., three-phase transformers. Specifications from City Electrical Engineers' Office, Melbourne.—*Industrial Australian and Mining Standard.*

Bray.—January 30th. Urban District Council. Electricity Works. One 200-B.H.P. Diesel engine, direct coupled to a 135-K.V.A. single-phase alternator and exciter. (January 9th.)

Barnes.—January 20th. Urban District Council. Electricity Department. Supply of water-tube boilers, economisers, draught plant, turbo-alternators, condensers, air and circulating pumps, transformers and rotary converters. (December 12th.)

Battersea. — January 21st. Borough Council. One 5,000-KW. turbo-alternator, with condensing plant; one 1,500-KW. rotary converter; pipework for the 5,000-KW. turbo-alternator; switchgear for the 5,000-KW. turbo-alternator and 1,500-KW. rotary converter. (January 2nd.)

Bradford.—January 28th. Corporation. Two electric battery locomotives. (December 26th.)

Chile.—March 15th. Comision de Puertos, Santiago. Electrical machinery (power and lighting) for the Port of Valparaiso. Comision de Puertos, Santiago, Chile. Copies of the specifications can be seen at the Chilean Legation, 94, Gracechurch Street, London, between 3 and 5 p.m.

Colne.—Electricity Department. New or second-hand 1,250-KW. to 2,000-KW., 6,600-v. turbo-alternator, with condensing plant. (See this issue.)

Dundee. — January 23rd. Corporation. Electricity Department. Three 750-KW. converter sets; one 300-KW. ditto; 11,000 v., E.H.T. switchboard; two 750-KW., D.C. control panels; one 300-KW. ditto. (December 19th.)

Edinburgh.—February 9th. Electricity Supply Department. One overhead travelling crane. (See this issue.)

Ilford.—January 27th. Urban District Council. Electricity Department. One 1,000-KW. converting plant, cooling tower, motor-driven air compressor, L.T. cables. (January 9th.)

Kingston-upon-Hull.—January 23rd. Electricity Committee. One 10,000-KW. turbo-alternator, with exciter, and one condenser outfit complete. (January 2nd.)

London.—ISLINGTON.—January 28th. Electricity Committee. Stores, including cables, meters, electric lamps, &c., for 12 months. (December 19th.)

HAMMERSMITH.—January 20th. Electricity Department. Wiring schemes for small property, boiler setting and furnace work, &c. (January 9th.)

STEPNEY. — January 22nd. Electricity Supply Committee Two water-tube boilers, chimneys, economisers, &c., and one 5,000 KW. turbo-alternator, with condenser, accessories and switchgear. (December 19th.)

HAMPSTEAD.—January 28th. Borough Council. 12 months' supply of electrical engineers' stores; 6 or 12 months' supply of oils for the electricity station. Forms of tender from Mr. A. P. Johnston, Town Clerk, Town Hall, Haverstock Hill, N.W.3.

CAMBERWELL.—February 2nd. Borough Council. 12 months, maintenance of the private telephones and electric bells at the Town Hall. Mr. F. J. Slater, Borough Engineer, Town Hall, Camberwell, S.E.

New Zealand.—AUCKLAND.—September 1st. Harbour Board. 12 5-ton (and alternatively for 12 3-ton) semi-portable balanced jib level Luffing electric cranes. Specifications from the Agents of the Board, Messrs. W. & A. McArthur, Ltd., 18/19, Silk Street, Cripplegate, E.C.

Pontypridd.—January 30th. Urban District Council. Electricity Department. Rotary converter, transformer and switchgear. (January 9th.)

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Venezuela.—June 30th. The Government *Gazette* of Venezuela publishes a decree inviting tenders for the installation of a wireless telegraphic station near Caracas. (See this column for January 2nd.)

Whitby.—January 30th. Urban District Council. Turbo-alternator, condenser, air and circulating pumps, water-tube boiler, rotary converter, transformer, A.C. switchboard, E.H.T. cables. (See this issue.)

York.—January 20th. Electricity Committee. Tenders for the carrying-out of a hydro-electric scheme at Linton Lock. (January 9th.)

CLOSED.

Australia.—Sydney.—City Council. Accepted :—

Sub-station switchgear for Palmer Street sub-station £1,756.
" " Bulwarra Lane; " 954.
" " Irvine Street " 954.
Metropolitan-Vickers Electrical Co., Ltd.—*Tenders.*

Glasgow.—The Tramways Committee has accepted the following offers :—

Aluminium ribbon.—Coe Ribbon Gold Leaf Manufacturing Co.
8-in., single-way, fireclay ducts.—Doulton & Co., Ltd.
·102 D.C.C. wire.—London Electric Wire Co. and Smiths, Ltd.

The Tramways Manager is to report upon offers received for the supply of a rotary converter for the Dalhousie Street sub-station, and inspect types submitted.

London.—STEPNEY.—The Electricity Committee has accepted the offer of Messrs. Foster & Co. to supply 13,000 tons of coal at prices varying from 34s. 1d. to 35s. 4d. a ton.

Two new converters, £11,800, Bruce Peebles & Co., recommended.

Troughs, covers and earthenware pipes :—

Sutton & Co.	(recom.)	**£254**
Siemens Bros. & Co.		£267

HACKNEY.—Public Health Committee. Recommended. Special plant in connection with the charging station for electric vehicles :—

250-amp., 110-v. motor-generator :—

	R.P.M.	£
Lancashire Dynamo & Motor Co.	720	475
" " "	1,000	445
J.H. Holmes & Co. .. "	900	445
Electromotors, Ltd.	710	483
B.T.H. Co.	815	415
Electric Construction Co.	1,800	280
" " .. (recom.) ..	1,000	330

Charging gear :—

Lancashire Dynamo & Motor Co.	£629
J. H. Holmes & Co.	480
Igranic Electric Co. .. .. (recom.)	433

Nelson.—Town Council :—

Generating machinery, £47,600.—Brush Electrical Engineering Co.

Tasmania.—LAUNCESTON.—City Council.

One battery complete with spares and instruments (Australian manufacture) delivery in 26 weeks, £3,529.—Accumulators, Ltd.

No tender was accepted for the booster equipment owing to the abnormally high prices.—*Tenders.*

Wolverhampton.—Town Council. Accepted :—

Two K.V.A. transformers, £456.—Brush Electrical Engineering Co., Ltd.
Wheel lathe, £940.—Wirth & Co.
Power press, £665.—Leeds Engineering Co.
Consumers' meters, £495.—Chamberlain & Hookham, Ltd.

FORTHCOMING EVENTS.

Association of Engineers-in-Charge.—Saturday, January 17th. At St. Bride's Institute, Bride Lane, E.C. At 7.30 p.m. Social and dance.

Salford Technical and Engineering Association.—Saturday, January 17th. At the Royal Technical Institute. At 7 p.m. Presidential address by Mr. J. Morris, and musical evening.

Institution of Post Office Electrical Engineers (London Centre).—Monday, January 19th. At 5.30 p.m. At the Royal Society of Arts. Lectures on "Victory Line to Germany," by Major H. Brown; "Evacuation of Helles," by Major Turner; "Buried Cable Works," by Capt. Reid.

Royal Institution of Great Britain.—Tuesday, January 20th. At Albemarle Street, W. At 3 p.m. Lecture by Sir John Cadman.
Friday, January 23rd. At 9 p.m. Lecture on "Researches at High Pressures and Temperatures," by Sir Chas. Parsons, F.R.S.

Society of Technical Engineers (North-Eastern District).—Wednesday, January 21st. At the City Hotel, Newcastle-on-Tyne. At 7 p.m. Mass meeting.

Junior Institution of Engineers.—Friday, January 23nd. At 39, Victoria Street. At 7.30 p.m. Paper on "Evaporation in the Chemical Industry," by Mr. J. A. Reavell.

Institution of Electrical Engineers.—Thursday, January 22nd. At the Institution of Civil Engineers, Gt. George Street, S.W. At 6 p.m. Paper on "Transformers for Electric Furnaces," by Mr. J. L. Thompson.
Informal meeting. Monday, January 19th. At the Institute of Patent Agents, Staple Inn Buildings, W.C. At 7 p.m. Discussion on "Functions of a Trade Journal," to be opened by Mr. F. H. Masters, O.B.E.
(North-Western Centre—Liverpool Sub-Centre.)—Monday, January 19th. At the University, Liverpool. At 5.30 p.m. Lecture on "The Application of Electric Power on Board Ship," by Mr. C. H. Wordingham, C.B.E. At 7 p.m. Chairman's (Prof. E. W. Marchant) address, also addresses by the President, Mr. C. H. Wordingham, and Mr. J. A. Robertson.

Institution of Mechanical Engineers—Friday, January 23rd. At Storey's Gate, S.W. At 6 p.m. Paper on "Recent Advances in Utilisation of Water Power," by Mr. E. M. Bergstrom.

Electrical Power Engineers' Association (West Yorks. Section).—Saturday, January 24th. At the Y.M.C.A., Albion Place, Leeds. At 6.45 p.m. Lecture on "The Legitimate Sphere of Trade Unionism," by Mr. F. Kirkley.

Royal Photographic Society, Russell Square, W.—Exhibition of prints lent by the Röntgen Society. Open till February 7th.

NOTES.

The 10s. Coal Rebate.—We are informed by the secretary of the Provincial Electric Supply Committee of the United Kingdom that he has, at the request of the Coal Controller, sent to electricity supply companies 200 copies of the printed prescription issued by the Board of Trade with reference to obtaining and passing on to the consumer the rebate of 10s. per ton on coal used for generating electricity sold for domestic or household purposes, together with an explanatory memorandum approved by the Coal Controller. In case, however, any particular undertaking has not received a copy, one may be had on application to Mr. T. W. Cole, secretary of the above Committee, at Moorgate Court, Moorgate Place, London, E.C. 2. The prescription is printed on p. 75, with an abstract of the explanatory memorandum.

Central-Station Salaries.—A recent issue of *Power* gives the undermentioned details of the salaries paid to the various classes of typical central-station employés in the U.S.A. :—

SALARIES IN CENTRAL STATIONS.

Capacity in KW.	Chief engineer.	Watch engineers.	Oilers.	Firemen.	Chief electricians.	Electricians.	Sw.-board operators.	Pipe fitters.	Labourers.
35,000	250	175	156	156	225	154	135	134	104
30,000	185	135	—	130	145	118	112	140	—
24,000	208	108	104	—	114	104	127	104	89
15,000	275	173	154	142	—	—	132	228?	120
11,250	225	140	115	120	—	180	120	120	93
6,000	300	180	150	180	175	145	—	165	110
2,000	150	120	—	115	150	65	—	—	—
670	152	105	104	—	—	—	—	—	—
425	160	122	—	108	—	—	—	—	—

Salaries in dollars per month.

A "Live" Lorry.—It is reported from Wallsall that a Foden steam wagon became electrically "live" whilst standing on the roadway, and the driver complained to the motorman of a passing tramcar that he thought the energy was coming from the tramway system. On touching metal parts of the steam engine, a shock was felt, yet there was no contact either with the tramway rails or a pole. The motorman, however, noticed that steam from the wagon was ascending directly to the tramway wires, and on the steam being shut off, no further shocks were perceptible. It is presumed that the current from the wires travelled down the column of vapour.

The Patents and Designs Act.—The Patents and Designs Act, which became law on December 23rd, 1919, makes numerous alterations in the British patent law, of which the following are those of most general interest to inventors and patentees :—

1. The period of provisional protection is increased to nine months. Any application, therefore, accompanied by a provisional specification, and lodged subsequent to March, 1919, may be completed within nine months of the date of application, or, by the payment of a fine, within 10 months.

2. The term of a patent is increased to 16 years. This applies to all patents on applications dated December 23rd, 1905, or later. The fees, if any, to be paid for the fifteenth and sixteenth years are not yet fixed.

3. A patentee, other than a late enemy, who has by reason of the war suffered loss or damage (including loss of opportunity of dealing with or developing his invention, owing to his having been engaged in work of national importance connected with the war), may apply in a simpler and cheaper manner than was before possible for a prolongation of the term of his patent, and the Court in considering the application, may have regard solely to such loss or damage.

4. Any person who has acquired, or may acquire, by assignment, licence, or the like, any interest in a patent or design, must register his interest at the Patent Office.

5. The grounds on which the grant of a patent may be opposed are enlarged. Such grant may now be opposed on the ground that the invention has been published in any document published in the United Kingdom prior to the application.

6 (*not yet in force*). At any time after the sealing of a patent, the patentee may request the Comptroller to endorse the patent with the words "Licences of right." The Comptroller, on being satisfied that the patentee is not precluded from making such request, will so endorse the patent, and thereafter the patentee will only have to pay half the normal renewal fees, but any person who wishes to use the invention will have the right to a licence on terms to be settled by the Comptroller in default of agreement between such persons and the patentee, and the Comptroller may, in order to secure equality of advantage among several licencees, reduce the royalties payable under any licence previously granted.

7 (*not yet in force*). Somewhat drastic provisions as regards the grant of compulsory licences and revocation have been substituted for Sec. 27 of the old Act, the so-called "working" section.

8. Under certain conditions publication of an invention in a paper read before a learned society does not invalidate a patent subsequently applied for. This provision, however, is fraught with the greatest danger, and should not be taken advantage of without professional advice.

9. No person other than a registered patent agent may now practice, describe, or hold himself out as a patent agent.

The foregoing summary has been drawn up by the Council of the Chartered Institute of Patent Agents.

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H.M.S. Hood.—On January 9th *H.M.S. Hood*, the latest British capital ship, left Messrs. John Brown's Clydebank yard for her official trials. She is to be completed at Rosyth, and it is understood that she will replace *H.M.S. Queen Elizabeth* as flagship of the Atlantic Fleet. Possibly the new *Hood* will be the last of her kind; there are no other capital ships under construction for the British Navy. This vessel, on which electricity is made use of extensively, is a blend of battleship and battle cruiser; she embodies all the lessons of the war, including "blister" protection against torpedo attack. She is 860 ft. long, displaces 41,200 tons, has a horse-power of 144,000, and a designed speed of 31 knots. Her main armament consists of eight 15-in. guns, and her secondary armament of 12 5·5-in. and four 4-in. anti-aircraft guns. When completed for sea, the *Hood* will have cost £6,025,000, and the annual cost of her maintenance in commission will be £539,000.—*Evening News.*

The Slough Motor Depôt.—In view of the fact that our note last week on the above depôt might be read as if the Benjamin Electric, Ltd., was carrying out the electrical installation, we wish to make it quite clear that, while Benjamin reflector fittings, and reflectors are being used throughout for interior lighting, the installation work is being carried out by Messrs. Dixon & Sons, Ltd., of Leeds, Messrs. Malcolm & Allen, and Messrs. Foote & Milne, of London.

The "Threat" to Dartmoor.—In a letter to *The Times* of January 10th, Mr. J. E. Addinsell, secretary, the Wilson Syndicate, Ltd., points out that the Dartmoor and District Hydro-Electric Supply Bill is a Bill which the Wilson Syndicate have taken over from its original sponsors, and to every detail of which they are not wedded. It will be quite possible in Committee to safeguard the desire, with which the promoters sympathise, to preserve the historic monuments and the amenities of Dartmoor. Thus, for example, there is no intention to submerge the stones of Scorhill Circle, about the destruction of which so much has been said. Again, there will be no generating station and consequently no disfiguring poles on the moor itself.

With regard to the proposed metal works in the neighbourhood of Newton Abbot, most of the criticism of these is based on a complete misconception. The works are to be situated in a spot already so "industrialised" that there can be no question of spoiling its beauty. It is not the intention of the promoters to use any processes which will cause destruction to the surrounding vegetation. The methods which will be employed at these works will be such as to ensure a total absence of any noxious fumes or any gases which might be deleterious to vegetation, even to the extent that there will not be any smoke whatsoever.

Further, with reference to the objections raised to the proposed copper refining, blister copper, and not copper ore, is the raw material which will be used, and this material will be sulphur free.

We recently explained that the use of the water power would not necessarily interfere with the amenities of the district.

Training of Disabled Men.—Satisfactory progress with regard to the training of ex-service men in the West Midland area, of which Birmingham is the centre, is reported by the Divisional Director. The men in training total 922 in Birmingham, and 220 in country areas; making aggregates of 1,146 and 414 respectively. There are still 1,272 awaiting industrial training. Forty-six men are learning electrical engineering, either in technical school or workshop; a figure which compares well with other industries.

A B.T.H. Dinner.—The annual dinner of the B.T.H. Co.'s testing department will be held on the third or fourth Saturday in February. The Committee trusts that all past members of the department will endeavour to attend. Application for tickets should be sent as soon as possible so that final arrangements can be made to Mr. K. R. Hopkirk, c/o Testing Department, B.T.H. Co., Rugby.

Appointments Vacant.—Shift engineer (£264) for the Accrington Corporation Electricity Department: cable jointer (78s. + 12½ per cent.), for the Wrexham Corporation Electricity Works; lecturer in electrical engineering (£350, rising to £400), for the Faculty of Engineering, Merchant Venturers' Technical College, Bristol; assistant electrical engineer ($3,600 + $720, equal to £504 per annum, dollar = 2s. 4d.), for the Municipal Commissioners of Singapore; instrument maker (£300), for the East London College; two vacancies in the Electrical Engineering Department (Telegraphs) (600 rupees a month) in the Bombay and Baroda and Central India Railway, India; shift engineer (£4), for the Torquay Corporation Electrical Department; assistant mains engineer (£260), for the City of Coventry Electricity Department; traffic superintendent (£275); and rolling stock superintendent (£275), for the Wigan Corporation Tramways; charge shift engineer (£250 + 20 per cent. + £90), for the L.C.C. Tramways Department; mains superintendent (62/6 + 20 per cent. + £90), for the Tynemouth Corporation Electricity Works; switchboard attendant (37/6 + 33/6 + 12½ per cent.), for the Lancaster Corporation Electricity Department; assistant telegraph engineers (£250 + £65, for single men, and £115 for married men), for the Government of Uganda; Principal of L.C.C. Training Centre for disabled sailors and soldiers in the electrical and engineering trades at Hackney Marshes (£600).—See "Official Notices" to-day.

Volunteer Notes.—COUNTY OF LONDON R.E. (V.) LONDON ARMY TROOPS COMPANIES.—A cheque for £94 8s. 5d., being the balance of the funds of No. 3 Co. Royal Engineers (V.), London Army Troops Companies (Engineering Institutions Company), has been forwarded to Sir John Snell, for distribution to the Benevolent Funds of the three Engineering Institutions, in accordance with the arrangement made when subscriptions were invited.

Joint Electricity Authorities.—GLOUCESTERSHIRE.—At a meeting of the Gloucestershire County Council, on January 12th, the proposed formation of a joint electricity authority for the county and parts of Wilts and Monmouthshire was discussed. The chairman stated that the Ministry of Shipping was anxious to dispose of the generating station at the Government works at Beachley, which could be used to supply the Forest of Dean district west of the Severn; other schemes were being brought forward for the supply of electricity to the Forest of Dean mines. With Mr. Gardom he had attended a meeting at Bristol, at which certain resolutions (reported in our pages last week) were passed, and he asked the Council to adopt them. The resolutions expressed agreement with the formation of a joint electricity authority, with forming part of such authority, with contributing to the expenses, and with the appointment of an Organising Committee to prepare a scheme. The resolutions were adopted.

At a meeting of the Organising Committee, on Friday last, Mr. H. Faraday Proctor was elected chairman.

SOMERSET.—At a meeting of the Somerset County Council, held on Friday last, resolutions expressing agreement with the formation of a joint electricity authority were adopted.

Housing and Transport.—Addressing the members of the Auctioneers' and Estate Agents' Institute, on Friday last, on "Some Aspects of the Housing Problem," Mr. Frank Hunt, Chief Valuer of the London County Council, said that hitherto the traffic at cheap workmen's fares ceased on arrival at the London terminus at 8 o'clock, and there was another traffic peak period extending up to 10 o'clock. The alteration in the hours of labour had tended to cause these two traffics to coalesce, and to be compressed into a shorter period; and this also operated in a somewhat similar way at the other end of the day. There was no doubt that considerable improvements would be needed in the methods of transport, and he thought the present lack of system, whereby there seemed to be no co-ordinated action to use the various instruments of transport for the purposes for which they were best adapted, would need to be superseded by an intelligent system. When the various systems of transport in big towns were scientifically organised, it would be found most convenient to run the trains to nodal stations, and to organise around those stations systems of surface transport.

I.M.E.A. Convention.—The *Yorkshire Observer* states that the annual convention of the Incorporated Municipal Electrical Association is to be held in Bradford in June next, and a special Sub-Committee of the Bradford Electricity Committee has been appointed to make all the necessary local arrangements.

Memorial Tablet at Stuart Street.—On January 11th the Lord Mayor of Manchester unveiled at Stuart Street generating station a memorial tablet, bearing the names of all employés of the station who volunteered for service in the war and laid down their lives. The names are 25 in number out of 212 who joined up from the works.

Electricity to the Rescue.—At Newcastle-under-Lyme the annual New Year's Fair was held, last week, on a piece of land adjacent to the electricity supply station. Shortly before 1 o'clock on the Monday, Mr. Pat Collins's representatives came to the works in great distress, saying that their engine had broken down, and unless something could be done for them there would be no Fair, as the place would be in darkness after sunset. Mr. A. J. C. de Renzi, the borough electrical engineer, immediately got to work, and had a pair of leads run from the switchboard of the scenic railway to a small motor-generator which was used in the ordinary way as a milking booster. By 5 p.m. everthing was connected up, and a supply of 150 amperes was given, enabling the whole of the shows to run with the usual blaze of light which is such a prominent feature of festivities of this kind. Quick work!

It is interesting to note that the motor-generator referred to above was installed chiefly for the purpose of charging battery vehicles. The town being situated on the main road between London, Birmingham, Manchester, and the North, there is an enormous amount of motor traffic passing through daily, and the electricity department has already given a charge to a number of electric vehicles going through from Birmingham to places in the North. A vehicle can be put on charge within five minutes from the time it enters the works. When such charging facilities are provided everywhere, the one obstacle to the use of "electrics" for long-distance runs will be removed.

A Red Rag to John Bull.—Since our leading article on page 65 of this issue was written, Mr. Edward Price Bell, of the *Chicago Daily News* London Bureau, has expressed in a letter to *The Times* some most admirable sentiments on the task of educating mankind internationally. Under the title "Light and Leading," he says that practically everybody everywhere is occupied with the all but overwhelming problem of giving the world "a happy peace—the only kind of peace that can last." While we cannot hold Mr. Bell answerable for all the utterances of men like Mr. Montague, it is not inconceivable that he might be able to use his newspaper influence to prevent indiscretions which cannot make for "happy" international peace and harmony in respect of trade. Perhaps he will be expressing his views on the application of his most noble sentiments in connection with international trading relations.

Signal Experimental Ship.—The steam and electrical trials of the cruiser *Antrim* are to be carried out from the 12th to 17th inst. On February 18th the vessel will commission as an independent command, with a special complement drawn from Portsmouth, for service as signal and wireless experimental ship at Portsmouth.—*Morning Post.*

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INSTITUTION NOTES.

Salford Technical and Engineering Association.—The first meeting on the new syllabus will be held on January 17th, when the Presidential address will be given, after which the meeting will resolve into a musical social evening. On March 13th, Mr. D. H. Ogley will read a paper on "Works Lighting," and the "Barton Electric Power Station" will form the subject of a paper by Mr. S. L. Pearce on September 11th. A reunion of members will be held on November 13th to celebrate the home-coming of the "boys"; the annual general meeting will be held on December 4t h and the annual social on December 27th.

Institute of Metals.—The programme of meetings shows how the Birmingham, Sheffield and Scottish local sections of the Institute are developing; the membership of the Institution is now over 1,200. The annual general meeting will be held on March 11th and 12th, the annual dinner is also to be held on the latter day.

Institution of Electrical Engineers.—The first meeting of the Liverpool sub-centre will be held on January 19th at the University, Liverpool; Mr. Roger T. Smith (president), Mr. C. H. Wordingham, C.B E. (past president), and Mr. J. A. Robertson (chairman N.-W. Centre), will address the meeting. Prof. E. W. Marchant, D.Sc. (chairman, Liverpool sub-centre), will deliver the chairman's address, and there will be demonstrations in wireless telephony and telegraphy. Mr. C. H. Wordingham will lecture on "The Application of Electric Power on Board Ship," at 5.30 p.m. This meeting is called to inaugurate the new Liverpool sub-centre, and it is hoped that there will be a good attendance from all parts.

Barrow and District Association of Engineers. — Mr. H. Thackeray, A.M.I.C.E., read a paper on "Fuel Economy and the Use of the Large Gas Engine," before a meeting of the Association on January 9th. The subjects were exhaustively dealt with by the speaker, who emphasised the need for large ironworks to utilise or recover all the by-products from their blast furnaces. He reminded his audience that Middlesbrough was supplied with gas from the coke ovens of local ironworks. Referring to the subject of gas engines, Mr. Thackeray gave particulars of an 1,800-B.H.P. horizontal tandem engine at present under construction at the works of Messrs. Vickers, Ltd. This engine is of the four-cycle, double-acting type, with 43-in. diameter cylinders, and a stroke of 47½ in. At normal load the I.H.P. is 1,970, with a mean pressure of 60 lb. per sq. in. and a speed of 100 R.P.M. It is designed for driving either a D.C. generator of 1,150-KW. capacity (230 volts, 5,000 amperes), or an A.C. 1,200-KW. generator. Alternatively it may be coupled to a reciprocating blower with a capacity of 27,000 cb. ft. of air per minute,

Birmingham and District Electric Club.—At a meeting held on January 10th, Mr. Wolton, A.M.I.E.E., A.M.I.M.E., the new president, delivered his inaugural address. The speaker, commenting upon present industrial unrest, said that the stabilising forces present during the war were still needed during the period of reconstruction. He thought that the Electricity (Supply) Act carried with it enormous possibilities in the direction of cheap power supply. In conclusion, Mr. Wolton suggested the formation of an Engineers' Club to provide a meeting place for engineers of all branches.

Mr. R. A. Chattock, proposing a vote of thanks to the speaker, said that his experience led him to hope that Industrial Councils would be instrumental in solving labour troubles. Referring to the Electricity Act, the speaker said that reorganisation had already commenced, and in a short time the progress would be plainly seen.

Institution of Civil Engineers.—The Council has arranged for the delivery to students of the Institution in London and at some of the Local Associations of two Vernon-Harcourt lectures, by Mr. R. B. Dunwoody, Assoc.M Inst.C.E., on "The Economic Requirements for Inland Navigation Transport in the British Isles." The lectures will be delivered to London students at the Institution on January 16th and 30th, at 6 p.m.

Faraday Society.—At the annual general meeting, on Dec. 15th, 1919, the following officers and Members of Council were elected to serve for the ensuing year :—

President.—Sir Robert Hadfield, Bart., F.R.S.

Vice-Presidents.—W. R. Cooper, Prof. F. G. Donnan, F.R.S., E. Hatschek, Prof. A. W. Porter, F.R.S., E. W. Rayner.

Treasurer.—Robert L. Mond, F.R.S.E.

Council.—Dr. J. Allmand, Dr. H. Borns, Prof. C. H. Desch, Dr. J. A. Harker, O.B.E., F.R.S., Cosmo Johns, Harold Moore, Prof. J. R. Partington, Dr. W. Rosenhain, F.R.S., Sir T. Kirke Rose, Dr. George Senter.

On March 1st, 1920, the Society will hold a joint meeting with the London Section of the Society of Chemical Industry to receive and discuss a report by Dr. T. Martin Lowry, F.R.S., and Mr. E. C. Hemmings on "The Setting of Salts and other Crystalline Substances."

On March 23rd, 1920, the Society will hold a general discussion on "Basic Slag from the Metallurgical and Agricultural Standpoints."

Wireless Society of London.—The next general meeting will be held on January 29th, at 6 p.m., at the Institution of Civil Engineers, when a lecture, illustrated by experiments and lantern slides, will be given by Mr. R. C. Clinker, entitled "A Portable Valve Set and Some Properties of C.W. Circuits."

A number of provincial Wireless Clubs and Societies have signified their desire to become affiliated to the Society.

South African Institute of Electrical Engineers.—A special general meeting of the South African Institute was held at Johannesburg on November 20th, 1919, for the purpose of considering and, if approved, adopting with or without further amendments, certain amendments and alterations to the constitution and rules proposed by the council. Mr. A. E. du Pasquier (president) was in the chair. The first amendment was to Rule II, which originally read that it was necessary for a new member to be proposed by a member, seconded by another member, and to be supported by at least two other members, all from personal knowledge. Candidates wishing to join the Institute who went straight out from home, and who did not know members out there who had known them in their home capacity, were handicapped by this rule. It was agreed that the rule be altered so as to provide for such a candidate being proposed and seconded by members from personal knowledge, and the other support to be from information supplied. The next proposal was to amend Rule 20, with the object of increasing the subscription rates of country members, associates, and technical associates, but not of students. The council felt that country membership terms were too low, namely, £1 11s. 6d. and £1 1s. for a member and associate member respectively. After some opposition on the score that country members should not be taxed, the proposal was carried.

Institution of Civil Engineers of Ireland.—At a general meeting of the Institution, at Dublin last week, Mr. L. J. Kettle said there was coal underneath 1,800,000 acres of Ireland—nearly one-tenth of the surface of the whole country. The finest samples of anthracite coal he had seen were from the County Tipperary. Although anthracite coal was valuable, their consuming apparatus in Ireland had been designed for bituminous coal, for the bulk of British coal was bituminous. The exploitation of Irish coal had been handicapped by the absence of a proper mining survey; the railways of the country had apparently been built with the idea of avoiding the coalfields.

Mr. Marshall Harriss, manager of the Dublin Electric Tramways Co., agreed as to the usefulness of Irish anthracite coal. With proper appliances and furnaces, they could burn it and raise steam efficiently. Some of the owners feared that if they attempted to exploit the mineral, the Government would intervene.

Mr. S. J. Horne testified to the excellent results obtained from Irish anthracite coal in connection with suction gas producers.

Mr. J. J. Parkinson, proprietor of the Castlecomar, Co. Kilkenny, collieries, said that one of the great uses of Irish anthracite in the future would be in the form of powdered coal.

Association of Engineering and Shipbuilding Draughtsmen.—Lectures will be given at Birkenhead on January 21st; Manchester, on January 22nd; and Chesterfield, on January 23rd.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

THERE was a long debate at Blackburn Town Council, on January 8th, on a resolution to increase the salary of the electrical engineer (Mr. P. P. WHEELWRIGHT) from £800 to £1,000 a year. It was pointed out that the town had saved £15,000 by Mr. Wheelwright undertaking the personal oversight of the new super-power station at Whitebirk at a cost of over £300,000, and that having regard to the importance of his position the proposed increase was little enough. The Labour element opposed on the ground that Mr. Wheelwright was receiving far more than engineers in charge of larger works in the county, notably Stockport, Bury, and Oldham. It was also urged that the Blackburn works did not show the same favourable percentage as other works. Eventually the resolution was carried, and a motion that a further proportion of the munition profits at the electricity works should be allocated to Mr. Wheelwright was withdrawn.

Captain H. NIMMO, R.E. (T.), recently gave up his appointment as district education officer for the Woolwich district hospitals, and he left Liverpool by the s.s. *Derbyshire* on January 9th for Rangoon to rejoin the Government of Burma P.W.D. At the outbreak of war he was officiating electrical inspector to the Government of Burma, and came home at the end of 1915 to join the Forces. He was in the London Electrical Engineers R.E. (T.), until February, 1919, when he took up educational work.

Mr. C. T. ASTBURY, burgh electrical engineer of Wishaw, has resigned, having accepted a post with the Cable Accessories Co., Ltd., Tividale, Tipton, as their Scottish representative, with offices at 35, Robertson Street, Glasgow, where he takes up his new duties on January 17th.

Mr. WILLIAM STEAD, M.I.M.E., M.I.E.E., has opened an office in Manchester at Duchy Chambers, 4, Clarence Street, Albert Square, from which he will conduct his practice of consulting, mechanical, and electrical engineer. Mr. Stead's tent—by 463,135. Of the total units 43.5 per cent. were sold for private lighting; 46.5 were for power purposes; other purposes took 6.1 per cent., and public lighting absorbed 3.55 per cent. He told them at the last meeting that they

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experience of power plant design and use extends over 30 years; it has included the utilisation of waste gases from blast furnaces and coke ovens, &c.

Mr. EDWIN JACOB has resigned his position as managing director of the Tudor Accumulator Co., Ltd., as from December 31st, 1919. The London office will, in future, be under the management of Mr. A. C. Soutter, who has been in the service of the company for the past 22 years. The works at Dukinfield will continue under the management of Mr. Paul Pescatore, with the same staff as hitherto.

Mr. W. A. PERRY, electrical and mechanical engineer, who has been manager of the Amoy electric light station for the last five years, has returned home after ten years' residence in the East, and is open to take up a responsible appointment.

St. Pancras Borough Council Parliamentary and General Purposes Committee, after consideration, recommends that awards No. 84 and 101 to Government employés be applied to the chief electrical engineer, whose present salary and bonus is £1,150. The increase by award 84 would be £110, and by award 101 £100, making the total £1,360.

Mr. G. F. CRAVEN, manager of the Corporation tramways at Reading, has resigned, and is succeeded by Mr. Calder. Mr. Craven has joined the board of the local engineering firm of Allen & Simmonds, Ltd.

The Batley Town Council has increased the salary of Mr. S. DERWEN JONES, electrical engineer, to £400 a year, and that of Mr. A. RUSLING, station superintendent, to £275.

Mr. J. WALKER, electrical engineer to Messrs. Bruntons, Wiremills, Musselburgh, has been appointed manager of the electrical department, Messrs Wood & Cairns, of Edinburgh, and takes up duties to-day.

Mr. J. C. ELVY, A.M.I.E.E., M.I.E.Soc., who resigned from St. Pancras to join H.M. Forces, being attached to R.A.F. Headquarters Technical Staff, was demobbed last August, and is now engaged in preparing a scheme for the electrical equipment of a large kinema studio, involving a plant of 1,000 KW. capacity.

NEW COMPANIES REGISTERED.

Electric Motors (South Wales), Ltd. (162,293).—Private company. Registered January 1st. Capital, £20,000 in £1 shares. To carry on the business indicated by the title. The first directors are: W. H. Diamond, 168, Newport Road, Cardiff, ship repairer (chairman); M. Wideman, Trewinard, 48, Victoria Road, Penarth, shipowner; T. Diamond, 5, Palace Road, Llandaff, coal merchant; E. C. R. Mackadam, 3, Plasturton Place, Cardiff, coal merchant. Qualification, £500. Registered office: 1, Wood Street, Cardiff.

Electric Repairs, Ltd. (162,566).—Private company. Registered January 8th. Capital, £1,000 in £1 shares. To carry on the business indicated by the title. The first directors are: W. Boffey, 189, Coventry Road, S. Yardley, Birmingham; W. H. Scott, 11, Bilston Road, Wolverhampton, B. F. Waiter, 4, Evelyn Villas, Brook Lane, Codsall; T. Withers, jun., Hill Top, West Bromwich. Registered office: Old Bilston Road, Wednesbury.

Pourlock Co., Ltd. (162,547).—Private company. Registered January 7th. Capital, £50,000 in £1 shares. To take over the British and certain foreign patent rights relating to an invention for differential gearing, to adopt an agreement with R. A. Rothermel and C. A. Vandervell, and to carry on the business of manufacturers and repairers of and dealers in gearings, machinery, automobiles, motor cycles, &c. The subscribers (each with one share) are: T. G. Conyer, 49, Pemberton Road, Harringay, N., clerk; J. P. England, 97, Strathyre Avenue, Norbury, S.W.16, cashier. R. A. Rothermel is the first director. Solicitor: W. C. Rundle, 20, Eastcheap, E.C. Registered office: 24-6, Maddox Street, W.1.

Huffam & Son, Ltd. (162,448).—Private company. Registered January 5th. Capital, £3,000 in £1 shares. To carry on the business of engineers, manufacturers of and dealers in internal-combustion engines, steam, electrical and other motors, dynamos, motor and other cycles, &c. The permanent directors are: W. S. Huffam, 62, Mount Pleasant, Norwich; V. Huffam, Surlingham, Norfolk. Registered office: 39, Exchange Street, Norwich.

G. P. Dennis, Ltd. (162,532).—Private company. Registered January 7th. Capital, £5,000 in £1 shares. To carry on the business of manufacturers of and dealers in electrical, mechanical and general engineering supplies, &c. The subscribers (each with one share) are: G. P. Dennis, 6, Normanston Road, Birkenhead, electrical engineer; Mrs. L. Dennis, 6, Normanston Road, Birkenhead. The first directors are: G. P. Dennis (governing director) and Mrs. L. Dennis. Registered office: 66, South John Street, Liverpool.

Electro-Dynamic Construction Co., Ltd. (162,481).—Private company. Registered January 6th. Capital, £10,000 in £1 shares. To acquire the business carried on by N. Pensabene, and to carry on the business of electrical engineers, workers in metals, contractors for the supply of electrical plant, producers and distributors of electrical energy, &c. The first directors are: N. Pensabene, 4, New Cross Road, S.E. (permanent managing director), and E. J. Timberlake, 4, New Cross Road, S.E. Registered office: 4, New Cross Road, S.E.

Ebonestos Insulators, Ltd. (162,480).—Private company. Registered January 6th. Capital, £100,000 in £1 shares. To take over the business of makers of moulded "Ebonestos" insulators, turners and workers in hard woods, ebonite and fibre, &c., carried on at 127, Pomeroy Street, New Cross, S.E., and elsewhere, as the "Ebonestos Manufacturing Co.," and to enter into an agreement with J. B. Alexander and B. Weaver. The first directors are: J. B. Alexander, 62, Water Lane, Brixton, S.W.2, engineer; B. Weaver, 7, Glensdale Road, Brockley, S.E.4, manufacturer. Registered office: 127, Pomeroy Street, New Cross, S.E.14.

Steel Wire Co., Ltd. (162,320).—Private company. Registered January 1st. Capital, £700,000 in £1 shares. To carry on the business of wire drawers and bar drawers of steel, iron, copper and other metals, compounds, alloys or substances, manufacturers and owners of aerial and other ropeways, cableways and tramways, &c. The first directors are: E. Smith, The Coppice, Barrington Road, Torquay; A. Smith, 113, Westbourne Terrace, W.; Harry Smith, Manor Heath, East Morton, Bingley; Herbert Smith, Gamstone House, Gamstone, Retford; F. Smith, Pollard Hall, Gomersal; E. Smith, jun., White House, Newark. (All directors of Doncaster Wire Co., Ltd., Ordsal Wire Co., Ltd., and E. & A. Smith Co., Ltd.) Solicitors: Chadwick, Son & Nicholson, Church Street, Dewsbury.

Engineering Agency, Ltd. (162,294).—Private company. Registered January 1st. Capital, £1,000 in £1 shares. To carry on the business of an employment agency for the engineering and allied trades, &c. The first directors are: T. B. Bower, 7, Oakhill Road, Surbiton, consulting engineer; C. W. Chater, 9, Norwich Avenue, Bournemouth, consulting engineer; Florence M. Milliken, 124, Fordwych Road, West Hampstead, N.W.2. Qualification, £100. Secretary: Florence M. Milliken. Registered office: 68, Victoria Street, S.W.1.

Mica and Asbestos Insulating Co., Ltd. (162,495).—Private company. Registered January 6th. Capital, £10,000 in £1 shares. To carry on the business of manufacturers of and dealers in mica, asbestos, carta, insulating cloth, enamelled wire, &c. The subscribers (each with one share) are: Thekla Muller, 35, Fitzroy Square, W., commercial manager; Horace Barrett, 2-3, West Street, Finsbury Circus, E.C., solicitor; J. Fogg, 69, Knatchbull Road, Camberwell, S.E., clerk. Table "A" mainly applies. Solicitors: Goldberg & Barrett, 2-3, West Street, Finsbury Circus, E.C.

Holders, Ltd. (10,863).—Private company. Registered December 30th. Capital, £10,000 in £1 shares. To carry on the business of electrical, mechanical and general engineers, contractors, manufacturers and agents. The subscribers (each with one share) are: L. R. Morshead, 17 Victoria Street, London, S.W.1, engineer; R. Steel, 8, Gladstone Place, Leith, engineer. The first directors not named. Qualification, £250. Secretary: R Mitchell. Registered office: 87, Hanover Street, Edinburgh.

Mountain Railways, Ltd. (162,384).—Private company. Registered January 2nd. Capital, £12,000 in £1 shares (6,000 preference). To obtain from the French and Italian Governments concessions for the construction and working of a railway from Briancon, in the Hautes Alpes Department of France, to Oulx, in Piedmont, in Italy, across the Mont Genevre Pass of the Alps, and to adopt an agreement with G. N. Fell. The subscribers (each with one share) are: W. Brown, 40, Woodgrange Avenue, N.12, engineer; W. R. Makepeace, 22-3, Laurence Pountney Lane, E.C.4, iron, steel, and engineering exporter. The subscribers are to appoint the first directors. Solicitors: Wilkinson, Raikes & Son, 34, Nicholas Lane, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Dartmoor Electric Supply Co., Ltd.—Issue registered December 5, 1919, of £2,350 debentures, part of a series of £5,000 already registered.

Tyne Electric Steel Foundries, Ltd.—Particulars filed November 25th, 1919, of £15,000 debentures, charged on the company's undertaking and property, present and future, including uncalled capital, amount of present issue being £4,400.

W. A. & R. J. Jacobs, Ltd.—Debenture for £10,000 registered November 22nd, 1919, charged on land at Edgware Road and land and buildings at Hendon and the company's undertaking and property, present and future, including uncalled capital. Holders: L.C.W. and Parr's Bank, Ltd.

CITY NOTES.

Adelaide Electric Supply Co., Ltd.

The annual meeting was held on Friday last, Mr. J. B. Braithwaite presiding. The chairman said that the most important change in the balance sheet was caused by the steps which the board had thought it prudent to take in raising the additional capital necessary to establish the future of the company. During the year they had issued £250,000 of 5 per cent. cumulative preference shares of £1 each. In view of the rates which were now being paid on similar securities he thought they were fortunate in getting those shares issued at par. They provided them with the capital which they estimated would be necessary for erecting the new power house at Port Osborne. The 5 per cent. debenture sinking fund stock continued to be redeemed, and they were offering to exchange the stock for 5 per cent. War Loan. They hoped that would enable them to obtain the amount of stock they required for the sinking fund, and would still further reduce the amount outstanding. The dividend equalisation account stood at £25,000, the same as for some years past, and was a sort of guarantee that the dividend was likely to be maintained at the figure at which it had stood for some years. The results of the past year had been disastrously interfered with by the prolonged strike in Australia, which only just ended about the close of their financial year. The strike cost the company very considerable sums directly and indirectly. They lost 2¼ millions of units in output, and in the net result, the profit instead of being, as they had every reason to expect it would have been from the results of the first seven or eight months of the year absolutely a record for the undertaking, was nothing very striking. As it was, the revenue had increased by £18,993 which in the circumstances was very satisfactory. The increase in consumers connected was very satisfactory, but it would have been larger but for the seamen's strike, which delayed the shipment of poles, so that they were unable to make the necessary connections. It was a very satisfactory thing that the expenditure they had made in the past on extending their mains into districts where they were likely to get new consumers, was now bearing fruit, as was evidenced by the fact that of the new consumers connected last year no less than 832 were made with no extensions of the mains at all; it was a thickening up of the mains they had already laid. In spite of the strike, not only did the gross revenue increase a little, but the units sold increased to a small ex-

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had established a night tariff with a view to inducing people to take current during the night, when the load was not wanted for other purposes. The number of consumers who had availed themselves of that night supply had increased from 65 to 95, and they were still continuing to receive inquiries. With regard to the new power house at Port Osborne, a lease had been secured on satisfactory terms, and they were now actively engaged in the laying out of the station. In view of the labour troubles he did not like to say when they hoped to have the power house running, but the board would press on with the matter with the utmost possible speed, so that they might reap the advantages they expected at the earliest possible date. The record of the company's employés in regard to the war was: 91 enlisted, of whom seven were killed, and 34 had already returned to the company's employ. They continued to give preference in employment to returning soldiers, whether they were previously in their employ or not, and out of a total establishment of 323 male and female employés, 62, or 19.2 per cent., were returned soldiers.

Mr. R. Percy Sellon seconded the motion.

German Companies.

The E. H. Geist Elektrizitats A.G., of Cologne-Zollstock, which was compelled to go into liquidation several years ago in consequence of the competition of the big firms even for comparatively small contracts, has now held its final meeting, and will be removed from the register.

The report of the *Norddeutsche Kabelwerke A.G., of Berlin-Neukoln*, states that it was impossible for sale prices to keep pace with the growth in the working expenses in 1918-19. After placing 15,000 marks to depreciation, as compared with 260,000 marks in the previous year, the accounts indicate net profits of 400,000 marks, as against 378,000 marks, permitting of the payment of a dividend of 14 per cent., as contrasted with 15 per cent. in 1917-18. The share capital is now to be increased from 3,000,000 to 5,500,000 marks.

The A.G. fur Elektrizitats Anlagen, of Berlin, which is chiefly an investment company, states in the report for 1918-19 that two of the company's works are situated in Poland, one in the free State of Dantsic, and one in the occupied district of the Saar. The future of these works was uncertain, and the liquidation of the interests held in the Imatra Co., of Brussels, and the Moscow Electric Power Transmission Co., of Petrograd, could also not be foreseen. The net profits amount to 533,000 marks, as against 630,000 marks in 1917-18, and the dividend is at the rate of 5 per cent., this contrasting with 6 per cent. in the preceding year.

The directors of the *Rheinische Elektrizitats A.G., of Mannheim*, which owns and contracts for the erection of supply works and installations, state in their report for 1918-19 that the company had been compelled to purchase large stocks of raw materials owing to the great activity in new construction and installation work, the high prices paid absorbing a considerable sum. It was therefore proposed to issue 4½ per cent. debentures for 5,000,000 marks, and to increase the share capital from 11,000,000 to 16,000,000 marks. The accounts show net profits of 1,000,000 marks, as against 1,001,000 marks in 1917-18, and the dividend is 7 per cent. and 5 per cent. in the two years respectively.

The report of the *Siemens-Schuckert Werke, of Berlin*, for 1918-19 states that the company was confronted with difficult problems owing to the oppressive burdens of the Treaty of Peace and the taxation policy of the "Empire." The great requirements of the world could afford the company an abundance of work; it must be remuneratively fashioned in the interest of German industry. The unfavourable situation of German currency should not lead to the dumping of national manufactures. A recovery of the national economy could only be brought about by a material increase in the production, which was not attainable with the present average output per workman, and by the greatest economy at home and an expert financial policy. Including the balance brought forward the gross profits are returned at 28,488,000 marks, as compared with 26,940,000 marks in 1917-18, and the net profits at 15,293,000 marks and 15,837,000 marks in the two years respectively. The dividend is at the rate of 10 per cent., being the same as in 1917-18.

Anglo-American Telegraph Co., Ltd.—Balance dividends of £1 10s. per cent. upon ordinary consolidated and preferred stocks, and a first and final dividend of £1 10s. per cent. upon the deferred stock, less tax, in each case, making, with dividends already paid, £3 15s. per cent. upon ordinary consolidated stock, £6 per cent. on preferred stock, and £1 10s. per cent. on deferred stock for 1919.

Dublin United Tramways Co. (1896), Ltd.—After paying 7 per cent. final on the ordinary shares, making 6 per cent., plus a bonus of 1s. 6d., tax free, for the year, £17,080 is carried forward. To track renewals £30,000 is put; £27,000 to car renewals; £12,821 to general reserve; and £1,000 to depreciation of investments.

Kaministiquia Power Co.—Dividend on the common stock for the quarter ending January 31st at the rate of 8 per cent. per annum.

Montreal Light, Heat & Power Consolidated Co.—Quarterly dividend of 1 per cent., less tax.

STOCKS AND SHARES.

TUESDAY EVENING.

WHILE in some departments of the Stock Exchange business has quieted down to a slight extent, on the whole there is still a lot of trade doing. The disappointment felt at the failure of negotiations in the moulders' strike has not sufficed to hold back prices of iron, steel and engineering shares, but the possibility of imminent railway trouble makes itself felt in the Home Railway market, where prices have yielded ground again. Speculative investment continues active. The view is generally expressed round the Stock Exchange, however, that if the railwaymen should strike, and particularly if they do so without warning, the effect upon markets would be much the same as it was last autumn, when for a few days a sort of semi-paralysis settled over enterprise, forcing down the prices of speculative issues, while at the same time it produced a demand for the more sober stocks. The anomaly in the coal trade, whereby manufacturing concerns, having to pay more for their coal than the ordinary householder, are enabled to obtain supplies fairly freely, removes the apprehension of acute coal shortage from the industrial departments, and the electricity supply section, amongst others, has hardened up.

Statements which were current to the effect that the General Electric Co. and Edison Swan were going to amalgamate have been promptly denied, and the course of Edisons has been rather curious. The shares, after being 27s., fell to 24s. 9d., from which latter figure there was a brisk recovery to 26s. 3d., and the market looks a good one, with several substantial buyers about. Expectation is kept alive by mysterious hints as to developments which are likely to occur, and it is said that next week should bring definite news. In the meantime, it would appear to be advisable for proprietors to keep their shares.

Another rumour which was current some time ago, and which was contradicted at the time, seems likely to prove material after all. As we mentioned here, the Anglo-Argentine Tramways Co. was expected to pay off the arrears of interest which have accumulated on the first and second preference. Like the report of Mark Twain's death, this turned out to be premature. News, however, has come in this week that the municipality of Buenos Aires has sanctioned the ordinance approving a 12-cent fare. This is exactly what the company had been hoping, and should make such a difference to the receipts of the undertaking as may easily enable the arrears of dividends to be paid. Prices of the company's issues are therefore harder. The last time that the first preference received a dividend was in June, 1917, while the second preference have gone without anything since January, 1916, so that there is 2½ years, equivalent to 13s. 9d., less tax, due on the former class and £1 3s. on the second. It looks, moreover, as though the company were likely to regain its earning capacity, and the announcement is very gratifying to those who have maintained their faith in the concern during the war period.

Underground Electric income bonds have dropped back 3½ to 84. The ordinary shares shed ¼ to 2¼, and the "A" went back to 7s. 6d., while Districts and Metropolitans are both lower at 21 and 25 respectively. Congestion on the lines meanwhile becomes, if possible, more acute. Between the company's intention to raise fares and the furious protests which have arisen against such a step on the part of the uncomfortably-carried travellers, the investor has little inducement for buying Undergrounds, and the present holder is somewhat in despair at the whole position. Nevertheless, the income bonds may be cautiously recommended as worth mixing with other investments owing to the return which they offer, the fact that the dividend is paid free of tax and also that the coupons can be cashed in New York at the fixed rate of 4.86 dollars to the £. As soon as the present tyranny of uncertainty is over-passed, the price might easily go to the neighbourhood of 90, though it has to be remembered that more capital is likely to be wanted before long, and that anything of this sort may rank in front of these income bonds.

The feature amongst electricity supply shares is the strength of Citys, a rise of £1 carrying the price to 13. This is fully 30s. higher than it was at the time when attention was first drawn here to the likelihood of the company increasing its dividend in respect of the last six months. Metropolitans are ¼ up at 3⅛. It is reported in the market that there is rather more inquiry for shares in this group, although it must be admitted that popular attention is still meagre. General Electrics are better at 41s. British Insulated at 2 1-16 are the fraction to the good. India-Rubber shares fell away abruptly to 16, which is ex the dividend. Siemens lost 1s. of their previous half-a-crown rise. Castner-Kellners have further added 8s. 9d. to their price on the proposed arrangement with Brunner Monds, whereby the latter company offers two of its own shares to every one of Castner-Kellner. Brunner Monds stand about 41s. 3d. Several other possible amalgamations are talked of in this department, and all the tendency nowadays is in the direction of big combinations. In which connection it may be incidentally observed that a broker asking the price of some unfamiliar share the other day was told that it was not known in the market, the company being "a small affair, with a capital of only a quarter-of-million sterling."

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The cable market is uninteresting. Anglo-American deferred rose ⅛ on the declaration of the dividend, which is 30s. for the year. United River Plate Telephones have recovered to 7¾. Marconis are a better market at 4 5-16. Gossip once more plays with a report, said to emanate from the other side of the Atlantic, that there may be coming fusions in this group before very long. Possibly this accounts for the recent buying of Canadian Marconis, which has stiffened the price to 14s. 3d. American Marconis remain a quiet market at 33s. Callenders at 8⅝ have started to recover after their recent heaviness, and the preference are better at 4¾. Automatic Telephones have risen to 35s. bid.

Mexicans have gone ahead in fine style. Practically everything connected with the country advanced by leaps and bounds. The advent of a Commissioner to this country from Mexico is held as a precursor to the ardently-desired settlement which has been tantalisingly within reach for the last year or two. Carranza is declared to be heartily sick of chaos, and to be anxious to consummate a loan with the United States that shall re-establish his distressful country. Consequently, rises ranging from 2 to 10 points have occurred in various issues of the Mexican government, railway and utility companies. There has not been much actual business, quotations being marked up largely as a matter of sentiment. This accounts for the lack of discrimination which has occurred in adding points to prices, various anomalies being noticeable in the way in which common and preferred shares have been lifted to nearly the same levels as the bonds. Best prices were not maintained, but any confirmation of the more favourable atmosphere (which is all it can be called at present) would probably advance prices still further. In Engineering shares, Babcock & Wilcox are ½ harder. Rubber shares keep tolerably active, although a setback in the price of the raw material laid a check upon the previous optimism.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1917.	Dividend 1918.	Price Jan. 13, 1920.	Rise or fall.	Yield p.c.
Home Electricity Companies.					
Brompton Ordinary	10	8	5⅞	—	£6 16 2
Charing Cross Ordinary	4	4	3	—	6 13 4
do. do. do 4½ Pref.	4½	4½	2⅞	— ⅛	8 3 8
Chelsea	5	3	2⅝xd	—	5 14 3
City of London	8	8	13	+ ⅜	6 3 1
do. do. 6 per cent. Pref.	6	6	9½	—	6 6 4
County of London	7	7	9⅜	—	7 9 4
do do. 6 per cent. Pref.	6	6	9⅜	—	6 11 8
Kensington Ordinary	7	6	4⅜	—	6 6 4
London Electric	Nil	Nil	1⅜	—	
do. do. 6 per cent. Pref.	5	6	8⅜	—	8 17 10
Metropolitan	4	5	8¼	+ ⅛	8 0 0
do. 4½ per cent. Pref.	4½	4½	2⅝xd	—	7 16 6
St. James' and Pall Mall	9	10	6	—	8 6 8
South London	5	5	2¼½	—	7 8 6
South Metropolitan Pref.	7	7	1	—	7 0 0
Westminster Ordinary	9	8	6½	—	7 12 5
Telegraphs and Telephones.					
Anglo-Am. Tel. Pref.	6	6	90½	—	6 12 8
do. Def.	1½	88/6	22⅜	+ ⅛	6 14 1
Chile Telephone	8	8	6⅜	—	6 5 6
Cuba Sub. Ord.	7	7	10⅜	—	*6 13 4
Eastern Extension	8	8	16	—	*5 0 0
Eastern Tel. Ord.	8	8	167½	—	*4 15 7
Globe Tel. and T. Ord.	7	8	16⅜	—	*4 19 8
do. do. Pref.	6	6	9⅜	—	6 3 1
Great Northern Tel.	22	22	23⅛	—	9 7 2
Indo-European	13	13	48½	—	6 13 4
Marconi	20	25	4 5/16	+ 1/16	5 16 8
Oriental Telephone Ord.	15	10	2⅛	— 3/8	4 14 1
United R. Plate Tel.	8	8	7¾	+ 1/16	*5 8 3
West India and Panama	1/3	1/3	1 1/16	— 1/16	Nil
Western Telegraph	8	8	17	—	*4 14 2
Home Rails.					
Central London Ord. Assented	4	4	58½	—	6 16 9
Metropolitan	1	1½	25	— 1	5 0 0
do. District	Nil	Nil	21	— ½	Nil
nderground Electric Ordinary	Nil	Nil	2⅞	— ⅛	Nil
do. do. "A"	Nil	Nil	7/6	—3d	Nil
do. do. Income	4	5	8¼	—3½	*5 19 3
Foreign Trams, &c.					
Adelaide Sup. 6 per cent. Pref.	6	6	87⅛	—	7 14 10
Anglo-Arg. Trams. First Pref.	5½	Nil	4	+ ½	—
do. do. 2nd Pref.	—	—	3½	+ ½	—
do. do. 5 Deb.	5	5	64½	+3	7 15 0
Brazil Tractions	—	—	60	—1	—
Bombay Electric Pref.	6	6	13½	—	4 9 0
British Columbia Elec. Rly. Pfce.	5	5	62½	—	8 0 0
do. do. Preferrred	Nil	2½	56½	—	4 8 9
do. do. Deferred	Nil	Nil	52½	—	Nil
do. do. Deb.	4½	4½	63	+ ½	6 15 0
Mexico Trams 5 per cent. Bonds	Nil	Nil	46	+3½	Nil
do. 6 per cent. Bonds	Nil	Nil	86½	+7½	Nil
Mexican Light Common	Nil	Nil	22½	+5	Nil
do. Pref.	Nil	Nil	35	+5	Nil
do. 1st Bonds	Nil	Nil	58	+4½	—
Manufacturing Companies.					
Babcock & Wilcox	15	15	3⅜	+ ⅛	*4 9 0
British Aluminium Ord.	10	10	1 5/16	—	5 12 3
British Insulated Ord.	25	12½	2 1/16	+ 1/16	6 1 6
Callenders	25	25	8⅝	+ ⅛	7 5 0
,, 6½ Pref.	5	6½	4¾	—	7 2 1
Castner Kellner	25	20	3¾	+ 7/16	3 15 7
Crompton Ord.	7	10	21/6	—	9 6 0
Edison-Swan, "A"	—	10	1 5/16	+ ⅛	7 12 4
do. do. 5 per cent. Deb.	4	5	79½	—	6 5 9
Electric Construction	10	10	1 1/16	—	9 8 2
Gen. Elec. Pref.	6	6½	19/6xd	—	6 12 6
do. Ord.	10	10	41/-	+1/-	*4 17 7
Henley	25	25	2¾	—	5 11 1
do. 4½ Pref.	4½	4½	3¾	—	6 4 2
India-Rubber	10	10	16	—1½	*6 5 0
Met.-Vickers Pref.	—	—	2 1/16	—	5 14 0
Siemens Ord.	—	10	28/6	—1/-	*7 0 4
Telegraph Con.	20	20	26½	—	*4 10 6

* Dividends paid free of Income Tax.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Tuesday, January 13th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Oxalic	per lb.	1/5	...
a Ammoniac Sal	per ton	£95	...
a Ammonia, Muriate (large crystal)	,,	£75	...
a Bisulphide of Carbon	,,	...	...
a Borax	,,	£39	...
a Copper Sulphate	,,	£44	£3 inc.
a Potash, Chlorate	per lb.	1/1	...
a ,, Perchlorate	,,	1/3	...
a Shellac	per cwt.	£43 10/-	£10 10/- in.
a Sulphate of Magnesia	per ton	£15	...
a Sulphur, Sublimed Flowers	,,	£28	...
a ,, Lump	,,	£25	...
a Soda, Chlorate	per lb.	6d.	...
a ,, Crystals	per ton	170/-	...
a Sodium Bichromate, casks	per lb.	...	...
METALS, &c.			
g Babbitt's Metal Ingots	per ton	£118 to £345	...
c Brass (rolled metal 2" to 12" basis)	per lb.	1/3⅜	¼d. inc.
c ,, Tubes (solid drawn)	,,	1/7 to 1/7½	¼d. to 1d. inc.
c ,, Wire, basis	,,	1/4	1d. in.
c Copper Tubes (solid drawn)	,,	1/9¼	1¼d. in.
g ,, Bars (best selected)	per ton	£167	£10 inc.
g ,, Sheet	,,	£167	£10 inc.
g ,, Rod	,,	£167	£10 inc.
d ,, (Electrolytic) Bars	,,	£125	£3 dec.
d ,, ,, Sheets	,,	£156	...
d ,, ,, Wire Rods	,,	£140	£3 dec.
d ,, ,, H.C. Wire	per lb.	1/5⅛	¼d. dec.
f Ebonite Rod	,,	3/-	...
f ,, Sheet	,,	2/6	...
n German Silver Wire	,,	2/9	4d. inc.
h Gutta-percha, fine	,,	13/-	2/- to 3/- inc.
h India-rubber, Para fine	,,	2/7½	¼d. inc.
i Iron Pig (Cleveland Warrants)	per ton	Nom.	...
l ,, Wire, galv. No. 8, P.O. qual.	,,	£48 10/-	£4 10/- inc.
g Lead, English Pig	,,	£48 10/-	£2 inc.
g Mercury	per bot.	£23 10/-	10/- dec.
e Mica (in original cases) small	per lb.	6d. to 4/6	...
e ,, ,, ,, medium	,,	5/- to 10/-	...
e ,, ,, ,, large	,,	12/6 to 25/- & up	...
g Phosphor Bronze, plain castings	,,	1/8 to 2/-	1½d. to 2d. inc.
g ,, ,, rolled bars and rods	,,	2/2 to 2/6	...
g ,, ,, rolled strip & sheet	,,	2/3 to 2/9	...
d Silicium Bronze Wire	per lb.	1/11	¼d. inc.
r Steel, Magnet, in bars	per ton	...	...
g Tin, Block (English)	,,	£378	£38 inc.
n ,, Wire, Nos. 1 to 16	per lb.	5/-	6d. inc.
White Anti-friction Metals	per ton	£90 to £345	...

Quotations supplied by—

a G. Boor & Co.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
r W. F. Dennis & Co.

Two American Turbine Accidents.—A 3,000-KW. horizontal Curtis turbine, installed in the station of the Connecticut Light and Power Co., Waterbury, Conn., eight years ago, completely wrecked itself on November 18th, killing two men, injuring others, and doing damage to other turbines and the power-house building. The machine ran at 1,800 R.P.M., and had a rim speed of about 400 ft. per second, which is much lower than velocities which are safely carried upon modern machines by the same builders. Some of the wheels were split apart, others were badly battered and broken at their peripheries; the shaft was broken, and the bolts in the coupling were bent. The turbine end of the shaft was hurled upward, just clearing the adjacent turbine, but bending the lifting bolts in the top of its casing; the broken shaft continued on, striking and bending the crane rail and landing outside the turbine-room. Exclusive of the generator stator and rotor, the heaviest piece of broken metal probably did not weigh more than 500 lb. Viewing the wreck and the turbine-room, it seems remarkable that the severe damage was confined to one machine. This turbine was one of six, all set transverse of the room, having two machines to the north and three to the south of it.

News comes also of the failure of a 4,000-KW., six-stage, 1,800-R.P.M. unit at the Ashley Street station of the Union Electric Light and Power Co., at St. Louis. This was installed in 1911, and was the second of the horizontal type put out. Investigations of both accidents are under way.—*Power.*

Sparking at Brushes. — Although sparking at the brushes of low-speed machines may not cause serious trouble, it is as well to take steps to prevent it. The peripheral speed of the commutators is insufficient to throw off dust particles and cleaning at intervals is a troublesome operation. A suggestion, put forward by Mr. B. A. Briggs in *Power*, for the prevention of sparking is that an additional brush be mounted in a separate holder. This brush can be made of wood or fibre, the actual part in contact with the commutator consisting of two or three pieces of canvas cut to the necessary width. The canvas can be turned or changed when necessary, the frequency depending upon the nature of the surrounding atmosphere.

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THE PHYSICAL SOCIETY'S EXHIBITION.

THE tenth annual exhibition of electrical, optical and other physical apparatus held under the auspices of the PHYSICAL SOCIETY OF LONDON and the OPTICAL SOCIETY at the Imperial College of Science and Technology, South Kensington, on January 7th and 8th, was looked forward to with more than usual interest, it being the first post-war exhibition, and was hoped to reveal the progress that had been made during the war period by scientific instrument manufacturers. Although there was a good deal of interest to be seen, we were disappointed to find on the occasions of our visits that the attendance was very small.

The discourses by Prof. F. J. CHESHIRE, C.B.E., on "Some Polarisation Experiments," and by Prof. A. O. RANKINE, D.Sc., on the "Use of Light in the Transmission and Reproduction of Speech," were full of interest. The latter explained that the main effect of light upon the element selenium was due to the red rays of the spectrum. Its susceptibility to red rays was illustrated by a magnified beam passed through red-coloured glass and thrown on a scale by a mirror galvanometer; the maximum effect lay somewhere between the orange and the red. Prof. Rankine then explained his photophone, which consists essentially of a gramophone sound-box with a delicately poised mirror in place of the needle. The mirror oscillates in accordance with the fluctuations of the sound, and the beam from the mirror, travelling to the receiver, conveys these oscillations with it, the sound being reproduced in a telephone with the aid of a selenium cell. With sunlight there would be practically no limit to the range of transmitting speech through the medium of light other than that interposed by the curvature of the earth. With a helio mirror of 6 in. diameter, however, distinct hearing was possible at a distance of eight miles. There was an important advantage in this over wireless telegraphy in the fact that speech transmission between the transmitter and the receiver could not possibly be intercepted. The two instruments had to be in line with the beam. Photographs of speech recorded by the selenium apparatus were shown, including the vibrations produced by articulating the words "one" and "five." The open vowel sound of the latter was brought out conspicuously.

One of Prof. Rankine's conclusions is that the average individual makes more vibrations than his auditor requires, but the ear makes up for many deficiencies.

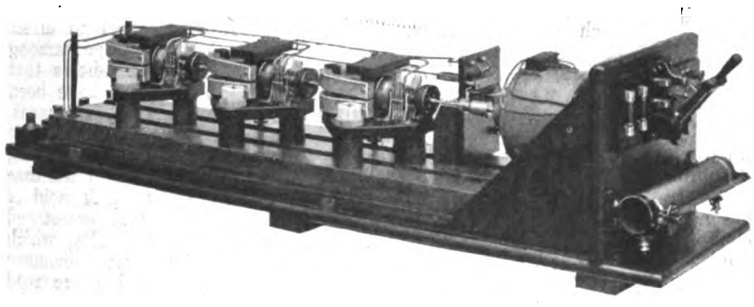

FIG. 1.—EVERSHED HIGH-PRESSURE D.C. SET, WITH COVER REMOVED.

The collection of WAR EXHIBITS included a number of interesting captured German instruments relating to artillery and gun sighting. German compasses were exhibited by the ADMIRALTY COMPASS OBSERVATORY, Slough, while the AIR MINISTRY had on view a collection of captured German instruments, amongst which the following were noted: A type A.F.S. 43B. Telefunken sender; type E. Vi 89C. amplifier in a case with valves, resistance tubes, voltmeter, H.T. battery in case, and suspension springs; a W/T type D. No. 1,115 transmitter from a D.F.W. two-seater; a Huth short-wave receiver complete in case; a 270C. Telefunken generator; a Grass & Worff signalling lamp and Bosch landing light; an Accumulator-Fabrik A.G. "Varta," 12-volt, 26 amp.-hour unspillable accumulator; a wind-driven, 200-watt, 50-volt, D.C. Telefunken generator; a Sachsenwerk 250-watt, 50-volt, D.C. gear-driven generator; and an electrically-heated muff and boot.

The "SHERINGHAM DAYLIGHT," which we described in a recent issue, was experimentally demonstrated at intervals by Mr. L. C. MARTIN. This invention is a reflector for correcting artificial light, the result, it is claimed, closely approximating daylight. An attempt is made to reduce the excess of rays in the red end of the spectrum present in artificial light and thereby to emphasise the effects of the blue and violet rays.

MESSRS. NEWTON & Co. showed optical lanterns and fittings for use in lecture halls, &c., including a hand-feed arc lamp for optical projection work, and a new half-watt metal-filament lamp with resistance for any supply from 100 to 240 volts. Another new half-watt lamp was shown with an accumulator and a special mirror for use in optical lanterns. This lamp, being provided with a special cone form of concentrated filament, is claimed to give very good results for small halls where electricity supply is not available. It is made in two patterns for use with 6 or 12-volt batteries, consuming 5 amps. in each case.

MESSRS. EVERSHED & VIGNOLES, LTD.—Standard "Megger" and "Bridge Megger" resistance testing sets, the "Dionic" water tester, portable indicating instruments, and recording instruments formed the basis of this exhibit. "Workshop" ohmmeters were shown, which without the use of a bridge rapidly give not only insulation resistances but also other resistances by direct reading, and can be supplied to cover a range from 10 microhms to thousands of megohms. An improved form of D.C. leakage indicator, which not only gives warning of the development of a fault but also enables the insulation resistance of each main to be measured, was exhibited in operation; the chief difference from the earlier pattern is the use of a switch instead of pressing keys to obtain the successive readings. An accompanying table at once gives the insulation resistance of each main from these readings.

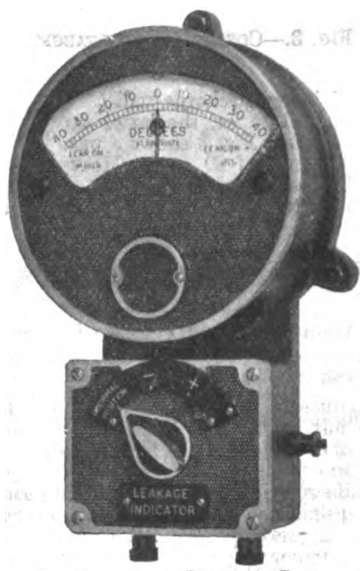

FIG. 2.—EVERSHED LEAKAGE INDICATOR.

The most striking feature of the exhibit was a high-pressure D.C. motor-generating set, giving 15 milliamperes at any voltage up to 5,000 volts; the set consisted of a motor driving three small magneto-generators, which were connected in series and mounted on a base-board with suitable insulators. A specially designed cut-out protects the machine from damage due to overload or a sudden short-circuit. The generators are so constructed that the pressure wave-form is practically free from ripples, and the current generated is suitable for X-ray, cathode-ray, and research work generally.

MESSRS. ELLIOTT BROTHERS (LONDON), LTD., had a handsome show of their standard apparatus, including a laboratory wattmeter with a variety of ranges, millivoltmeters, a portable bridge, the "Century" testing set, and their tubular magneto and revolution indicator, which is used to indicate at a distance the speed of the engines of aircraft. Other items were parts of the Elliott gyrostat, and a variety of etched metal name plates, dials, &c., a branch of work in which the firm has attained to a high degree of accuracy and excellence of workmanship.

MESSRS. CHANCE BROTHERS & CO., LTD.—Protective glasses for use in connection with the arc and in the presence of ultra-violet rays and X-rays were a special feature of this exhibit; a nickel-chromium arc was used as a source of ultra-violet rays, and demonstrations were given of the fluorescence of uranium glass and light barium flint glass. It was shown that when the visible rays of the arc were completely cut off by a thick screen of apparently opaque black glass, the ultra-violet rays were transmitted almost unaffected, but in turn were stopped by the interposition of a thin glass plate which was as transparent as window glass. Sir William Crookes's spectacle glasses "A" and "B," which are manufactured by the firm, were exhibited; their opacity to ultra-violet rays depends upon the use of cerium and didymium in their composition, and they can be made practically as white as ordinary spectacle glasses. By the use of screens opaque to visible rays but transparent to

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ultra-violet rays, with the aid of a sighting device, our merchant ships were able to keep station in convoys whilst no visible light was emitted to betray their positions to enemy submarines.

MESSRS. A. C. COSSOR, LTD., exhibited a representative collection of the latest models of X-ray tubes, applicators for electro-medical treatment, wireless valves, and other manufactures, which are of entirely British manufacture and of which a large number was supplied to the War Office. The X-ray tubes on view included the water-

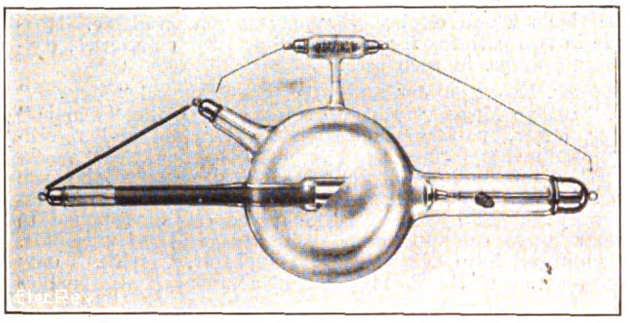

FIG. 3.—COSSOR IRIDIUM-TARGET X-RAY TUBE.

cooled and heavy-discharge radiator types of both iridium and tungsten target tubes, the latter target having, it is claimed, a very long life. Fig. 3 shows a pure iridium target tube with a bulb diameter of 20 cm. Heavy-anode and special-treatment tubes were included in the exhibit, each of the latter being guaranteed to have, before issue, turned a Sabouraud

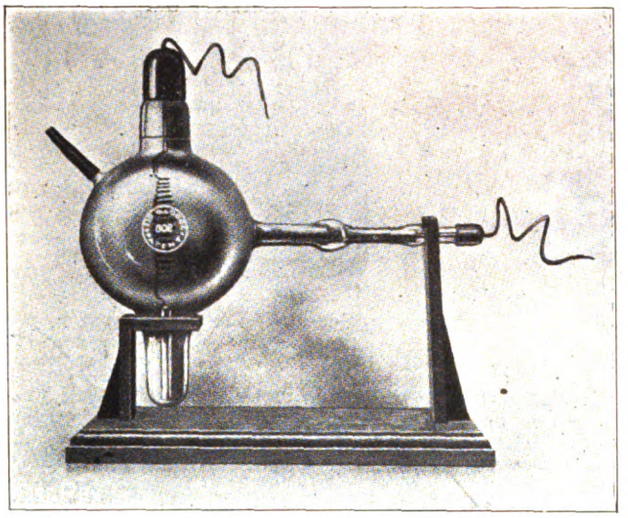

FIG. 4.—LODGE HIGH-TENSION VALVE.

pastille, placed 7.5 cm. from the target, to the standard tint in 10 minutes when using one milliampere. Sir Oliver Lodge's high-tension valves for heavy discharges, which require practically no regulation, were also shown. This type of valve, fig. 4, is noted for long life, high efficiency, and heavy current-carrying capacity.

MARCONI-OSRAM VALVE CO., LTD.—This interesting exhibit was almost entirely of an historical nature, illustrating the evolution of the thermionic valve, from the rectifying valve of Dr. Fleming in 1904 to the most recent three-electrode types made by the company, which supplied them in large quantities to the Government during the war. The first valve manufactured in quantity was the "T.1" (150-200-watt transmitting), made for the Navy in May, 1917, by the Osram-Robertson Lamp Works; the first high-vacuum power valve (T.3, 350-watt transmitting) was made by the same company in February, 1917. During the same year several other valves were developed, for receiving, amplifying, rectifying and transmitting, and improved types followed one another in quick succession. Twelve of the exhibits date only from 1919, and amongst these are found many large valves, including a 1-KW. rectifying valve developed in March last by the Marconi-Osram Valve Co., and a 500-watt transmitting valve developed in September by the Osram-Robertson Lamp Works for commercial use. With the Marconi MT.1 valve (250-watt) wireless telephonic communication has been accomplished across the Atlantic. During the war the products of the Osram works were of the utmost value to our fighting forces, and it would be difficult to assign a limit to the possibilities of the thermionic valve in its peace-time applications.

(To be continued.)

ELECTRICITY IN BRITISH MINES.

THE section of the annual report of the Chief Inspector of Mines for 1918 dealing with labour, which has just been issued as a White paper* contains some interesting details regarding the use of electricity in mines. According to the Coal Mines Act a return has to be made on January 21st of each year of the aggregate horse-power of electric motors in use above and below ground at each coal mine, and the following summary shows the position at that date in 1919:—

	Surface. H.P.	Underground. H.P.	Total. H.P.
Scotland	40,330	143,869	184,199
Northern	112,375	114,949	227,324
York and N. Midland	98,451	82,049	180,500
Lancs., N. Wales and Ireland...	20,989	31,109	52,098
South Wales	125,770	124,286	250,056
Midland and Southern	18,860	52,330	71,190
	416,775	548,592	965,367

Comparing these three totals with the previous year, an all-round increase is shown, though the percentages are not high, being 6.39 in the case of surface motors and 5.12 for underground. The percentage increase of H.P. above and below ground together amounting to 5.66, was lower at January, 1919, than in any year since (and including) 1912, when the figures were first available. This is particularly reflected in the small increase in the number of electrically-driven coal cutting machines in use. These numbered 1,797 at the end of 1918, an increase of only 58, or 3.3 per cent. over the previous year. The slow rate of growth in 1918 was, of course, primarily due to other and more urgent demands upon the engineering works of the country.

During the year 1918 there were altogether seven fatal accidents at mines definitely due to electricity, resulting in one death in each case. Only one of these accidents took place above ground, and the figure for electric-shock accidents below ground (viz., 6) shows a disappointing increase of four over the preceding year. Consideration of the details of each accident—which are published in the report to direct the attention of managers and electricians-in-charge (among others) to the defects of plant or organisation—shows that with one or two possible exceptions, all might have been avoided by attention to simple and well-established safeguards. In two cases, for example, conduits or cables were used by men to help themselves along on particular occasions, causing an undue strain which snapped the cables, while in the case of the surface accident a surface boiler stoker took hold of a broken overhead lighting wire, consisting of one-strand 16 S.W.G., carrying alternating current at 230 volts, which was in his way while moving a wagon. In another instance a collier, while signalling on an underground haulage road by means of a pull wire, was killed owing to the wire coming in contact with an armoured cable on which the insulation had become defective. Three-phase alternating current, 400 volts, was in use.

Turning from coal mines to metalliferous mines, the following table shows the aggregate horse-power in use above and below ground in the latter at the end of 1918:—

	Surface. H.P.	Underground. H.P.	Total H.P.
Scotland	629	329	958
Northern	603	3,373	3,976
York and Midlands	194	284	478
Lancs., N. Wales and Ireland	2,775	3,246	6,021
South Wales	348	113	461
Midland and Southern	5,714	1,537	7,251
	10,263	8,882	19,145

American Plans in British India.—There are rumours of the probable early appointment of a permanent Trade Commissioner in India by the United States Government, although so far the American Consulate in Calcutta is without definite news on the subject. In this connection, however, it is of interest to observe that Mr. W. H. Rastall is now visiting India as a Special Trade Commissioner of the United States Government to investigate the prospects for the extension of the sale of American machinery. Mr. Rastall is a mechanical engineer, who during the war was in charge, in Washington, of the aircraft productions of two of the American States, and he was dispatched on this special mission to the East just before the Armistice was signed. He came to India *viâ* Java and the Straits Settlements, and proposes to stay four months, then proceeding to China and the Far East. Up to the present, with the exception of the American Consular officers in Calcutta and Bombay, virtually no commercial work has been conducted on behalf of the United States Government in India, but this mission and the probability of the appointment of a permanent Trade Commissioner would seem to indicate a determination to foster trade officially, and to presage still keener American competition in the Indian markets.—*Board of Trade Journal.*

* Mines and Quarries: General Report, with Statistics, for 1918. Part II—Labour (Cmd. 490). Price 6d. from H.M. Stationery Office.

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FAILURES OF TURBO-GENERATORS, AND SUGGESTIONS FOR IMPROVEMENTS.

By J. SHEPHERD, M.I.E.E.

(*Abstract of Paper read before the* INSTITUTION OF ELECTRICAL ENGINEERS.)

AFTER several years of experience in many stations and with different designs of machines, the more usual types of failures have been determined and may be roughly classified under :—

(1) Mechanical weakness,
(2) Electrical weakness,
(3) Heating and fire risk,
(4) Ventilation difficulties.

MECHANICAL WEAKNESSES.

The efficiency of the steam turbine increases materially with its speed, and modern generators are now run at speeds which would not have been considered practical six years ago. The centrifugal stresses in the rotor teeth, upon the rotor coils and their insulation are serious in amount, particularly so with speeds of 3,000 R.P.M., the centrifugal forces increasing with the square of the speed.

To limit these stresses and retain the maximum speed of rotation, the diameter of the rotor is reduced to the smallest practical dimension, the increase in size for increasing output being more in length than in diameter. As a result, the running speed of the generator is generally above its first "critical" speed.

One serious result of the high speeds of rotation is the difficulty of effectively holding the rotor coils against centrifugal forces. The portion of the coils within the winding slots is retained in place by metal wedges driven into dovetailed recesses, machined out of the top of the rotor teeth. The portions of the windings forming loops at each end of the rotor cannot be held in this manner. Originally they were secured in place by steel wire bands wound tightly upon the completed coils.

Such steel bands are, however, open to grave objections. When a short-circuit occurs at the ends of either the rotor or the stator, the bands are usually fused and the steel wires rapidly unwind. Again, the ends of the wire banding may become unanchored. Whenever a wire band fails, the result is invariably the wreckage of the rotor and stator windings, with more or less serious destruction of the ends of the stator core.

Consequent upon these troubles, solid rings of high-tensile steel are now used instead. These rings are turned out of substantial forgings in which internally hidden flaws may exist, and, from the standpoint of reliable mechanical strength alone, they have not the advantage of drawn-wire bands. Moreover, alloys like nickel and chrome steel are comparatively new, and the effect on them of prolonged heat and continued stress has yet to be determined. If during ageing, a slow and continuous reduction in elastic tensile strength occurs, a periodic renewal of the bands will be necessary. The failure of a band is a catastrophe to be avoided at all costs, for it generally results in serious loss of life and plant.

For many years a flexible type of coupling between the rotor of the alternator and turbine was generally used. Such flexible couplings required two bearings each for the turbine and generator. As the size of the combination increased, mechanical difficulties were experienced. Some 12 years ago, Continental makers began to discard flexible couplings, and that practice has now been followed in this country.

The internal losses of a modern generator are about 4 to 5 per cent. of the rated output, and the heat resulting from these losses is almost invariably dissipated by forced air ventilation through specially constructed air vents in the rotor and stator. With higher speeds, smaller diameters, and increased length of rotors, it becomes a matter of great difficulty to pass the required amount of cooling air through the rotors. Generally there is adequate room in the stator for the air ventilating-spaces at the expense of iron space. On modern machines, the volume of the stator taken up by ventilating spaces is from 15 to 25 per cent. of the total volume.

This method of open construction gives a mechanically weak form of stator core and, under the alternating stress, chattering of the teeth may occur with consequent breakage. A further mechanical weakness occurs at the end of the stator where the winding must have spacings for the air freely to pass between them.

Another mechanical defect in the stator is the method of attaching the stampings to the frame. In earlier designs of generators, each stamping had two (or more) dovetailed keys on each sector, and these keys were threaded into machined keyways cut in the cast-iron frame. The cheaper form of construction afterwards adopted on the Continent was to stamp the dovetailed keyways in the sectors with corresponding keys let into the frame. This construction does not give so direct a connection to the frame as the former, and has been the cause of numerous failures. With faulty workmanship and inadequate proportion of the keys, the core worked slack at the keyways, with complete failure of the stator after a few months' working. In other cases the volume of iron has been insufficient, and the induction in the iron near the keys has caused serious overheating of the stampings and reconstruction of the stators became necessary. The probable cause was the formation of eddy currents in the steel keys, with the overheating of the keys and the portions of the disks near them. With certain conditions of load, this overheating became so serious as to burn off the paper insulation on the disks and to throw out a shower of sparks from the burnt paper at the air discharge. The former construction having dovetailed keyways punched out of the stampings gives a sounder machine. At the same time the later method may give a good machine provided the keyways are well punched, of adequate size, and that proper allowance is made for the active metal lost by punching the keyways out of the sectors.

Inaccurate punching of the plates is another source of trouble, entailing excessive filing of the stampings after building; and to prevent serious eddy currents across the burrs caused by the filing, the plates are more lightly packed together than is desirable, and vibration takes place.

Owing to the limitation of railway facilities the stators of large generators must be built on site under usually somewhat primitive conditions. Consequently the preparation of the stampings and their building up is not always so carefully carried out as when erection takes place in the shops.

ELECTRICAL WEAKNESSES.

The electrical weaknesses in turbo-alternators have generally developed since the size of the machines and the systems to which they were connected increased to over 30,000 KW. on a single set of busbars. The insulation on the stator bars is almost invariably micanite, worked on hot with a Haefley wrapping. If the stator bars are not adequately supported, bending will occur and cracking of the micanite insulation will result usually just inside the ends of the stator core. A number of different types of insulation have been introduced using Empire tape and similar fabric, interleaved with mica. After use at the ordinary working temperature of turbo-alternators the fabric loses its flexible character and becomes as brittle as mica.

The joint between the bars and the end connectors is generally soldered, and if care and time be taken a sound joint can be made by experienced workmen. There is, however, always the difficulty that out of hundreds of joints in a machine one may be defective. In practice it usually happens that a faulty joint is only detected through the machine giving way and the solder melting, with every risk of a fire.

The greatest electrical weakness in turbo-generators constructed a few years ago was their inability to withstand the stresses set up on short-circuit. If even moderate movement of the stator bars occurs, cracking of the insulation is probable, especially if the insulation is of some age, setting up a

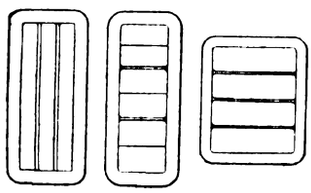

FIG. 1. FIG. 2. FIG. 3.

FIG. 1.—THREE-TURN BAR DIVIDED RADIALLY.

FIG. 2.—THREE-TURN BAR DIVIDED AXIALLY.

FIG. 3.—ONE-TURN, FOUR BARS IN PARALLEL.

defect which will develop sooner or later into serious trouble. In fig. 1 is shown a three-turn per slot winding for a 5,000-KW. machine, 6,600 volts between phases. The three copper tapes are arranged lengthways in the slot, giving a stiff bar with which there was no trouble on short-circuit. In fig. 2 is shown the winding of another machine of similar size, laminated across the slot, and of better design for reducing the eddy currents, but the bar is not so rigid. Both machines worked under similar conditions, and were connected to the same busbars, but the winding shown in fig. 1 gave no trouble on short-circuit, whilst the winding in fig. 2 repeatedly broke down.

On the multiple-bar and crushed-strand construction, difficulties occur with stator bars of considerable section. The conductors do not nest firmly together, and a tight mica wrap around them cannot be made. An example is shown in fig. 3, where the conductors were slack within their insulation, and in less than three years the insulation was worn away at the corners and caused a breakdown to earth at a very moderate working pressure.

The latest method of constructing stator bars is a more complete development of lamination. The stator bars are divided radially into several copper tapes, each separately insulated, and each tape is connected to another tape in the several bars forming the winding pitch at the ends of the stator. At each joint the tapes are twisted relatively to each other, giving a complete change of position in each complete phase winding from the star point to the main terminal.

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This construction eliminates eddy currents and gives a uniform distribution of current in every section of the stator bar. It has the additional advantage of small joints, which enable the tapes to be fusion-welded together. The only large joints occur at the star points and at the main terminal connections, and these can be arranged well out of the revolving field. However, a bar laminated so completely has little stiffness or mechanical strength and requires very careful support.

Heating and Fire Risk.

With the old type of low-speed generator the fire risk was not considerable, as the proportion of inflammable material was small. With a modern turbo-alternator, owing to the high speed and compact design with small volume of active material, a very considerable portion of inflammable insulation is built into the machine. The stators have usually two-pole windings, consequently about 50 per cent. of the stator winding length is usually taken up by the connectors between the stator bars. These connectors are purposely spaced in an open manner to allow the cooling air to circulate, and the air is circulated at the speed of a tornado and is constantly renewed by the fans. The inflammable character of the winding may be augmented by oily vapour and dirt carried into the machine by the ventilating air and deposited as sticky material on the conductors. A fire once started at or near the end connectors is immediately swept round the openly spaced windings, and their destruction is a matter of only a few seconds.

Ventilation Troubles.

The amount of air required to carry away the internal heat is dependent upon the internal losses and upon the permissible temperature rise. Allowing a rise of 50 deg. F. in the cooling air, and a loss of 4 per cent. in the generator, about 4 cu. ft. of air per minute per kilowatt of output is sufficient, and this allows for a certain amount of the air being short-circuited within the machine. Except under very exceptional conditions some form of filtering and cooling the air is necessary. The amount of dust caught by a dry filter from an air blast of 40,000 cu. ft. of air per minute has been found per week of continuous working to be 5 lb. in the centre of London and 2 lb. at the outskirts of London.

Unless this dust be removed, it is sufficient to choke up the narrow air passages in the rotor and stator, which passages can be cleaned only with considerable difficulty, even when the rotor is removed.

The correct distribution of the air after entering the machine is a matter of difficulty. Even should the various air currents be correctly distributed when the machine is new, deposits of dirt after use will soon alter the air distribution, and the effect of incorrect distribution of air is of serious practical importance.

The temperature of the ventilating air leaving the machine indicates roughly the amount of heating of the machine, but gives neither the maximum nor the average temperature, as the temperature gradient is unknown. If the separate discharge temperatures of each air current were known, a better indication would then be obtained of the hottest part of the machine.

Suggested Lines of Improvement.

From the operating point of view, the requirements of modern turbo-generators are (1) reliability, (2) efficiency, (3) ease of operation. Reliability calls for machines which shall be fireproof, the coils of which cannot break down or overheat, the insulation of which shall not fray, crack or deteriorate, and the electrical joints of the machine shall be so constructed that there is no chance of their giving way under load. Most operating engineers would consider reliability the most important of the above conditions, and would be willing to obtain it at the sacrifice of some electrical efficiency.

Ease of operation requires some better means of knowing what is happening inside the machine. It ought to be possible to determine continuously, with some accuracy and by simple means, what is the temperature of any part of the machine, and it is desirable to anticipate breakdowns by the indication of rising temperature of the faulty part, or otherwise, before the fault develops.

The output of the machine should be independent of air temperatures, and if possible there should be some reserve of capacity to meet sudden overloads.

Rotor coils' centrifugal force.—When it is realised that a pressure of over 2 tons per sq. in. may be encountered, and that the insulation must stand continuously a temperature of 200 deg. F., it will be seen that the insulation problem is not one of easy solution. The choice at present is restricted to mica and various forms of hard paper. The coil should be made of as great a width as possible, and the separate turns laid flat upon each other. The support of the coils against distortion at the end of the loops can be prevented by substantial metal packing between the loops.

The safest band over the coils would be one of drawn steel tape, which would require centering by other means than the coils themselves. With a laminated tape band, each turn can adjust itself to the strains upon it.

Stator cores.—The trouble of soft cores is usually due to the end plates being of insufficient stiffness, and as they are generally attached to the frame only at the periphery, there is a considerable spring across the face of the plate. In the case of cores of considerable radial depth, one or more rings of insulated bolts may be necessary in addition, in which case all electrical contact with the bolt heads and nuts on the end plates must be carefully avoided. Stronger supports should be provided for the teeth.

Stator windings.—The end connections, if attached to weak laminated stator bars, are difficult to stay adequately. Usually fibre spaced blocks are laced between the ends of the stator bars at the junction with the end connectors; these give mutual support between the bars in a circumferential direction, but stresses on short-circuit are also radial from the centre, and in this direction the space blocks give but little support. The remedy is to provide continuous coil supports having winding slots for the entire length of the end connectors.

Joints.—In the ideal machine all the joints would be fusion-welded, except possibly in the case of the largest joints, where clamped and soldered connections would be permissible if well removed from the rotating field.

Heating and fire risks.—The relation of the temperature to the useful life of the insulation is of great importance. A reduced temperature gives a greatly increased life.

It would appear that for large machines working continuously night and day for months together, a temperature of 150 deg. F. has much to recommend it from the point of view of capacity to meet sudden overloads and long life of insulation.

Having the fire risk in view, all inflammable packing insertion and all fibrous insulation should be avoided in both stator and rotor. The ideal insulation is yet to be found, but it would have a substantial body of mica built up without inflammable gum or varnish and with some degree of flexibility. The binding material of the mica and packing must have a high thermal conductivity and suitable specific inductive capacity to give a uniform electrical pressure gradient through the mass of insulation.

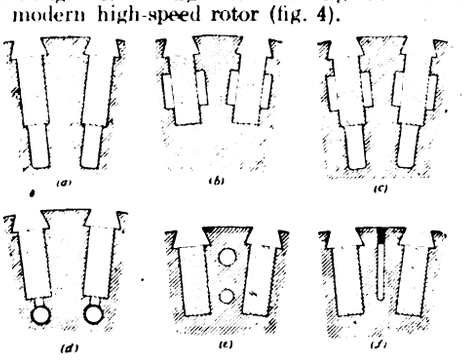
Ideal Machine.

Various designs have been proposed using liquid cooling. Whilst the majority of them are of foreign origin the initial adaptation of water cooling to modern machines is to be credited to Messrs. C. A. Parsons & Co., Ltd.

All the liquid cooling designs on record appear to deal with the problem of heat dissipation as an adjunct to air cooling. If, for the moment, the principle of liquid cooling be accepted and be completely developed as a practical feature, a number of important modifications at once become possible. Air ventilation, with the difficulties of cooling and cleaning, becomes unnecessary, and the fire risk of machines largely disappears if there be no air to feed the flames. By splitting up the water paths in the machine, and by providing adjusting cocks in the water supply to each cooling device, it becomes a simple matter to determine the temperature of each part of the machine and to adjust the water flow to give a uniform temperature with elimination of hot spots, and having regard to the superior cooling effect of water over air, a lower temperature would be possible with enhanced life of the insulation.

A further and great advantage would be in the provision of continuous supports to the end connections of both stator and rotor windings, which at present are the weakest features of most generators.

Various designs of cooling rotor windings have been drawn out for a modern high-speed rotor (fig. 4).



(*a*), (*b*), (*c*) air cooled. (*d*), (*e*), (*f*) water cooled.

Fig. 4.—Rotor Winding, various methods of cooling.

Taking the ordinary air velocities in rotor ducts as 10,000 ft. per minute, and a moderate water velocity of 500 ft. per minute, the relative cooling capacities of the streams of air and water are as shown in the table below. The size of cooling ducts are taken as large as can be constructed with the winding slots shown.

Arrangement.	Proposed by	Relative cooling capacity.
Fig. 4 (*a*)	Ordinary arrangement	1
„ 4 (*b*)	Siemens	0·8
„ 4 (*c*)	Schuckert	1·8
„ 4 (*d*)	Parsons	54
„ 4 (*e*)	Siemens Dynamo Works	83
„ 4 (*f*)	Author	89

The actual heat-abstracting powers of the two sets of conditions per degree F. rise in temperature of cooling medium for the velocities stated are:—

Air: 1,266 therms per minute per sq. in. of air duct.

Water: 216 therms per minute per sq. in. of water duct.

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The capacity of water over air cooling is very marked, as might be expected, and may be in excess of the capacity of the insulation to conduct the heat. A rotor constructed with cooling ducts as shown in fig. 4 (*f*) is detailed in fig. 5, where water-cooled supports are shown for the end loops against side slip.

Water cooling for the stator does not appear to have been developed to any great extent.

If full advantage is to be taken of water cooling, it would appear desirable for the cooling arrangements to be in close proximity to the coils, with very low-resistance heat paths. Designs have been developed by the author upon these lines.

In fig. 4 (*f*) the heat from the rotor coils is directly transmitted to the iron tooth, which would be made slightly wider

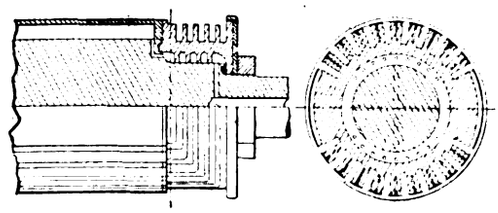

FIG. 5.—ROTOR WITH SEPARATE COIL SUPPORTS, WATER-COOLED.

than usual to compensate for the loss in section where the water duct is milled out of the solid tooth; the top of the duct is closed by a steel plug, fusion-welded in place.

Fig. 5 shows a rotor with teeth cooled as described, and provided with separate bronze coil supports at each end of the core. The supports would provide continuous slots for the end loops of the rotor coils. The metal teeth between the coils give substantial support at the rotor periphery for supporting and centering flexible steel tape bands. The steel ring over the end flange is arranged to give a mechanical anchor for the end of the steel binding tape.

(To be concluded.)

DISCUSSION IN LONDON.

Mr. A. B. FIELD said that the suggestions put forward by the author for a water-cooled generator were not new, and they could not be adopted at the present time because they would have to await improvements in details. By that he meant improvements in methods of insulation upon which the whole thing depended. It was his opinion that the present methods of air-cooling generators would certainly be superseded. A method worthy of consideration was that of incorporating an air circulator and cooler in the generator itself; such a device had, he thought, greater possibilities than the author attributed to it. He agreed that in, say, 15 years time present practice would be considered quite as antiquated as that of 1904 was considered to-day.

Mr. E. W. DICKINSON's opinion was that the author's propositions would not solve the problem; some considerable time would elapse before the introduction of the water-cooled generator would be possible. With regard to the suggested use of solid strip in place of binding wire, he thought the same objection, namely, the possibility of "wiping" end coils, would apply to both. Also concerning the merits of solid and flexible couplings, the former were, in his opinion, much preferable. One of their greatest troubles was, he thought, that of workmanship. To-day the average workman was nothing like so careful in carrying out his work as he used to be a few years ago. Carelessness and low-grade workmanship were responsible for a great many faults; if they could be sure of the workman putting high-class work in the machine the majority of common faults would automatically disappear.

Mr. G. W. PARTRIDGE was afraid that the author must have been very unfortunate in his machines. The statement that generally the rotor and its shaft were turned out of a single forging held good only for machines up to 12,000 KW. and 3,000 R.P.M.; beyond that size the plated construction was, in his (the speaker's) opinion, preferable, so that the inside of the rotor could be seen, and what was going on inside could be noted. He regretted the attack in the paper on the Parsons' flexible coupling; personally he had always preferred a flexible coupling, especially for large machines. One serious form of trouble had been omitted from the paper, namely, a single-phase short-circuit, which would result in the burning up of the wedges between the coils and would also disturb the end windings. He had fortunately been free from most of the troubles cited by the author, although his service was perhaps one of the most severe. With regard to water-cooled generators, such machines would be very expensive, and the problems to be overcome in making and maintaining watertight joints would be difficult. Condensation would also be a serious difficulty unless the machine were kept working on a constant load, and that was not always possible. Moreover, he was certain that trouble would be experienced with deposits and corrosion due to the cooling water and the space taken up by ducts for the latter could be utilised to much better purpose if used in conjunction with air cooling.

Mr. A. M. TAYLOR assumed that it was vital that alternators should be absolutely reliable under all conditions. The alternator makers were bound to defend themselves against any charge of unreliability, and they would probably be content if it could be shown that only one alternator in five broke down within, say, three years of purchase. But he (the speaker) knew of at least one case where, with the very best modern alternators, even half this reliability was not attained. He submitted that the degree of reliability obtained with locomotives on main-line railways was something like 100 times as great. He suggested that as, in the near future, they were to have stations generating at 30,000 to 60,000 volts, which would necessitate step-up transformers, it was a question whether the transformers could not be efficiently used to improve the reliability of the generators. Suppose, for example, that, instead of earthing one end of each generator coil, the coil were insulated at both ends and the two ends taken out to a corresponding coil on the primary of the transformer and that the midpoint of this coil were earthed. They would then at once halve the potential stresses between any part of the generator winding and earth. The arrangement would really be the equivalent of six phases on the generator, though there would be only three coils, as at present. Suppose, further, that a second three coils of intermediate phase were added to the generator, then, for the same kilowatts, the voltage of all six coils could be again halved, thus quartering the stresses to earth. The second three coils would be connected to a second lot of primaries on a second transformer; and in order to rectify for the phase displacement, the second transformer would have its H.T. side in delta, while that of the first transformer would be in star, both being coupled to the same busbars. Besides quartering the stress to earth on the generator windings, the arrangement would have the decided advantage of reducing the tendency of the sound coils on the generator to deliver energy to the faulty coils, for, in the case of coils that were feeding different transformers, there were two primary and two secondary reactances in series. He believed that when the great advantages of multiphase transmission were appreciated, this (multiphase) form of transmission would be adopted for all long-distance work, and in such a case the 6-phase, double-star generator winding mentioned above could be put direct on to the (cable) line, and this would at once give 70 per cent. better regulation on the cable system and 58 per cent. of the line losses, or conversely greater distances could be covered for the same amount of copper. In cases where three existing cables ran to an existing sub-station, approximately 70 per cent. more power could be transmitted by running the cables as a 6-phase system. At the sub-station end an ordinary 3-phase transformer could be used to give a 3-phase supply. The special generator could be dispensed with if a transformer were introduced between the busbars and the line. A 12-phase, long-distance transmission line could be carried out with two 6-phase cables, and would reduce the line losses to 29 per cent. of that of the 3-phase system and improve the regulation 340 per cent.; or conversely the distance of transmission could be extended 3½ times for equal copper investment.

Mr. W. MCCLELLAN, O.B.E., who was particularly interested in the paper from the point of view of electric ship propulsion, said that the author had not exaggerated the difficulties in this connection. This was at once apparent when it was remembered that the air trunk pipes that would be necessary for cooling a large electrically-propelled battleship would have diameters approaching 20 ft. Moreover, the cooling of large ship's motors was particularly difficult, as they were situated in such confined space at the stern of the ship. Air ducts on board ship also multiplied the problems encountered in connection with water-tight compartments and bulkheads. In America maximum speed of vessels had been sacrificed to obtain efficient cruising speeds.

Dr. S. P. SMITH pointed out that if the buyer insisted upon having the cheapest machine he could obtain, then he had no one to blame but himself when breakdowns occurred. Further, if the practice of allowing a lower factor of safety for an electric generator than for any other type of machine continued, they could expect little else than trouble. On the other hand, it should be pointed out that there were machines which had been running perfectly for years without any trouble whatever. Some of the faults enumerated by the author were out of date; slack cores, for instance. Surely they should not have to be told how to make cores in these days. They should be on their guard against being misled by statements that water was a better cooling medium than air. For instance, they might cool the iron portions of the machine in direct contact with the water more efficiently and yet the copper conductors might be no better off due to the thick mica insulation preventing the heat escaping to the water. The whole problem was one of insulation. The author's proposals had many good points, but in his (the speaker's) opinion a water-cooled generator as proposed in the paper would not be a success.

Mr. F. H. CLOUGH complained that many of the weaknesses enumerated in the paper were out of date: the author advocated low temperatures, and yet he proposed the use of windings which would lead to high temperatures. There was also much misconception regarding where stresses in the windings really occurred. It should not be forgotten that the proposition of a new type of machine was quite a different task to that of persuading a customer to buy the said new machine. The state of affairs was not really so bad as was

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suggested by the author, but his paper would lead to very serious thought. There was no doubt that water cooling would be adopted eventually, but they were not ready for it yet, and if it came too soon it might lead to serious trouble, perhaps even more serious than that experienced to-day.

Mr. J. SHEPHERD, in reply, explained that the paper was put forward to see if they could not from two points of view build better machines; first cooler, and secondly safer machines. With regard to the faults mentioned being out of date, he could only say that he had personally experienced all but one of them, and that had been included at the express request of a friend. It was his opinion that in, say, 10 years' time air cooling would have gone out of use; that method weakened the machines on account of the large number of air holes that were necessary, and it also led to the accumulation of dirt inside the machine. The air-circulating system suggested by Mr. Field had its good points, but no method except water cooling would allow of the insulated conductor being supported along its entire length. The user found the insulation to be the seat of all disorders. He agreed with Dr. Smith that a larger margin of safety should be allowed; a conductor should be supported for the whole of its length and not only for part of its length as was done at present. Bars should be so shaped to assist insulation which should be the same along its whole length. Present practice resulted in the straight portion of the bar being more efficiently insulated than its curved portions. Wire bands were superior to solid steel rings, because during the process of drawing the wire was thoroughly tested. On the other hand, alloys like nickel and chrome steel were comparatively new, and the effect on them of prolonged heat and continued stress had yet to be determined. With regard to the unsuitability of the flexible coupling, he instanced a number of firms that had discontinued its use.

The paper was illustrated by lantern slides.

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

A Water-cooled Cable System.

In order to cool high-tension cables run through the walls of a tunnel in Cincinnati the Union Gas & Electric Co. has installed a system of water pipes which will tend to prevent any excessive cable heating. The system, fig. 1, consists of 25 1.5-in. (37-mm.) pipes running parallel to the ducts. At each end of the horizontal section of the tunnel, which is 64 ft. (19 m.) long, the pipes project into the tunnel chamber and are fitted at their ends with removable plugs. About 7 in. (15 cm.) from the end of each pipe tees are inserted for inlet and outlet connections to manifolds. These manifolds are connected to a gravity or forced-feed circulating system as conditions dictate.—*Electrical World.*

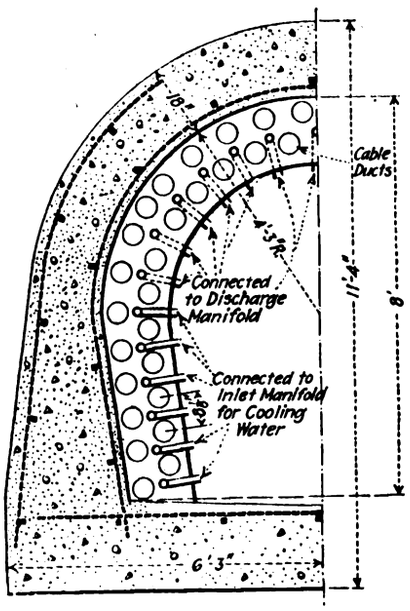

FIG. 1.—COOLING SYSTEM FOR CABLE DUCTS.

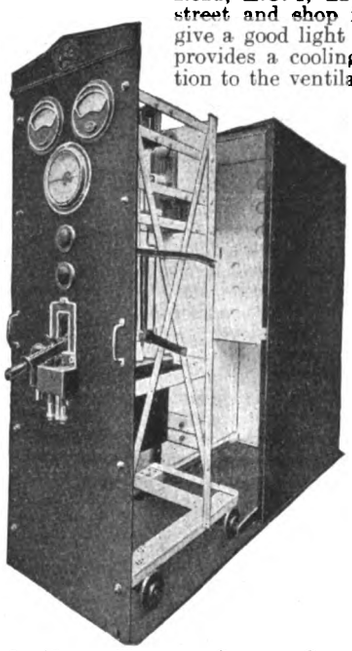

FIG. 2.—FRONT VIEW OF SWITCH CUBICLE WITH TRUCK WITHDRAWN.

G.E.C. Switch Cubicles.

For the control of three-phase machines and feeders up to 6,600 volts where floor space is limited the GENERAL ELECTRIC Co., Ltd., of 67, Queen Victoria Street, E.C. 4, manufactures "truck" type switch cubicles as shown in fig. 2, in which the "truck" is seen withdrawn for inspection, cleaning, &c. The construction allows of their being placed directly against a wall, as a passage way behind is unnecessary, neither are special foundations required. The cubicles are constructed of steel, so that the equipments are rendered fireproof; no marble or slate is used in their construction, all terminals, busbars, isolating switches, &c., being supported by means of porcelain insulators. They are designed to accommodate the usual instruments, oil-break switches, isolating plug switches, transformers, and sealing boxes; the whole of this apparatus (excepting the sealing boxes) together with the inter-connections and small wiring, are mounted on a movable truck with wheels fitted with ball bearings. When the truck is withdrawn the whole of the gear is rendered "electrically dead," and easy access is afforded to facilitate renewals, adjustments, cleaning operations, &c. By means of an interlock it is made impossible for the truck to be withdrawn or placed in position with the oil-break switch in the "on" position. Furthermore, when the truck is withdrawn all live parts mounted on the fixed section are entirely covered in by a steel shutter, which moves into position, thus covering the plug-switch holes.

Where busbars are required, these are accommodated in a separate chamber at the top of the fixed cubicle, and are entirely covered in. Inspection covers are provided to enable the busbars to be inspected when necessary. Any desired combination can be arranged with the truck type cubicle illustrated so as to form a complete main switchboard.

The "Melton" Lantern.

MESSRS. FALK, STADELMANN & Co., LTD., of 85, Farringdon Road, E.C. 4, have produced a lantern, fig. 3, designed for street and shop front lighting. The reflector is designed to give a good light distribution, and the lower section of casing provides a cooling chamber to prevent overheating. In addition to the ventilating points provided round the globe seating under the cap of the lantern, the body is ventilated midway to promote a cooling current of air round the neck of the lamp. All ventilation points are adequately protected against the weather.

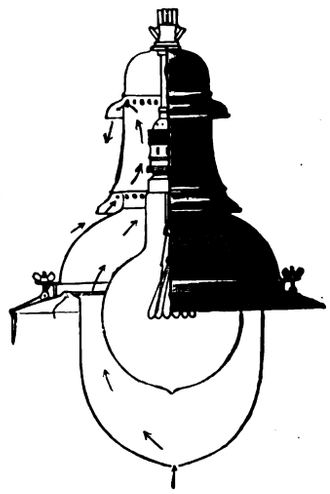

FIG. 3.—THE "MELTON" LANTERN.

Central Suspension for Street Lighting.

The accompanying illustration shows the latest installation of street-spanning gear carried out by the LONDON ELECTRIC FIRM, Brighton Road, Croydon, viz., at Hove, near Brighton. The gear consists of a simple set of span-wire fittings, which has been devised for use without lowering gear, the cable being led down the wall in screwed conduit and finished off with a watertight switch and fuse. The cable is so arranged that there is no possibility of water trickling down the wire into the lamp. The efficiency of central-suspension lighting, and its advantage in eliminating posts with attendant obstruction and risk of collision by passing vehicles, will no doubt be more appreciated with the advancing speed and volume of street traffic, and also in view of the Road Board's recent pronouncement in favour of this system, and the powers which are being sought to obtain compulsory rights for attaching fixtures to frontagers' buildings. Varying sizes of buildings are no bar to the system, as short poles can be

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erected on a low building, or attachment can be made to a chimney stack or the like, where opposite buildings are not

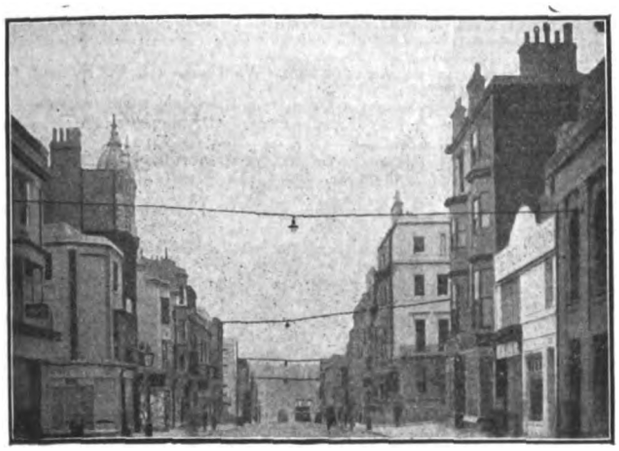

FIG. 4.—CENTRAL SUSPENSION AT HOVE.

of equal height. Similar gear has been supplied to the City of London and many other places.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Unspeakable Bosh.

I notice your leaderette of the 2nd inst. entitled "Where angels fear to tread," commenting on the *Daily Mail's* account of Mr. Steele's scheme of generating electricity. You appear, however, to have missed another gem in the same paper (I am sorry I cannot refer you t othe particular date of their issue) in which they describe a "Fuelless motor bicycle": this, briefly, is to operate by means of a hydraulic cylinder upon which the saddle is fixed, and which is connected through a pump to a water motor. The bumping along the road causes the weight of the rider to operate the pump, and produces one horse-power. If there are two pumps installed, it produces two horse-power, and if three pumps, three horse-power.

As you say in your article, moderate language is utterly inadequate to the occasion, and this is specially so when dictating to a lady typist.

T. C. Parsons.

Glasgow, *January 6th*, 1920.

Transformer Oil.

In the course of a number of investigations into cases of transformer breakdown, we have come to the conclusion that many engineers find difficulty in deciding when to change the oil in their plant. We therefore put forward a few suggestions for testing the condition of transformer oil, in the hope that they may be of interest.

The oil should be sampled at regular intervals, say, once in three months, preferably from a cock near the bottom of the tank. The first pint or so drawn should be returned, and then a small quantity should be mixed with twice its volume of natural petroleum spirit (not cracked spirit, shale spirit, or benzole) in a clean, well stoppered bottle, and allowed to stand 12 hours in a cool place.

This treatment will cause any sludge which may be forming in the oil to fall to the bottom as a deposit, and if the bottles are kept, the amount of deposit from any test may be compared with that from preceding tests.

When an oil oxidises, sludge begins to form long before it begins to deposit—a quantity being held in solution—and it should, we take it, be the aim of the engineer to change his oil just before it reaches saturation point. Since warm oil will hold very much more sludge than cold, it follows that a good deal can be learnt by simply cooling samples overnight and noting the amount of turbidity.

A close watch should also be kept upon the dielectric strength, or what in the case of high-class oils amounts to the same thing, upon the dryness of the oil. It is not sufficiently appreciated that during oxidation of petroleum water is formed as well as sludge. This fact would have forced itself upon the attention of engineers long ago were it not that the warmth of the transformer generally causes the moisture to evaporate. Whether the moisture escapes as quickly as it is formed depends, however, upon the design of the transformer case.

A rough test is to heat the oil in a test-tube, when a crackling and frothing indicates moisture, but this is only sensitive enough to indicate a really dangerous proportion. A much better method is to determine the dielectric strength by raising the voltage to breakdown point between a pair of electrodes immersed in the oil at a known distance apart. When traces of moisture are present small sparks traverse the gap at a voltage considerably below that of complete breakdown.

We do not attempt to propose rigid rules for managing the oil insulation of a transformer, but we think that by studying his oil in the manner indicated above, an engineer may acquire experience which will help him in guarding against breakdown.

Alexander Duckham & Co., Ltd.

London, E., *January 7th*, 1920.

Relativity.

I do not rightly know if I have understood the nature of the difficulty that arises in your article of the 9th inst. on "Relativity," but it seems to me that all difficulties disappear if it is remembered that the higher dimensions are not used in the "mystic" sense of nineteenth century mathematics. The time function is treated simply as a spatial quality, and not as a coefficient. The three-dimensional treatment of space itself is, of course, purely arbitrary. A creature physically constituted like H. G. Wells's "Martian" (and equally egotistic) would probably devise a radial system with or without the integral treatment of the time function. The same writer has treated time as a spatial quantity in the "time machine" with fantastic results, and has perhaps intuitively appreciated the true constitution of space in the curious short story of the man whose "optical field" is shifted by lightning stroke while experimenting between the poles of a huge magnet.

It would seem that we must treat time-spatial relations as a product of psychic-motion scrapping the ether hypothesis. Upon the extraction of motion and, or, the psyche (whatever it may be), space and time would collapse like a burst bubble as a result of the rupture of all tensions. This, however, is ultimate and by-the-way. It would be interesting to hear some practical views upon a theory which to me appears intuitively satisfactory, and which will take a deal of refutation.

Wilfrid J. Jones.

Eastleigh.
January 12th, 1920.

The "Lesco" Lampholder.

As the patentee of the "Lesco" holder, may I venture to reply to Mr. Turnbull's criticisms on this holder?

Before doing so I should like to point out that in the correspondence with Mr. Turnbull the point of his criticism has been misunderstood. The arguments the Lesco Co. put forward were based on the assumption that Mr. Turnbull was objecting to the method by which the shoulder which supports the shade was attached to the body, whereas he was really objecting to the method that was used to join the two parts together. Of course, there is no suggestion that the top and bottom parts of the holder should be a tight fit in order to take weight off the indentations.

With regard to this point, now that we understand what he really means, our answer is that the heaviest shade, holophane or any other kind, that is likely to be put on a holder will not exceed 3 lb. in weight, and a deep conical opal 12-in. shade weighs 1 lb. The Lesco holder, Mr. Turnbull will find, will carry 50 lb. weight. Surely this is a sufficient safety factor to allow for corrosion or any other cause.

Mr. Turnbull goes on to say that this is more important in that the holder is made from light spinnings and not from castings. This remark is a deliberate misstatement of fact. In our letter to Mr. Turnbull of December 29th, we gave him the information definitely that the "Lesco" holder is made of solid-drawn brass tube throughout. It is not a spinning, nor is it a stamping job. There is more metal in the Lesco holder than in the best quality English holders. Mr. Turnbull talks of holders being made from castings; the quantity of holders made from castings in this country or anywhere else is probably less than 5 per cent. of the total output.

In conclusion, whilst I do not object to Mr. Turnbull going to the public Press to express his views on the mechanical design of the holder, what I do object to is his attempting to convey the impression that the holder is made of light stampings, and that it compares unfavourably with the best quality of English holders, whereas in reality it contains more metal and is quite as substantial in every way.

Vernon Hope.

Manchester.
January 12th, 1920.

The Fuel of the Future.

In reading the articles referred to by "Economy," whose letter you published in your issue of January 2nd, I cannot see that there is anything that Mr. Klemens said in those articles which would have the effect of discouraging electrical men from emulating the gas engineer by salving the valuable by-products of coal to the utmost extent.

Mr. Klemens does not attempt to deal with that aspect of

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the problem, and the main lesson to be learnt from his articles, as I understand them, is that it is a fallacy to argue that electrically-produced heat is dearer than gas-produced heat, merely because British Thermal Units can be produced by gas more cheaply than by electricity.

In the case of gas heating, British Thermal Units are blown to waste, whereas in the case of electric heating, all heat produced can be usefully employed.

If we are to get all we possibly can from the coal, then we must have gas, but the argument is that it would be better utilised in the power house than in the home.

Super-Economist.

January 7th, 1920.

NEW PATENTS APPLIED FOR, 1919-1920.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by MESSRS. SEFTON-JONES, O'DELL AND STEPHENS (successors to W. P. Thompson & Co., of London), Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

32,764. "Method of altering electrical conductivity of metals." F. H. LORING. December 31st.

32,767. "Electric cut-out devices." A. J. AMEY and H. V. FROTT. December 31st.

32,770. "Means for measuring electric currents." M. B. FIELD. December 31st.

32,776. "Sparking plugs." C. L. BINKS. December 31st.

32,783. "Electric generators and motors." VAN RADEN & Co. and R. RANKIN. December 31st.

32,789. "Indicators for electrolytic cells." I. H. LEVIN. December 31st.

32,790. "Separators for electrolytic cells." I. H. LEVIN. December 31st.

32,791. "Electrolytic cells." I. H. LEVIN. December 31st.

32,792. "Feeding attachments for electrolytic cells." I. H. LEVIN. December 31st.

32,793. "Electros." I. H. LEVIN. December 31st.

32,794. "Electrolytic apparatus." I. H. LEVIN. December 31st.

32,812. "Radio navigational apparatus, &c." H. L. CROWTHER and J. EPSKINE MURRAY. December 31st.

32,813. "Radio-receiving systems." BRITISH THOMSON-HOUSTON Co. (General Electric Co.) December 30th.

32,845. "Method of fixing insulating rings on shafts or cores." NAAMLOOZE VENNOOTSCHAP ELECTROTECHNISCHE INDUSTRIE VOORHEEN, W. SMIT & Co. December 31st. (Holland, February 20th, 1915.)

32,853. "Method for electrolysing a solution of nickel salt." C. HEBERLEIN. December 31st.

32,879. "Electric cigar lighters, &c." QUAIN ELECTRIC Co. and J. R. SPINK. December 31st.

32,886. "Apparatus for electrolysis of metal salt." FREDRIKSSTAD ELEKTROKEMISKE FABRIKER AKTIESELSKABET F.E.F. December 31st. (Norway, February 13th.)

44. "Meter for measuring, recording and indicating quantity of electrical energy on electrical circuit." W. W. LACKIE. January 2nd.

52. "Enclosed-bulb electric devices." O. DURDLE, GENERAL ELECTRIC Co. January 2nd.

60. "Treatment of paper, &c., for electrical, chemical, &c., purposes." S. BRYDON. January 2nd.

64. "Electric battery." A. CAYROL and P. ODION. January 2nd. (France, April 25th, 1914.)

66. "Process for manufacture of electric insulating material." E. F. A. BULTEMANN. January 2nd. (Germany, January 29th, 1918.)

72. "Sound amplifiers." J. B. MITCHELL. January 2nd.

94. "Valve amplifiers and inter-valve transformers." G. A. MATHIEU. January 2nd.

103. "Electric air-heating devices." A. REMARTINI. January 2nd.

104. "Sparking plugs and manufacture of same." G. N. HALL and H. G. RAMSELL. January 2nd.

127. "Induction manifold for internal-combustion engines." G. SCOTT. January 2nd.

128. "Methods of electric distribution with alternating currents." A. M. TAYLOR. January 2nd.

151. "Signalling systems." BRITISH THOMSON-HOUSTON Co. (General Electric Co.) January 2nd.

152. "Dynamo-electric machines." BRITISH THOMSON-HOUSTON, F. H. CLOUGH, J. HUTT and H. W. TAYLOR. January 2nd.

161. "Means for starting internal-combustion engines, also for generating electric current." W. S. JEAL. January 2nd.

170. "Dynamo-electric machines." A. H. MIDGLEY and C. A. VANDERVELL & Co. January 2nd.

190. "Indicators or annunciators." F. G. BELL and STERLING TELEPHONE & ELECTRIC Co. January 2nd.

209. "Arrangements for offering greater impedance to direct than alternating currents." AUTOMATIC TELEPHONE MANUFACTURING Co. and P. N. ROSEBY. January 3rd.

226. "Electric kettles, &c." R. W. COAN. January 3rd.

243. "Insulators." BRITISH THOMSON-HOUSTON Co. January 3rd.

244. "Controlling devices for alternating-current dynamo-electric machines." BRITISH THOMSON-HOUSTON Co. and H. W. TAYLOR. January 3rd.

254. "Electric oscillation arcs." B. BINYON and RADIO COMMUNICATION Co. January 3rd.

264. "Electric switches." Sir G. T. BUCKHAM and Sir A. T. DAWSON. January 3rd.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1918.

7,178. DISTRIBUTORS FOR HIGH-TENSION IGNITION DEVICES. Bosch Akt. Ges. R. May 26th, 1917. (116,270.)

8,200. ROTARY ELECTRIC MACHINES. K. Nobuhara. May 16th, 1918. (Convention date not granted.) (116,896.)

10,453. METHOD OF AND APPARATUS FOR CHARGING MATERIAL OF ELECTRO-OSMOTIC APPARATUS FOR REMOVING LIQUIDS FROM SUBSTANCES. Elektro-Osmose Akt. Ges. (Graf Schwerin Ges.) October 20th, 1917. (135,815.)

10,458. APPARATUS FOR ELECTRO-OSMOTICALLY REMOVING LIQUIDS FROM MATERIALS. Elektro-Osmose Akt. Ges. (Graf Schwerin Ges.) October 20th, 1917. (135,819.)

10,459. APPARATUS FOR ELECTRO-OSMOTICALLY REMOVING WATER. Elektro-Osmose Akt. Ges. (Graf Schwerin Ges.) October 20th, 1917. (135,820.)

12,709. ELECTRIC LIQUID HEATING APPARATUS. I. Sordi. August 3rd, 1918. (136,198.)

14,078. DYNAMO-ELECTRIC MACHINES. British Thomson-Houston Co. and H. W. Taylor. August 30th, 1918. (136,202.)

14,715. ELECTRICAL SYSTEM FOR GENERATING INTERMITTENT HIGH-TENSION CURRENT IMPULSES FOR IGNITION PURPOSES, WITH OR WITHOUT LOW-TENSION CURRENT FOR BATTERY CHARGING, LIGHTING, AND THE LIKE. C. H. Tower. September 10th, 1918. (136,203.)

16,582. AUTOMATIC TELEPHONE SYSTEM. W. Cross. (D. S. Hulfish.) October 11th, 1918. (136,207.)

18,216. ARRANGEMENT FOR EVENLY DISTRIBUTING SINGLE-PHASE LOADS BETWEEN THE PHASES OF A POLYPHASE SUPPLY SYSTEM. U. Magini and F. Bassanese. November 6th, 1918. (136,211.)

18,715. ARMATURE WINDINGS OF ELECTRIC ALTERNATING-CURRENT MACHINES. British Lighting and Ignition Co. and E. C. Turner. November 14th, 1918. (136,215.)

20,090. CONTINUOUS FEED FOR ARC LAMPS. A. H. Standeford. December 4th, 1918. (136,220.)

20,379. ARMATURES AND POLE SHOES FOR MAGNETS. Siemens Bros. & Co. and L. de M. G. Ferreira. December 7th, 1918. (136,240.)

20,452. SPARKING PLUGS. K. E. L. Guinness. December 9th, 1918. (136,247.)

20,458. SOUND TRANSMITTING AND AMPLIFYING DEVICES FOR GRAMOPHONES AND THE LIKE. W. R. Free. December 9th, 1918. (136,249.)

20,619. TROLLEY HEADS FOR ELECTRIC TRACTION. J. B. Parker and J. Smith. December 11th, 1918. (136,260.)

20,641. PROTECTIVE HEAD COVERINGS OR MASKS FOR USE IN WELDING OPERATIONS. C. J. Holstag. December 11th, 1918. (136,263.)

20,988. ELECTRIC ACCUMULATORS. H. F. Joel. December 16th, 1918. (136,282.)

21,139. VISUAL ELECTRICAL INDICATORS FOR COLLIERIES AND OTHER MINES. J. KING. December 18th, 1918. (136,287.)

21,457. COMMUTATORS FOR DYNAMO-ELECTRIC MACHINES. E. J. Harman and E. Le Bas. December 21st, 1918. (136,303.)

1919.

511. SPARKING PLUGS. C. C. Bryan. January 8th, 1919. (136,327.)

1,288. MEANS FOR DRIVING A DYNAMO AND ACCESSORY PARTS OF AN ENGINE. M. Birkigt. January 17th, 1919. (136,339.)

1,404. TELEPHONE REPEATER SYSTEMS. K. E. Edgeworth. January 20th, 1919. (136,340.)

2,269. TELEPHONIC TRANSMITTERS. B. S. Cohen. January 29th, 1919. (136,360.)

2,785. ELECTRIC FUSES. W. A. Coates and Metropolitan-Vickers Electrical Co. February 5th, 1919. (136,367.)

2,901. CONTROL OF ELECTRIC MOTORS DRIVING RECIPROCATING MACHINES SUCH AS PLANES AND THE LIKE. G. Stirk, R. Stirk, and J. G. Stirk. February 6th, 1919. (136,373.)

2,928. APPARATUS FOR NOTCHING OR PUNCHING CORE-PLATES FOR DYNAMO-ELECTRIC MACHINES AND THE LIKE. Lancashire Dynamo and Electric Co. and R. S. McLeod. February 6th, 1919. (136,374.)

6,051. ELECTRIC SOLDERING-IRONS. O. Stalhane and O. O. Kring. March 11th, 1919. (136,406.)

8,914. ELECTRIC SELECTIVE-SWITCHING APPARATUS. International Electric Co. and F. R. Baldock. August 14th, 1918. (Divided application on 126,775.) (136,436.)

9,323. SOCKET TUBES FOR ELECTRICAL CONNECTORS, WALL SOCKETS, AND THE LIKE. C. L. Arnold and C. R. Belling. April 12th, 1919. (136,439.)

9,741. GALVANOMETERS AND THE LIKE. W. H. Apthorpe and Cambridge Scientific Instrument Co. April 16th, 1919. (136,445.)

12,041. METHOD OF AND APPARATUS FOR OPERATING CABLE OR OCEAN TELEGRAPHY. H. Angel. May 14th, 1919. (136,094.)

12,841. ELECTRICAL SWITCHING MEANS. E. A. Graham, W. J. Rickets and E. A. Santleben. May 21st, 1919. (136,101.)

12,900. ELECTRICAL INSULATORS. P. Venturini. May 22nd, 1919. (136,102.)

13,024. WHIPPING FOR TELEPHONES AND TELEGRAPH CABLES. Johnson & Phillips and A. I. Tracey. May 23rd, 1919. (136,463.)

13,026. RELAY FOR ELECTRIC CIRCUITS. D. A. Christian. May 23rd, 1919. (Addition to 131,413.) (136,103.)

14,180. SPARKING PLUGS FOR INTERNAL-COMBUSTION ENGINES. R. Soyer. June 5th, 1918. (127,829.)

14,392. SPARKING PLUGS FOR INTERNAL-COMBUSTION ENGINES. W. V. Rutter, A. Farrington and G. M. Nicklin. June 6th, 1919. (136,109.)

14,583. ELECTRO-THERAPEUTIC APPLIANCES. A. H. Hewitt. June 10th, 1919. (136,110.)

14,675. ELECTRICAL INSULATORS. F. W. Le Tall. (Westinghouse Electric and Manufacturing Co.) June 10th, 1919. (136,112.)

15,658. SPARKING PLUG. A. Greensmith. June 21st, 1919. (136,115.)

15,921. SPARKING PLUGS FOR EXPLOSION MOTORS. J. Sender. June 24th, 1919. (136,117.)

17,237. SIGNAL SYSTEM FOR TELEPHONES. K. Tsukamoto and Kabushiki Kaisha Tsukamoto Denki Kenkyusho. July 9th, 1919. (136,494.)

17,640. SELECTING DEVICES FOR AUTOMATIC TELEPHONE SYSTEMS. Siemens Bros. & Co., E. A. Petithory and G. P. Sumner. July 14th, 1919. (136,497.)

17,988. ELECTRIC FURNACE CONTROL APPARATUS. H. A. Winne. January 2nd, 1919. (136,500.)

19,086. DISTRIBUTORS FOR MAGNETO GENERATORS. E. C. R. Marks. (Splitdorf Electric Co.) January 31st, 1919. (Divided application on 2,484/19.) (136,124.)

19,720. HORSESHOE MAGNETS. Scintilla. August 29th, 1918. (121,880.)

22,171. TELEPHONE RECEIVERS. E. Hausdorf. September 9th, 1919. (136,511.)

25,924. MEASUREMENT OF ALTERNATING ELECTRIC CURRENT POWER. S. Z. de Ferranti, G. Wall and Ferranti, Ltd. December 21st, 1918. (Divided application on 21,466/18.) (136,515.)

28,567. ELECTRICAL FUSES. Cable Accessories Co., F. H. Reeves, and A. Crawford. December 12th, 1918. (Divided application on 20,686/18.) (136,516.)

Municipal Enterprise in the U.S.A.—The National Electric Light Association *Bulletin* (New York), for December, 1919, gives, among other things, a long list of American municipal undertakings that have had to be closed down as "losing propositions." This seems to indicate that England is not the only hard place for ratepayers and electrical enterprise. The journal also contains an article setting forth the advantages of advertising by means of film cartoons. The author asserts that at least half the population of the average town attends the local kinema shows once a week, and there is, therefore, no better way of securing the public interest in the business.

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THE

ELECTRICAL REVIEW.

VOL. LXXXVI. JANUARY 23, 1920. No. 2,200.

ELECTRICAL REVIEW.

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THE PRICE OF THE "ELECTRICAL REVIEW."

During the War, almost exceptionally among technical publications and periodicals of the character of the ELECTRICAL REVIEW, we have refrained from increasing the price. Owing, however, to the constant increases in cost of paper, printing, engraving and production charges generally, we have reluctantly decided that the price from the beginning of this year must be raised to 6d. per copy. The change will not apply to unexpired subscriptions.

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THE TRADE SITUATION IN BRAZIL.

WE commend as deserving of serious study by British manufacturers and export traders the revised report issued by the British Chamber of Commerce in Brazil (Inc.) relating to "British Trade with Brazil." It is unnecessary to emphasise the immense importance of this great country with its population of over 25 millions and its area of 3½ million square miles—"nearly double the area of India, and larger than the United States without Alaska." For business purposes it should be remembered that it is the only country in Latin America where Portuguese is the language, and that the outstanding features of the moment are the development of local industries, a further increase in American competition, and the general prosperity of local merchants. As the recent visits to this country of Brazilian men of eminence have shown, there is a very cordial sympathy with British interests, but the Brazilian Government is naturally anxious to free its country as far as possible from its dependence on foreign goods. It is doing this by encouraging and subsidising the establishment of new industries, by extending its support to coal mining, &c. Certain importing interests will suffer in consequence, but it is hardly reasonable to fear that Brazilian electrical manufacturing will become a serious factor yet awhile, whatever it may do eventually. It is pointed out in this report that it would be folly for the British exporter to count upon any anti-American feeling as a means for defeating American competition which has latterly been steadily increasing. The Brazilian merchant, like others, will "subordinate his private feelings to his interest, and will buy from an American firm every time if it suits him to do so." With regard to German competition, it is worth noting that, during the war, German trade in Brazil was by no means eliminated. The Government permitted the enemy banks to operate with only slight restrictions, and business houses continued their operations unmolested. Our Black Lists notwithstanding, there have been exceedingly few cases where German firms have been obliged to close their doors. Somehow or other they managed to "carry on" by selling both British and American goods, although, of course, their business decreased very considerably.

There is some interesting advice to us at Home with regard to methods for dealing with the future situation. We have to recognise the need for organisation and co-operation both at Home and abroad, and to acknowledge the community of interest as between the banker, the merchant, and the manufacturer; but equally as important, if not more so, is the necessity for the carrying of stocks of British goods by British firms, as a means of introducing them. "The British manufacturer wishing to enter this market must adapt his wares to this market, as the market is not going to adapt itself to his wares." If the German trader is on the ground with certain lines,

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it will not be of the least use for the British exporter's agent to go to the buyer and say: "We could do that for you." Why should the buyer trouble to place a trial order with us if he is already getting what he wants without indulging in experimental purchasing? The absence of sentiment must be considered; regard must be paid to every-day human nature. If the British manufacturer wants to cut into German lines, he must be *doing it already*, at the time of his approach, not merely offering to do so. "The most efficient way to introduce British goods is to have them on the market, and distribute them throughout the country." The report advocates the opening of as many establishments as possible by British firms, not only as wholesalers, but as retailers, for retailers gain direct contact with consumers. It is advised that young Britishers should not be confined to office work. They are required to be conversant with the market, knowing the Portuguese language, understanding the Brazilian people—therefore, "put them on the road for a while as salesmen," and let them "travel the country." But, before sending them out, prepare them for foreign trade in the course of their education at Home, "so that young men coming out should not be too green." All of this, and much more like it, that appears in this publication should afford very useful reading for manufacturers, traders, and their staffs. We select one detail more. The Chamber strongly recommends the standardisation of parts of machinery "on the American principle," and proposes that illustrated catalogues be issued with the parts numbered, so that when a piece of machinery is broken or worn out, it is only necessary to telegraph Home for a new piece. Better still though, if possible, have the parts available in Brazil.

While referring to this report issued by an organisation which does not pretend to deal specially with electrical matters, we may remind readers of the pamphlet issued by the B.E.A.M.A., a short time ago, in which Mr. J. M. Glen, as representing a leading British electrical and engineering manufacturer, furnished some useful information of direct electrical value.

German Commercial Propaganda.

Shortly before the outbreak of the war, a large body of influential manufacturers, shipowners, and financiers in Germany conceived the idea of establishing a great scheme of commercial propaganda in other countries for the promotion of the export trade, but the project was never carried into effect on account of the war. Now, however, the proposal has been revived by the "Imperial" Association of German Manufacturers, which is a recent consolidation of the employers' interests in practically all the industries in that country, in conjunction with the Association of German Engineers. The working of the scheme has been entrusted to the Allgemeine Anzeigen Gesellschaft (General Advertisement Co.), which was already financially supported by many iron and steel and other firms in the West of Germany, before the Association of Manufacturers was constituted in its present form about a year ago.

As is reported, the scheme is to be carried out in the first place by the inundation of foreign countries with German journals dealing with all kinds of manufactures, and a technical journal published in German, English, French, and Spanish is to make its appearance shortly, although this is merely the reintroduction of a former practice. All the manufacturing undertakings on the eastern bank of the Rhine are stated to have given effective support to the company in the form of advertisement contracts and subscriptions, in order to ensure an extensive circulation of the technical journal for a period of five years. The F. Krupp Co., for instance, is credited with having undertaken to defray the cost of sending 3,000 copies of each issue to foreign firms during this period. In addition, a trust of the German industrial newspapers is in course of formation in order to work in co-operation with the advertisement company. The company also proposes to establish in foreign capitals publicity agencies, which will play the part of offices for the centralisation and distribution of news for the trans-Atlantic services, which have been placed in the hands of a commercial-news bureau which is associated with the company. As a result of the activities of the agencies, the Association of German Manufacturers hopes to succeed in "exerting a useful influence on the newspapers and commercial journals published abroad."

We ought to be thankful that the Germans are revealing their intentions, because we shall now be able to protect ourselves against the contemplated attacks. The scheme shows distinctly the German frame of mind, which utterly fails to understand that news circulated by Teutons in relation to Germany and German industries will always be regarded with suspicion, and be accepted, in their own words, as scraps of paper. A large amount of political and commercial propaganda was carried on—or, rather, sought to be carried on—in Spanish and Portuguese in South America during the war, but the newspapers, &c., were stopped by the British authorities. Now that Peace has been ratified, it will be impossible, even if we decided to do so, to arrest this new form of propaganda, but we can, at all events, be on our guard against the efforts which are to be made to influence newspapers with tainted news.

The Permanency of High Prices in Germany.

A significant announcement has been made to their customers by the Siemens-Schuckert Works, of Berlin. The notice states that the development of prices in recent months has led to the circumstance that the additions made on account of the dearness of materials and labour—additions charged in excess of pre-war basis prices—have gradually advanced approximately to 1,000 per cent. It cannot be assumed that prices will fall at any time to the level of those which prevailed prior to the war. On the contrary, even if the war-time additions can be partly removed at a later date, it may be definitely reckoned with that the basis prices will always be several times greater than those in pre-war times. As a consequence, the firms belonging to the price bureau of the Central Union of the Electrical Industry have decided to increase the basis prices and reduce the war-time additions to an equivalent extent. The new basis prices have been fixed at three times those which obtained in the first half of 1914. The only exceptions apply to the price lists for machines and motors constructed with substitute metals, and the prices of machines with copper and aluminium windings; and in these cases the quotations have only been doubled, as they had already been raised by 50 per cent. as compared with the prices in 1914.

Little Things that Count.

Years ago, enterprising business correspondents in a part of the world which shall be nameless, took unto themselves a reputation for slimness. They "forgot" to stamp their letters sufficiently; didn't know the rate; or were too busy "getting on in the world" to attend to such trivialities. By the hundred their underpaid communications reached us, and with British long-suffering we kept on smiling as we paid the excess charges at this end. One letter looks very much like another; and you never know, you know, what it may contain, until it is opened. There is a limit to human forbearance though, and it was reached when about half-a-dollar was paid on what proved to be a manufacturer's pamphlet. Is it to be wondered at that traders so neglectful of minor courtesies were criticised even by their own authorities because they in those days lacked aptitude for building up foreign trade?

What utter folly it is to begin by making a bad impression upon the man whose favour you desire to gain; how is he to know that that failure to pay sufficient postage is not a type of the other ways in which you will take advantage of him, on a larger scale, if you get the chance?

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We began this comment by recalling the past faults of others; as we proceeded, we found ourselves writing in the present tense and as though such errors were possible from this side too. Well, unfortunately, that is just what they are, and more than possible, for H.M. Consul-General at Antwerp has sent home a protest, and small wonder at it, seeing that 30 per cent. of the letters and packages sent by British firms in response to his appeal for catalogues and samples arrived under-stamped. In two days, 38 francs were expended on taxed letters. The *Board of Trade Journal* wisely publishes a hint to *commercial houses*—for they are the offenders—on the importance of ensuring the correct stamping of the foreign mail. In these days of great concerns and big ideas and strong policies, this may seem to be a trifling point, but after all, it's the little things that count!

Technical Books.

WITH the contention of Mr. A. C. Purday in our "Correspondence" columns to-day, that the date of publication should be provided in every book, we fully agree; and a mere reprint should never be misnamed "new edition." It is also to be regretted that so many authors think it necessary to start with the most elementary theory, but this practice is not now so common. We feel, however, that our correspondent's suggestion has little prospect of fulfilment. There would be "too many cooks," and however excellent the standardised books might be in substance, the loss of individuality of style and originality of treatment would be deplorable. A theoretically perfect standard diet might be developed by a Committee of Physiological Experts—but who could partake of it at every meal, or even at one meal daily, without ultimate loathing? We do not agree that an adequate selection of books cannot be made without excessive overlapping; there is to-day an embarrassing choice of good books on almost every subject with which we are concerned. It is true that, as in every other case, the nominal cost of technical books has greatly increased, but the "young engineer or student" is apt to under-estimate the intrinsic value of a set of good books. In this the English should learn from the Scots.

The Liabilities of Tramway Companies.

THE case of the Postmaster-General *v.* Blackpool and Fleetwood Tramroad Co., recently reported in our pages, illustrates very clearly the heavy liabilities imposed upon electric tramway companies. So long ago as 1896 the defendant company took statutory power to lay tramlines, and, incidentally, underground cables in Blackpool. Their Act contained a clause protecting the works of the Postmaster-General. In 1914 the P.M.G. laid wires within 7 ft. of the defendants' electric lines. A leakage from the latter occurred in 1916, the covering of the plaintiff's cable being electrolytically affected. Subsequently the danger was removed by the bonding of the plaintiff's cable to the tramway track, but the plaintiff, nevertheless, brought an action to recover the expenses to which he had been put in making good the damage. The Act above referred to provided that "if any telegraphic line of the Postmaster-General is injuriously affected by the construction by the company of their electric lines and works, or by the working of the undertaking of the company, the company shall pay the expense of all such alterations in the telegraphic lines of the Postmaster-General as may be necessary to remedy such injurious affection." It was held that neither the fact that the defendants had used all reasonable means to prevent injurious affection, *nor that the plaintiff by placing his cable in unnecessary proximity to the defendants' line had courted the injury*, nor, again, that he had, when laying the cable, omitted to take the reasonable precaution of bonding it to the defendants' lines, afforded any defence. This interpretation of the statute may be correct, but it certainly leads to a rather startling result. Logically, it follows that no matter how careless the Postmaster-General, or his servants, may be in the laying of a cable, the cost of all the evil results which follow from proximity to an electric tramway must be borne by the tramway company.

I.E.E. Informal Meetings.

THAT these meetings are informal to a high degree was evident on Monday evening last, when a discussion opened by Captain F. H. Masters, O.B.E., on "The Functions of a Trade Journal," rapidly degenerated into a discussion of the merits and demerits (mainly the latter) of the various organs of the electrical industry, and touched upon questions of policy, advertising rates, situations vacant, and combustibility—or arson. Much was said with regard to the make-up of the respective journals, and on this, as on other points that were raised, we could write a good deal; we will content ourselves, however, with the remark that the one crucial test of the satisfaction of the reader is the numerical test, and a constantly expanding circulation is an argument that admits of no refutation.

The author's able exposition was described as a hat-stand without pegs; perhaps that was the reason why some of the speakers talked through their head-gear. The discussion was lively and well-sustained, though the attendance was absurdly small—due, no doubt, to the uninviting title of the subject.

We are pleased to say that the journalistic atmosphere which has pervaded recent "Informal Meetings" has now been dispelled, and a very attractive programme has been put forward for the remaining meetings of the session; it will be found in our "Institution Notes" to-day. That Major T. Rich's "Engineering Experiences During the War" will be of absorbing interest is certain, and we confidently anticipate a full house on that occasion.

The 10s. Coal Rebate.

THE Coal Controller is much to be congratulated on the astute way in which he has extricated himself from a difficult position. He had the thankless task of devising some way or other by which the benefit of the 10s. reduction on household coal should enure to the domestic electricity consumer. It was a most complicated business. But he found a delightfully easy way out of his perplexities. He simply transferred the whole thing to the shoulders of the electricity supply undertakers. The Coal Controller was bland, the undertakers were guileless. Result—the Coal Controller has finished his task, but theundertakers have just begun theirs, as they will probably find to their cost before it is through.

Note what he has got them to agree to do. They will go to their coal merchants and get a rebate of 10s. per ton on such coal as they use for "household" electricity supply. They will then pass the whole of this on (less 5 per cent.) to those consumers who are entitled to it. By this procedure they lay themselves open to endless criticism and misunderstanding. There is no way of showing a consumer that he is being treated properly as regards the amount of his allowance. Consumers will get different rebates according to the company or municipality which is supplying them. The amount will be quite trivial compared with the great trouble given. In many cases the rebate will probably be less than a farthing per unit. As to the work that will be entailed, and the difficulties bristling round the whole matter, it is only necessary to see the documents placed in the hands of the undertakers, which were summarised in our last issue.

Altogether the electric supply undertakings would certainly seem to have had a reasonable case for refusing to become agents to hand to the public this Government "dole," unless it was done in some simple and direct manner, and one which placed no responsibility upon the undertakers. As it is, the Coal Controller now stands aloof, and leaves the problem to be settled by the mutually hostile triad—the coal merchant, the undertaking, and the consumer. We say mutually "hostile," since if they are not so when they begin, there seems every likelihood that amicable relations will not stand the wear and tear of carrying out the Controller's "prescription." And the undertakers have consented to be put in a position where they can neither tell the disgruntled consumer to go to the Coal Controller, nor—to the devil.

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THE ELECTRICAL EQUIPMENT OF PALMERS SHIPBUILDING AND IRON CO.'S WORKS.

MESSRS. PALMERS SHIPBUILDING AND IRON CO., LTD., which has for long been renowned for its large operations in shipbuilding, engineering, iron and steel manufacture, and allied industries, has during recent years made extensive additions and improvements at its two establishments at Jarrow and Hebburn-on-Tyne, but more particularly in connection with the iron and steel works at Jarrow.

The firm has for over half a century been one of the largest concerns of its kind in the United Kingdom, and at present its employés number about 10,000. The works will be interested in some particulars of the generation of electricity and adoption of electric driving at the Jarrow works which we are able to give.

During the last few years considerable progress has been made in the adoption of electrical machinery for use in the iron and steel works, and also in the shipyard. One of the chief reasons for this advancement in the adoption of electric driving is the fact that the gas emitted from the blast furnaces, which was previously, to a large extent, wasted by passing away into the atmosphere, is now

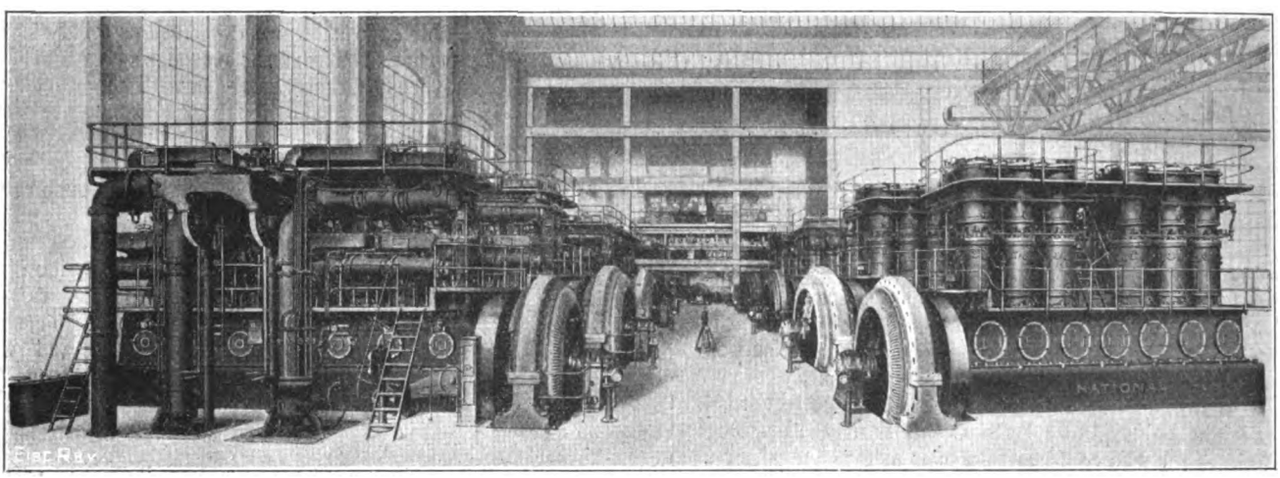

FIG. 1.—POWER HOUSE AT MESSRS. PALMERS WORKS, JARROW.

cover an area of about 150 acres, with a river frontage of nearly a mile, and consist of two large shipbuilding yards, two graving docks (one of them the largest on the North-East Coast), large engine and boiler works, blast furnaces, steel works, several foundries, and forge and galvanising works, and include within themselves the entire range of operations from the smelting of the ore to the complete equipment of the vessel. Amongst the vessels built for war purposes are some of the largest ships constructed for the British Navy, while the merchant tonnage consists of every class—cargo and passenger steamers, refrigerated meat vessels and large oil tankers. The firm has, indeed, built about 900 ships of all descriptions, and it is gratifying to know that the prosperity of the company has gone hand in hand with the developments and extensions which have during recent years distinguished its management.

It is not possible within the limits of our space to describe in detail the many departments of the firm, but our readers

cleaned to such an extent that it is possible to utilise it for driving large gas engines, which are used both for the generation of electricity and for driving the large blowers required for blast-furnace work. Previously the gas was used simply in a dirty or crude state for the heating of stoves and steam-raising in boilers.

The gas-cleaning plant is arranged on the well-known Halberger-Beth principle. The system consists of a primary cooler, re-heater, filtering compartments, and fans, with fina

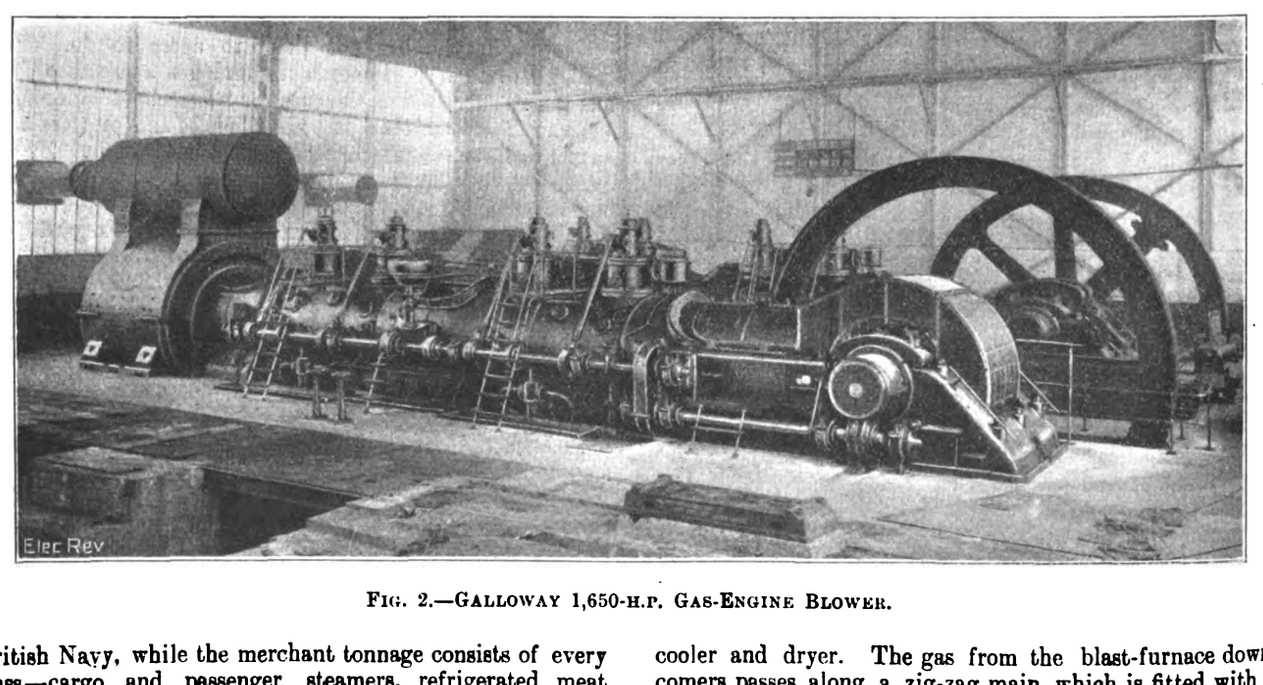

FIG. 2.—GALLOWAY 1,650-H.P. GAS-ENGINE BLOWER.

cooler and dryer. The gas from the blast-furnace down-comers passes along a zig-zag main which is fitted with a number of dry dust-catchers, after which it enters the primary coolers, and is reduced to about 160° F.

The cool gas next enters the reheaters, where it is heated to a steady temperature of about 175° F. by means of steam coils, the bottom of this heater, as well as the bottom of the neighbouring filtering compartments, being provided with a screw conveyor for carrying the precipitated dust

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into dust-catchers, from whence it is removed for the purpose of extracting by-products. After passing through the heaters the gas is conducted into a filtering chamber, which consists of a number of bags through which the gas is drawn by means of fans. The clean gas from the fan delivery is divided up, one portion passing to the boilers and stoves, the rest to the gas engines; the portion required to drive the gas engines is passed through a further, or final, cooler and dryer, the gas then being purified to such an extent that the dust content is reduced to 0·002 gramme per cubic metre, a lower figure being often obtained.

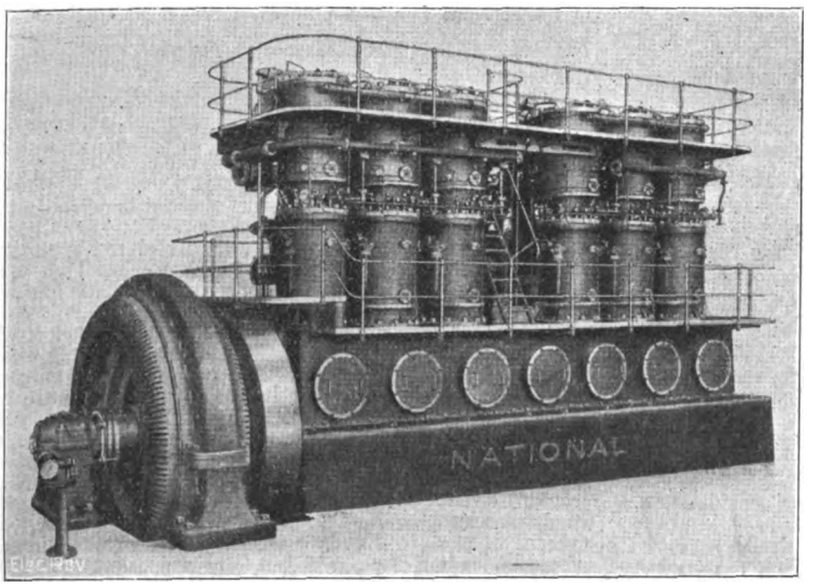

FIG. 3.—NATIONAL 1,500-H.P. GAS-ENGINE ALTERNATOR.

In the engine house (fig. 1), three large horizontal, low-speed Galloway gas engines (fig. 2) have at present been completed, and a fourth one is now being installed, each of them being of 1,650 H.P., for the purpose of driving the air blowers for the supply of blast to the blast furnaces, and, in addition, five 1,500-H.P. engines (fig. 3), built by the National Gas Engine Co., have up to the present been running direct-coupled to three-phase, E.H.T. alternators; these engines are of the vertical, 12-cylinder type, two cylinders working in tandem on each of six lines, the speed of the engines being 200 R.P.M. The alternators are designed to give an output of 1,330 K.V.A. at 40 cycles. Two further engines of this type are being erected, and, in addition, a 1,000-H.P., 8-cylinder, 4-line tandem engine has been working for a considerable time direct-coupled to a 700-KW. D.C. generator arranged with a choking coil necessary for three-wire balancing.

The three-phase supply passes from the H.T. switchboard, which is arranged on the remote control principle, to two 700-KW. Westinghouse rotary converters for an additional supply of direct current required in the works; a heavy three-phase ring main passes from the H.T. board to four static sub-stations situated in different parts of the iron and steel works and shipyard, the H.T. pressure of 5,500 volts being transformed down to 440 volts for the general A.C. supply.

(To be concluded.)

THE COLLECTION OF REVENUE.

By A. C. GLOVER.

COLLECTION of revenue may be hard and tedious work or light, bright and simple, and this short article is to assist those who seek the happier way. Instead of the old bound books for collection, I intend substituting loose leaves, arranged in streets or roads, and in the order of callings, as in the case of meter readings. Each division or district or a number of roads will be placed in a loose-leaf binder and lettered, in preference to being numbered. A street index is essential, and one is illustrated below on the vowel principle, which may hang in the office for immediate reference.

STREET INDEX.

A	District letter.	E	District letter.	I	District letter.	O	District letter.	U	District letter.
Strand	D	Cheapside ...	C	Bishopsgate ...	B	London Road...	E	Ludgate Hill ...	A
				King Street ...	C				

The district letter may be placed on the consumers' accounts before dispatch, *e.g.*, C 2,006. A number of consumers call to settle their accounts, and, for example, Johnson, of Cheapside, comes to pay his account, which is numbered C 2,006. The district letter, reference number, and amount are transferred to a cash-received sheet with a banking column. From this sheet the collector's "C" book is entered. The system has manifold advantages over the old way. The leaves may be placed in any convenient order; the system will allow of growth or revision with little trouble. A district book may hold 150 to 200 consumers' collection sheets, 8" × 5", convenient for a large pocket. After single letters are exhausted, double letters follow, *e.g.*, AB, AC.

COLLECTION FORM.

ADDRESS.....

NAME.....

Month.	Amount.	Arrears. Brot. forward.	Total due.	Amount paid.	Receipt number.	Arrears. Crd. forward.	Collector's signature.
January							
February							

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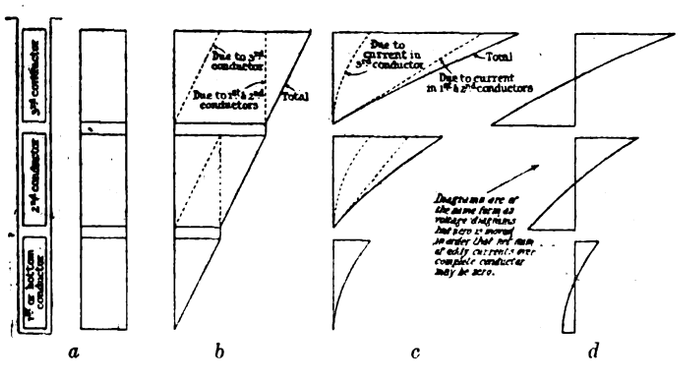
EDDY CURRENTS IN STATOR WINDINGS.

MR. H. W. TAYLOR, A.M.I.E.E., read a paper on the above subject at Birmingham last week before the SOUTH MIDLAND CENTRE of the INSTITUTION OF ELECTRICAL ENGINEERS. The paper, which does not lend itself readily to abstracting, attacked the problem of the elimination of eddy currents from stator conductors in a synthetic rather than an analytical manner, with a view to dealing with some of the more advanced problems which have demanded consideration in recent years. Development of this subject on these lines leads to an approximation, which considerably simplifies the calculation of most practical cases.

In the usual analytical investigation a symbol is taken to represent the complex current distribution in the conductor, and after operating upon the symbol in accordance with each physical relation, the result is equated to the original symbol, thus forming a differential equation, the solution of which only discloses in general details the nature of the current distribution as represented by the symbol. The exact details are subsequently determined from a knowledge of the distinctive features of the problem in hand.

The synthetical method starts by assuming the distribution of current to be uniform, as would be the case if the external electromotive force were the only one under consideration.


3rd conductor
2nd conductor
1st or bottom conductor
Due to 3rd conductor
Due to 1st & 2nd conductors
Total
Due to current in 3rd conductor
Total
Due to current in 1st & 2nd conductors
Diagrams are of the same form as voltage diagrams but turn is moved in order that net sum of eddy currents over complete conductor may be zero.
a
b
c
d

(*a*).—CURRENT DISTRIBUTION DIAGRAM. (*b*).—MAGNETO-MOTIVE FORCE DIAGRAM. (*c*).—FLUX LINKAGE OR VOLTAGE DIAGRAM. (*d*).—EDDY CURRENT DIAGRAM OF FIRST ORDER.

It then proceeds to determine the simple algebraical expressions for the physical quantities which, in turn, would result from this uniformly distributed alternative current. It is thus possible to calculate a local current in the conductor, which can be conceived to be superimposed upon the original current in order to satisfy the alternating flux set up by the original current. This A.C., whatever its actual value in any lamina, is everywhere 90 deg. out of phase in time with the original current. The next procedure is to take the eddy current thus found, called the eddy current of the first order, and carry through the same processes as were applied to the original uniformly distributed A.C., and what may be called the eddy current of the second order, which will flow in order to satisfy the alternating flux set up by the eddy current of the first order, is then found. This second eddy current will, in turn, be 90 deg. in time phase behind the first eddy current., *i.e.*, it will be in exactly opposite phase to the original uniformly distributed current. In the same way it is possible to go on indefinitely calculating successive orders of eddy currents, each of which will lag behind the previous one by 90 deg. When the calculations have been carried to a sufficient extent it will be found that the total resulting current is the same as that obtained by the analytical method.

The value of the present method lies in the fact that for most practical cases it is only necessary to calculate the eddy currents of the first order.

The simple mathematics for the proposed method as applied to the simplest case, *viz.*, that for the bottom conductor in a slot are then given; the process is indicated graphically in fig. 1.

The distribution of the first order of eddy current across the depth of the conductor is parabolic. The "extra loss factor" is defined as the ratio of the extra loss due to eddy currents only to the loss which would arise from uniform distribution of current. If all eddy currents beyond the first order can be neglected, the calculation of the extra loss factor is simple.

When the eddy-current losses in the second conductor are considered, it is found, fig. 1, that the flux which passes across the conductor depends not only upon the current in the conductor itself, but also upon the currents in the conductors below it. The graphical representation of this expression is a parabola of the same form as was found for the bottom conductor, with the addition of a straight line, the slope of which is proportional to the number of conductors below the one in question. Further, the height of the parabola at the end of the conductor is half the height of the straight line when drawn for one external conductor, fig. 1 *c*.

A full appreciation of these points is important in many of the subsequent sections of the paper.

The limitation to the use of approximate expressions for loss factor fully covers the practical range of conductors.

Under given conditions there is a critical depth of conductor which gives a minimum loss, which arises out of the fact that when this critical depth is exceeded the rate of increase of the eddy-loss factor is greater than the rate of increase of the depth of the conductor. This point may be very conveniently investigated by means of the approximate formula proposed, and the argument applies both to individual conductors and to the average value of the loss factor for all the conductors.

The author next considers losses in top conductors when subjected to the external influence of currents out of phase to those they themselves carry. For instance, in a multi-turn coil in which there are eight isolated conductors in the same slot, the losses in the four bottom conductors are calculated in the manner already indicated, as they all carry current corresponding to, say, phase *a*. The fifth conductor, however, carries current of another phase, say, phase *b*, but is subjected to the external influence of flux arising from four conductors of phase *a*. Similarly the sixth conductor carries current of phase *b*, but is subjected to the external influence of one conductor of phase *b* and four of phase *a*, and so on.

The losses in a conductor divided into a number of sections all connected together at the ends of the conductor are of importance, since this is the simplest method of minimising the eddy losses. The case of the infinitely laminated conductor is within the range of the present approximate treatment; the extra-loss factor is that of a solid conductor reduced by the square of the ratio of the core length to the total length of the conductor, *i.e.*, in the ratio $1 : b^2$. The more practical case of a finite number of laminations will give rise to an extra-loss factor intermediate between the solid and the infinitely laminated conductors. An interesting case of unequal sub-division is considered in the original paper where adjacent conductors in a bundle of six conductors are unequally divided in order that the separate sections may keep their proper places during the insulation process. Fig. 2 has been plotted from the formulæ in this section, and relates: (*a*) (full lines) to a conductor divided into laminations, namely, 2, 3, 4, and 5 parts to give the same total depth. Different curves relate to the first, second, third, and fourth of such conductors from the bottom of the slot. (*b*) (dotted lines) to similarly laminated third and fourth conductors in slots where the current in the top conductors differs in phase from that in the bottom conductors by 60 deg.

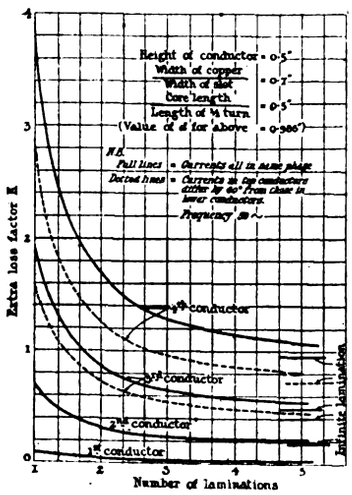


FIG. 2.—EXTRA LOSS FACTOR IN LAMINATED CONDUCTORS.

The author next considers in detail some of the cases which arise in practice, from which he passes on to the question of losses in conductors and coils in which insulated laminations are successively transferred.

The synthetic treatment is applied in the body of the paper so far as to deal with the most practical cases which will arise. An appendix is added in which the use of this method in the derivation of the complete factors is briefly dealt with, and in which the similarity between eddy currents and transmission line problems is noticed. In a second appendix the author shows how the approximate calculation of irregularly shaped conductors may be expeditiously carried out by developing and calculating step by step an equivalent transmission line from a knowledge of the mechanical shape and dimensions of the conductor.

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DISCUSSION AT BIRMINGHAM.

Mr. F. H. CLOUGH said that with increasing sizes of electrical machinery, especially turbo-alternators, the size of slot had grown very much, and it had become necessary to fully understand the causes which produced additional losses in the copper conductors so that suitable means could be adopted to avoid these losses. The author had in a proper engineering way attacked the problem from a physical aspect, and had used mathematics only as a means of solving the physical problems. He had thereby been able to simplify the mathematical part of the problem and evolve a method whereby practically all types of windings could be calculated comparatively simply. The paper marked a distinct step in progress in the design of electrical machinery.

Mr. R. G. JAKEMAN, after discussing briefly a certain mathematical feature of the paper, said the expressions "constant" and "variable" eddy currents looked strange at first, but he (the speaker) understood that a "constant" eddy current was one which was uniformly distributed. With regard to stranded conductors and the effect of compression on eddy currents, if the cable was very highly compressed, it was possible for the strands to cut into one another, and so form practically a solid conductor.

Mr. W. M. CRANSTON explained that the author had brought forward one or two methods of crossing over laminations in conductors, thereby eliminating to a large extent the eddy current loss. That this was of great importance might readily be appreciated when it was considered that the only alternative at present available was the adoption of a completely stranded conductor. The latter to reach its maximum efficiency should have its strands completely insulated throughout the whole of its embedded length, and should have such a pitch that a multiple of the pitch would exactly coincide with the length of the iron core. In normal practice neither of these features was completely obtained, but the resultant loss was usually so small that it would be found to be less than the eddy-current loss in the individual laminations of the interconnected conductor. The stranded conductor, however, cost about 50 per cent. more than a solid bar of the same dimensions. In large machines this economy would go a long way towards paying for the extra connections, and might induce manufacturers to adopt the proposed systems in spite of increased risk of breakdown due to the multiplication of connections. In smaller machines they were content to suffer the inconvenience of eddy currents, but designers were apt to attach too great importance to the depth of copper for minimum loss. With regard to the depth of copper for minimum intensity of heat dissipation, the author had given valuable figures. These showed that the depth of copper might under certain conditions be increased by about 30 per cent. with advantage to the machine. Of course, the losses in the slots were increased, but the gain on the overhang might more than compensate for that, and might result in a more efficient and cooler machine. In certain cases even this depth might be exceeded with impunity.

Dr. M. KAHN said the author had given a simple solution for each case which might arise by considering only the eddy currents of the first order. To neglect the eddy currents of higher orders was certainly justified, as an approximate knowledge of the increase of the copper losses was all that was required. In considering the losses in conductors consisting of a number of laminations connected solidly together at the ends, the statement that the extra-loss factor in case of an infinitely laminated conductor was reduced by the square of the ratio of the core length to the total length of the conductor seemed not to be quite correct; it neglected the fact that the losses in the part of the conductor outside the slot were increased by laminating the conductor. In the case of a solid conductor the alternating current was in the end winding practically uniformly distributed over the whole conductor, and the copper loss there equalled the loss which would take place with a corresponding direct current. If the conductor were laminated, and the laminations so insulated that no current could pass from one lamination to another, the loss per unit of length in the external part of the conductor and in the part of the conductor in the slot would be equal. In the case of stranded conductors where the strands were arranged in spirals the voltage between the various strands was very small, as each strand changed its position continuously and completed a cycle of transposition in each pitch of the spiral. The resulting voltage between strands was smaller than the voltage drop necessary to allow current to flow through the surface contacts between the various strands. In the case of a laminated conductor where the laminations were joined at the end of each half turn the voltage between the laminations was higher. Even so, the surface drop might still reduce the currents flowing between laminations in the end winding to negligible amounts, if the number of laminations was large. If the number of laminations was small, or if the ends of the laminations were not joined up each half turn, insulation was, of course, essential.

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

A New Brush Holder.

A new "automatically constant pressure" brush holder for dynamo-electric machines has been recently patented by Mr. C. M. Owen, of "Langstone," Avenue Road, Abergavenny (Mon.), wherewith an attempt is made to obtain a pressure upon the brush which automatically remains the same from the time the brush is put in new until it is removed worn out. No attention or hand regulation is required. The arrangement of the mechanism is easily seen from the drawings, fig. 1; the combination is so designed that the interaction of the spring and the two arms of the lever is such that the pressure upon the brush remains substantially constant during the wear of the brush. The means for adjusting the tension of the spring when desired comprises a threaded plug 14 screwed into the spring 8, the thread on the plug corresponding to the coils on the spring and the plug having a threaded extension 15 which is screwed into a saddle piece 16, supported in bearings, so as to be rotatable, in the arms 5, 5. When the adjusting means is employed the saddle piece 16 takes the place of the rod 7. The pitch of the thread on the plug 14 is the same as the pitch of the thread on the extension 15. A spring washer 17 and a nut 18 are provided for tightening purposes and a clamp 19 is disposed over the outside of the spring and the plug 14.

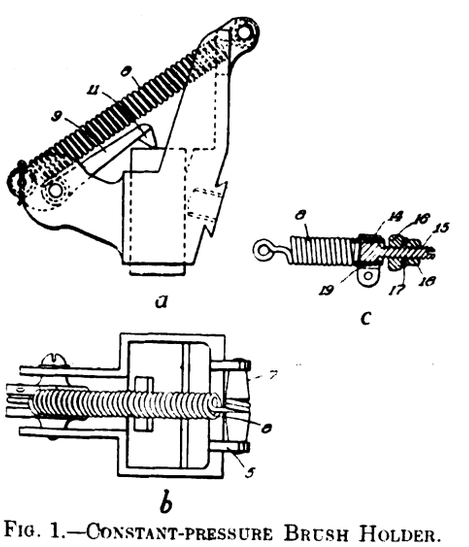

FIG. 1.—CONSTANT-PRESSURE BRUSH HOLDER.

In operation, as the brush wears away it descends in the frame and the lever 9 moves about its pivotal point. During this movement the end of the arm to which the spring is attached moves so that the effort of the spring acts at a greater distance from the pivotal point, and, though the pull of the spring becomes less, due to the movement of the arm, the moment acting on the lever remains substantially constant during the wearing away of the brush.

In cases when it may be desirable to alter the tension of the spring, the clamp 19 and nut 18 are loosened and the plug 14 is screwed into or out of the spring, whereby fewer or more coils of the spring are put into operation as desired. After adjustment, the clamp 19 and nut 18 are tightened. The pressure increases slightly from the time the brush is put in new until it is half worn out, and then decreases by the same amount until the brush is fully worn out. The initial and final pressures should, therefore, be equal. The slight increase in pressure may be made as small as desired by small increases in the size of the brush holder.

B.T.H. Workshop Lamp Bracket.

Although the present tendency in industrial lighting is to rely exclusively on general overhead illumination wherever possible, there are still some conditions where it is necessary to use additional local units. The important thing in local light-

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ing is that the light should come from the right direction. This means that the unit must be adjustable and under the complete control of the mechanic, because he will probably have to change his position or the position of his head and hands from time to time, which will generally require a corresponding alteration in the direction of the light.

To comply with these requirements the BRITISH THOMSON-HOUSTON CO., of 77, Upper Thames Street, E.C. 4, has designed an adjustable workshop bracket (fig. 2), which consists of a single, double, or triple extension arm, each section being made of two pieces of angle steel clamped together to form a hollow square tube, through

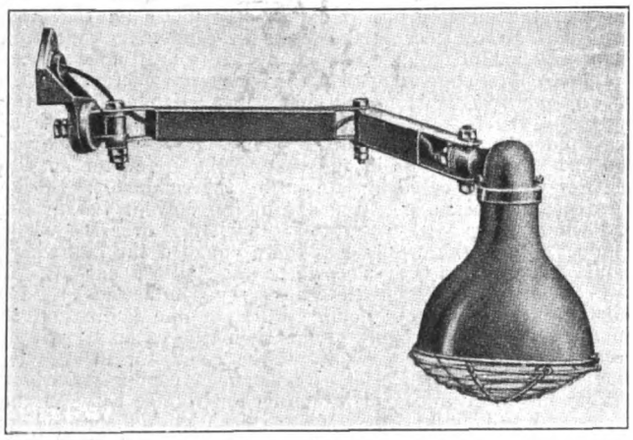

FIG. 2.—B.T.H. WORKSHOP BRACKET.

which the conductor is threaded. The rear section is attached by means of a bolted joint to a projection on the cast-iron back-plate, this projection being in turn secured to the back-plate by a turntable joint, the combination giving a universal movement. The various sections are connected together by means of bolts and lock nuts, while the reflector unit, consisting of reflector, combination cap and gallery and lampholder, is attached to the end of the bracket by a universal joint. The standard is the double extension bracket illustrated, which, when fully extended, is 27 in. in overall length. This bracket, which can be fixed to any horizontal, vertical or oblique surface, is equipped with a small intensive type Mazdalux reflector, fitted with a wire guard, which can, if desired, be sealed in position to prevent unauthorised interference with the lamp. The bracket can be arranged to throw the light in or from any desired direction without alter- to retain any position, but not too stiff for easy movement. without loosening the joint nuts, which are just tight enough to retain any position but not too stiff for easy movement. They can be tightened in an instant should the necessity arise.

Patent Wiring Connector.

Mr. J. DYSON, Aldermanbury, Bradford, has recently placed a new departure in small wiring connectors upon the market. As will be seen from the illustration (fig. 3), both the connector and the porcelain are slotted, enabling the wire to be slipped in without being cut. A grub screw through the top

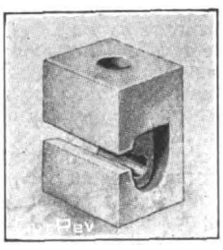

FIG. 3.—MOSS'S PATENT OPEN SLOT CONNECTOR.

of the porcelain clamps the branch wire into position. By this means it is possible to tap off the main wires while they remain *in situ*. The inventor, Mr. Harry Moss, informs us that he designed and made the first models of this connector while on active service in France.

Electricity in the Home.—The results of an interesting experiment in domestic electrical installation are reported from Glasgow. Two houses were selected, and electricity was installed and used exclusively for lighting, heating and household appliances. After more than a year, the total costs were calculated and found to be £32 per annum in one case, and £35 in the other. The occupants of both houses were absolutely satisfied with the results, and express a preference for electrical methods as being cleaner, healthier and more economical.

TEXTILE MILL ELECTRIFICATION.

INDICATIONS of the growing importance of electricity in the manufacture of textile goods are afforded day by day by the reports of applications by mill owners for the installation of electrical power, which are constantly being received. The production of textiles requires above all things a careful attention to the regulation of machine speeds. There is a certain maximum limit to the speed of textile mill machinery which, if exceeded, endangers the safety of the yarn and causes an enormous amount of trouble.

On the other hand it is necessary to run machines as near to this limit as possible in order to obtain the greatest possible

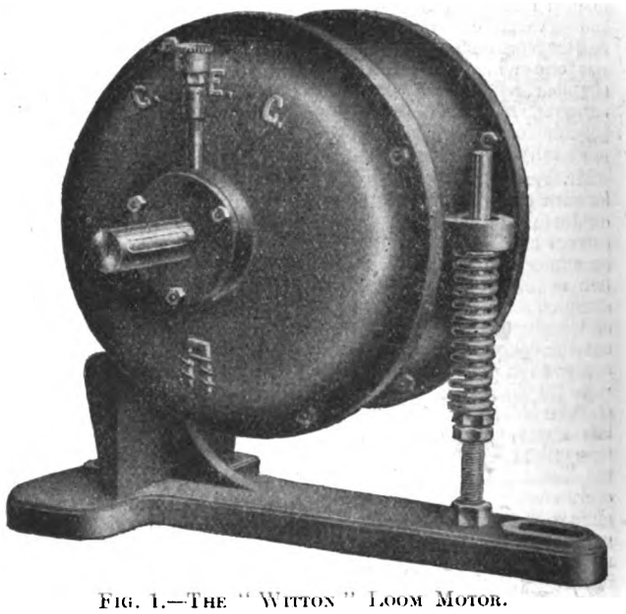

FIG. 1.—THE "WITTON" LOOM MOTOR.

output. Speed variation was a source of considerable loss to manufacturers in the days of the uncertain mechanical drive, and even with modern non-electrical methods it cannot be entirely eliminated, but by the application of a motor drive the variation in speed can be reduced to a minimum.

Another very costly feature of the mechanically (*i.e.*, non-electrically) driven mill is the amount of power lost in transmission. If the source of power is a steam engine it is necessary to arrange a complicated system of belts and pulleys,

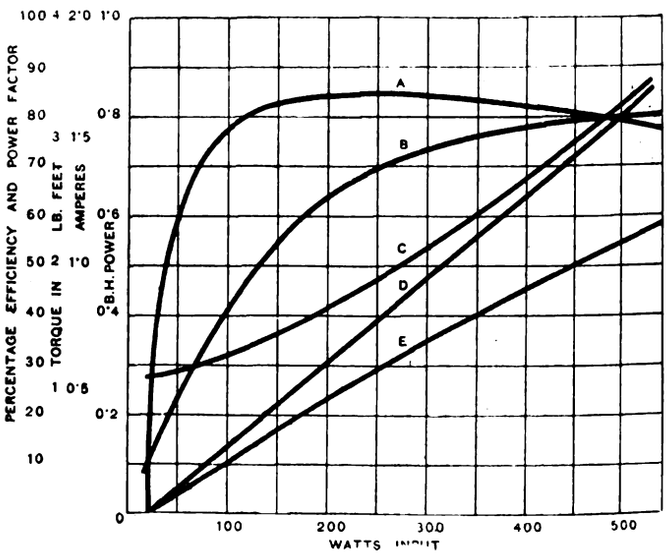

FIG. 2.—PERFORANCE CURVES OF "WITTON" ½-H.P. MOTOR.

and probably chains and gears. A mill receiving electricity from a central station will probably require a transformer to reduce the supply pressure to one applicable to the driving motors. This comparison may seen only slightly to favour the electrically-driven mill; it is in the intervals between working periods that its superiority is more pronounced.

If the machinery of a steam-driven mill has to be shut down for a short interval—up to, say, two days—it is usual and perhaps advisable to keep the boiler fires banked. This, of course, is a great waste of fuel—a mill provided with electrical driving can be shut down without incurring this loss. To meet the special conditions occurring in the driving of textile mill machinery the General Electric Co., Ltd., has designed the "Witton" motor (fig. 1). This is entirely en-

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closed to exclude dust and scraps of material. It is mounted on a small base plate, and supported at one end by a spring which keeps the transmission belt tightened automatically. The "Witton" motor is made in three sizes—½, ¾, and 1 H.P. Characteristic curves of performances of a ½ H.P. motor of this type are given in fig. 2. It will be seen from this record that at half-load the motor's efficiency is 85 per cent. At about 60 per cent. of full load its efficiency rises to 86 per cent., and an 80 per cent. efficiency is maintained at full load.

The question whether to install generators in the mill or to take in a supply from an outside undertaking is one that must be settled after close investigation of local conditions, and is purely a business consideration.

If the supply from a local authority is direct current it is usual practice to install rotary converters to effect a change to A.C., providing separate exciters to maintain a constant speed during changes in the load.

FIG. 3.—ELECTRICALLY-DRIVEN WEAVING SHED.

It has been found that for various reasons A.C. is more satisfactory for this class of work than D.C. The chief points in the former's favour are, first, cost of plant in cases where plant has to be purchased. Secondly, an A.C. motor runs almost synchronously with the generator, which renders the speed variation very small compared with a D.C. motor, the amount of "slip" being not more than 5 per cent. from full-load to zero. Then the A.C. motor has greater efficiency, and requires less and simpler starting gear than a D.C. machine. Although the employment of A.C. motors is advisable, it by no means follows that D.C. machines cannot be used, in fact circumstances will in some cases compel their use.

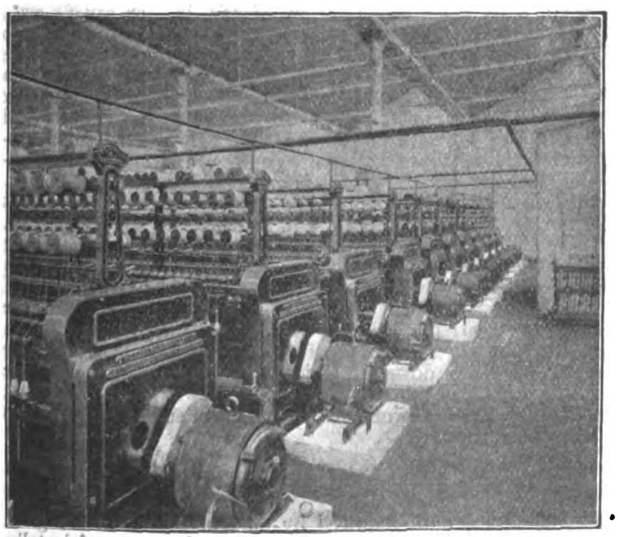

FIG. 4.—DOUBLE-FRAME INSTALLATION DRIVEN BY 7½-H.P. "WITTON" MOTORS.

Small mill alternators with capacities up to 400 KW. may be driven by high-speed reciprocating engines, but in larger installations the employment of steam turbines has been found to be more satisfactory, as the generators can be direct-coupled, minimising the transmission losses.

Another question which arises upon the installation of electrical plant is whether it is better to provide a separate motor for each machine or to drive groups by larger motors. From the efficiency point of view the individual drive is no doubt better than the group drive, but the cost of the former compared with that of the latter presents a difficulty if capital is limited. The absence of overhead gear is one of the many advantages of the direct-drive system; this is very clearly illustrated in fig. 3, which is a photograph of a typical weaving shed in a large textile mill, and fig. 4 showing a double-frame installation driven by 7½ H.P. "Witton" motors.

We are indebted to the G.E. Co. for the adjoining illustrations, which appear in the recently issued Bulletin No. 11 bearing the same title as this article. The Bulletin contains a great amount of interesting information and 40 illustrations, chiefly of textile mills equipped by the G.E. Co.

THE FARADAY SOCIETY.

AN ENGINEERING APPLICATION OF ELECTROLYTIC IRON DEPOSITION.

AT the December meeting of the Faraday Society, LIEUT. W. A. MACFADYEN described a process that had been worked out for the Electrometallurgical Committee of the Ministry of Munitions, and very usefully applied in the war area for the repair of aeroplane engines. The problem solved was to evolve a simple and reliable workshop method for obtaining thick, hard, adherent deposits of iron on steel mechanism parts which had been overmachined or worn down in a few places, so as to save them from the scrap heap. Existing electrolytic processes chiefly used for refining had to be rejected, for practical reasons; for example, they made use of hot solutions or solutions that could not easily be made up or replaced. Finally, a simple concentrated aqueous solution of ferrous ammonium sulphate was adopted, of acidity not exceeding 0.005 normal, and a current density of nearly 25 amperes per sq. ft. could be reliably employed at normal temperatures to yield hard, smooth, adhesive deposits. From such a solution heated to 65 deg. C., but with 0.02 normal free acid present, reguline deposits could be obtained at 200 amp. per sq. ft. The solutions were found to deteriorate after a few months' use, on account of the accumulation of organic impurities. Boiling expelled these substances and renovated the solutions, but later it was found that the presence of finely-divided wood charcoal in suspension absorbed the organic matter continuously, and prevented the deposition of momentary deposits of hydroxides—the supposed cause of the inferior deposits. The photographs appended to the paper strikingly illustrate the effect of the presence of the charcoal in suspension.

Adhesion to the articles covered was secured either by the common method, of an intermediate copper coating from a hot cyanide bath, or else by thoroughly cleaning the cathodes, either chemically or electrolytically. In the latter case, *i.e.*, direct deposition on to the steel base, heat treatment could be applied to the deposits, and annealing the article and deposit above the A, point (at 950 deg. C.) strongly welded the two together. Subsequent case-hardening and heat treatment gave a surface quite fitted for severe mechanical conditions, and photomicrographs of sections of the deposit showed that the line of demarcation between base and deposit to have been entirely eliminated.

In course of the discussion, it was made clear that the poor mechanical qualities of electro-deposited metals are frequently due to occluded hydrogen. In the case of some metals, *e.g.*, copper "annealing" in an oil-bath at quite a low temperature is sufficient to expel the gas and enormously improve the physical properties of the deposits.

It is clear that a useful future awaits the application of processes like that of Lieut. Macfadyen in the engineering works or repair shop. On this the opinion at the meeting was unanimous.

THE ELECTROLYTIC PRODUCTION OF SODIUM PERCHLORATE.

Sodium perchlorate is now produced commercially by electrolysing the chlorate solution between a platinum anode and an iron cathode. In a paper contributed to Mr. J. GUILFOYLE WILLIAMS, it was stated that better results are obtained at higher temperatures and current densities than those given in the text books. For example, at 60 deg. C. the production of 1 kilo: $NaClO_4$ requires only about 3 kilowatt-hours, as against 3.6 in the accepted practice, and the frequent addition of hydrochloric acid to keep down the alkalinity still further improves the efficiency.

THE MEASUREMENT OF PHYSICAL PROPERTIES AT HIGH TEMPERATURES.

No more difficult problem confronts the practical physicist than the testing of the refractory materials used in furnace construction, and in high-temperature apparatus generally, under the conditions to which they have in practice to stand up. Mr. A. GEORGE TARRANT described to the Society very carefully thought-out pieces of apparatus which he has designed for measuring thermal expansion, conductivity, and tensile strength. For the first of these, the principle adopted is to heat a cylinder 4 in. by ¾ in. diameter of the material under test in a tubular graphite sheath, and measure the expansion of the test piece relative to the tube. The expansion is magnified by the motion of a lever actuated by a long plunger attached to the test piece and extending considerably above the top end of the vertical nichrome-wound electric furnace, which furnishes the source of heat.

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For measuring tensile strength, the Harker type of spiral graphite tube furnace was employed, as in this temperatures up to 1,700-1,800 deg. C. were attained. Fig. 1 shows the general character of the apparatus, and indicates the arrangements for clamping and stressing the test piece. The point

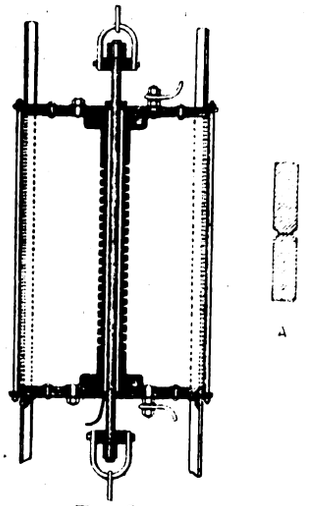

FIG. 1.

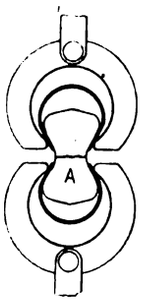

FIG. 2.

of fracture was localised by reducing the diameter of the test piece at the centre, as shown at A. Otherwise the bar was at its weakest and broke outside the hottest zone of the furnace. The simpler device shown in fig. 2 was used for tests at lower temperatures, and this apparatus was of great practical use during the war.

In the measurements of thermal conductivity, the author —as many before him—did not succeed (before the war abruptly terminated his experiments) in obtaining absolute figures that might be of general use. But several ingenious attempts were made, and an electrical and a gas-heating method are described which are well worthy of attention by others engaged on similar measurements. A rough thermoscopic method described was found to suffice for routine works tests.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Technical Books: Some Thoughts and a Suggestion.

That "of making many books there is no end" appears no less true of technical books than of other branches of literature. But the limitation of the time and money of the engineer or student, who desires to learn his profession or to keep in touch with the latest theory or practice, is much more determinate.

When to the host of new books that are poured forth are added reprints (without any additions) of books that were first published many years ago, it seems time that a protest should be made.

On a subject such as electrical engineering, which has made tremendous strides in theory, and perhaps even more in practice, a book published, say, in 1900, is largely out of date, and the mere reprinting of it appears to me to be almost taking advantage of ignorance.

When the date is nowhere mentioned in the book, the student has not even the consolation of *knowing* that he is buying an old book. One would like to see it made compulsory to insert the date of writing, or first publication, in every book.

Then the new (and old) books on any subject overlap one another, and generally endeavour always to start at the elementary theory, wherever they may end, so that the purchaser has to pay for many parts of his reading two or three times over.

Now, my suggestion is that in these days of standardising committees, yet another should be formed representative, say, of the technical institutions, colleges, Press, publishers, and, lastly (but not least), of the gentlemen who write technical books.

These should then agree on suitably graded series of books on the various branches of engineering, one book of a series leading to another more advanced.

They should be produced as cheaply as possible in the first instance, later they would doubtless become so, owing to their larger sale.

Periodically the committees should meet to revise the books, which might be done by adding a supplement from time to time, until sufficient alterations and additions warranted the book being rewritten.

When such a time came, no more reprints of the old one would, of course, be issued.

Thus, for a reasonable outlay, students and engineers could possess a library of technical books, up-to-date, of known contents, and not overlapping.

At present such a thing is quite beyond the purse of the young engineer or student.

A. C. Purday.

London, S.W.
January 10th, 1920.

Theatre Heating by Electricity.

Having had several years' experience in the heating of buildings by steam, hot water, hot air, &c., I found your article in a recent issue of the ELECTRICAL REVIEW on the heating of the Lyric Theatre, Hammersmith, by electric radiators most interesting.

The advantages claimed for the system are great, *i.e.*, low installation cost, reliability, efficiency, simplicity, ease of control, &c., and it will be interesting to learn whether, after a practical test of, say, six months' working, all these advantages, together with low running and maintenance cost, can still be claimed.

In the light of past experience I certainly consider that the electro-steam radiator is the best thing struck yet in the way of electrical heating, but it at once puts it on a par with any ordinary steam-heated radiator, and has all the advantages and disadvantages of the latter. One of the great disadvantages of steam heating is its well-known tendency to burn or dry the heated air to the extent of being quite irritating to the throat; frequently humidifying trays have to be attached to radiators to correct the fault. The electro-steam radiator should, however, enable manufacturers to give some reliable data regarding its heating capacity, such as the transmission of British thermal units per square foot of radiator surface per hour. Such data have hitherto been unprocurable from the manufacturers of electric radiators. Even when the number of B.Th.U. required for the heating of any building is known, it is difficult to decide on the number and size of electric radiators required owing to the lack of reliable data. Assuming that the electric radiators are cheaper to install than a system of hot-water heated radiators, with a coke-fired boiler, there remains the question of running and maintenance costs; the cost of maintenance of the electric radiators will largely depend on the life of the nickel-chrome wire heating elements, which may, or may not, require frequent renewal; the maintenance costs of a hot-water heating apparatus, if carefully installed, will be nil for several years, with the exception perhaps of a few new fire bars for the boiler. It is well to remember also that the hot-water heating does not burn the air in the way that steam and open-element type electric radiators do. As to running costs, it would appear that when all radiators are working at the Lyric Theatre the total energy consumption will be about 40 units hourly. I do not suppose that the hourly B.Th.U. given off by the 37 electric radiators in the Lyric exceeds 200,000; and taking the practical value of coke at 6,000 B.Th.U. per lb. (which is readily obtained with a boiler efficiency of 60 per cent.) we find that 33 lb. of coke would be required hourly for the same B.Th.U., making a total daily coke consumption of 264 lb., or say 2¼ cwt., obviously much cheaper than energy at 2d. per unit; add to the cost of coke an attendant's wages and the daily running cost would still be under £1 per day. In the case of a theatre very little heat will be required when the building is packed with people, as the air readily becomes warm and vitiated, but I venture to state that only a very small proportion of the theatres in the country are steam heated, hot-water heating or warm air systems being largely adopted. Ventilation is usually a difficult problem in the theatre, but for the best results heating and ventilating are inseparable. It is stated that the ventilation at the Lyric is now receiving attention; should this result in an increased air change, then in all probability the energy bill will also be increased. I consider much more will be possible in electric heating in the near future, particularly if the cost of energy comes down to, say, 0.5d. per unit, but before that happens, coal and coke must also come down in price. In the meantime electric radiators may be successfully applied in many instances, especially where intermittent heating will suffice and first cost is a consideration.

J. W. Hitchcock.

January 16th, 1920.

[Most of the data required by our correspondent are given in the article to which he refers. The cheapness of installation is not an assumption; it is a fact. The purchasers informed us that the cost was about *one-third* of that of a hot-water system to give the same results. The coke-fired furnace cannot be started and stopped at pleasure, whereas it is stated in the article that the electric radiators are used for six hours daily, and the efficiency of the latter must in this case be 100 per cent. The price of electrical energy for heating in Hammersmith is 1.5d. per unit with discounts + 25 per cent., and the running cost is stated by the purchaser to be half that of the gas-heating system, which was discarded because it failed to do its work.

On account of the pressure on our space we have been obliged to shorten our correspondent's letter.—EDS. ELEC. REV.]

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The Coal Muddle.

As it seems useless to protest to the Government with reference to their idiotic vote-catching "stunts," of which the 10s. rebate is the finishing touch, I suggest that the Electrical and Gas Associations should get together and try "passive resistance" by refusing to claim any rebate or allow any rebate to their consumers. They will save money and an enormous amount of work by doing this. The consumer will, of course, have to pay a trifle more for his electricity and a trifle less in taxation, so that although he will "grouse" he will on the average be no worse off.

Borough Electrical Engineer.

January 17th, 1920.

Awards Delayed.

Being a constant reader and a mechanic, I should like to bring before your notice the reason of much of the discontent of the present day, not always caused by the workmen, but more often by the employers. Holding no brief for either, I believe in square dealing. Why is it that the L.C.C. tramways dilly and dally with red tape and officialdom before paying different sections the awards? It is hard to define, no other employers could approach them. In 1917-18 an award was made to be paid from October. Some got it, others who were justly entitled to it did not until February, 1918, being only paid from then. Why so much letter writing to one official and another? Even the present day awards make practical men tired. These are things that the outside public know nothing of, and it is time so much officialdom was inquired into, as it gives rise to much discontent.

C. R.

A "Live" Lorry.

I was very much amused and interested to see under your heading of "Notes" the account of a "live" lorry at Walsall.

I have a Foden steam wagon under my care, and have experienced similar surprises in the shape of severe shocks upon touching the metal parts after its return from a trip. I may say I too was somewhat puzzled until one day the boiler inspector happened to be making one of his calls. Before going too near he asked where the "safety chain" was.

Noticing that I did not quite understand his meaning, he explained the necessity of having attached to the metal underframe a small piece of chain which would trail along the ground, and by so doing relieve any person from nasty shocks which he had experienced only too often.

It must be explained that this only applies to those wagons which have rubber tires. I take it that the entire wagon is insulated from the ground, and that a static charge is generated by the constant blowing-off of steam from the safety valve, as no matter what one might tell these drivers, they always like to see that "blow" going on; they know they have "a little to spare," as they put it.

It would be interesting to know whether the Walsall Foden was rubber-tired; if so, was the safety chain in order—or lost—on that particular trip? It has a knack of leaving itself on the road, through wear.

J. G. Paterson.

Warlingham, Surrey.
January 19th, 1920.

With reference to your note in the last issue on a steam wagon becoming charged with electricity whilst standing in the roadway. I once heard of a similar occurrence, but in this case the explanation given was that the friction of the steam issuing from the safety valve had caused the metal parts of the vehicle to become charged with static electricity, and as the wagon was mounted on rubber-tired wheels, the charge could not escape to earth, hence any person touching the engine would receive a shock.

Stuart F. Philpott.

Birmingham.
January 19th, 1920.

The Marconi International Code.

Having had some years' experience of both using and constructing telegraphic codes, I read with much interest "C. H. C.'s" able review of the "Marconi International Code" (THE ELECTRICAL REVIEW of December 26th, 1919).

It would appear that "C. H. C." was very favourably impressed with the greater part of the code, but is not so enthusiastic as regards the "Numerical System."

It is agreed by all who use codes that the three principal ends for which the compiler of a code should strive are:—

(*a*) Economy in transmission.
(*b*) Simplicity and rapidity of use.
(*c*) Safety in transmission.

Re (*a*), the compilers of the code claim to effect considerable economy over existing codes, and "C. H. C." in this connection only remarks that "A check which has to be worked out for each code word not only adds complications and increases the work of coding and de-coding, but decreases economy to the extent of the check syllable. As regards the last portion, surely "C. H. C." has overlooked the fact that the final syllable in the system under criticism, in addition to acting as a check, can be made to convey any one of 23 separate meanings which are in frequent use, *e.g.*, "C.I.F.," "F.O.B.," "for immediate shipment," "60 days' sight," &c. This I believe to be an entirely new departure in codes, and it will consequently be seen that C. H. C.'s remark (a little lower down in his review) that, "The fifth syllable then confirms this check figure in the usual manner," although in a way true, hardly does justice to the code. As regards the question of complications and increased work in coding (see also (*b*) above), with the expenditure (once and for all) of a very few minutes' preliminary study of the tables and explanations, the use of the numeral system becomes not only a very simple matter, but quicker in actual use and appreciably more economical than any other code I know.

Under heading (*c*) comes "C. H. C.'s" principal alleged weakness.

In theory, the more usual mutilations which occur in transit should be "caused by the omission, the addition, or the changing of a Morse dot or dash," but my own experience and that of many other users of codes with whom I have discussed the matter on frequent occasions, has satisfied me that in only a small percentage of cases is an error in transmission due to one of these causes. Possibly this is due to telegraphists being carefully trained and warned against these obvious errors. Many codes contain voluminous tables showing the probable mutilations of single letters and two-letter syllables, but I have yet to meet any de-coder who has ever really profited by them.

If absolute safety in transmitting figures is essential, then the entire telegram can be repeated (*i.e.*, sent twice) automatically; the cable companies charge only quarter rates for such repetition, and even if every message were so repeated there would still be an appreciable saving in cost in comparison with employing most existing codes, as well as a large saving in time of both coding and de-coding. In practice, however, it would meet all possible contingencies if the single code word which conveys the numerals were itself sent twice over in the original telegram.

It is a little difficult to grasp what is "C. H. C.'s" attitude towards "checks." In one place he falls foul of the use of a check, whilst in another he apparently holds up as an ideal some code which employs "a simple double check."

On the whole, I deduce that "C. H. C." is drawing a comparison between the numerical system of the Marconi code and an ideal (but as yet unattainable) perfect system, and not between the Marconi and any existing code. Taking the ideals to be aimed at in a code as economy, rapidity, and safety, it is an easy matter to produce a code which is practically perfect under one of these headings; a fair approximation to perfection can be obtained by devoting attention to two only and ignoring the third; but for all normal work in which all three factors have necessarily to be taken into consideration, the Marconi code is, in my opinion, far ahead of all existing codes, and has the further great commercial advantages of rendering the telegram equally intelligible in nine languages, and of employment also for conducting and translating foreign correspondence.

Code Enthusiast.

January 13th, 1920.

[We regret that we have been compelled to shorten this letter considerably.—EDS. ELEC. REV.]

The "Lesco" Lampholder.

Without wishing to enter into any controversy or express an opinion on the merits or otherwise of the above lampholder, there is a statement in Mr. Hope's letter in your issue of January 16th, that interests us. He says "There is more metal in the Lesco holder than in the best quality English holders."

The complete brass case of our Cordgrip lampholder is half an ounce heavier than the "Lesco."

For **J. H. Tucker & Co., Ltd.,**
W. J. LINE,
Chief of Technical and Design Department.

Birmingham, *January 17th*, 1920.

My attention has been drawn to Mr. Turnbull's letter to the ELECTRICAL REVIEW regarding the above, and, being the patentee of another lamp holder, I would like the opportunity of making it clear to your readers that although some of the features in my holder (the "Scot" lamp holder) appear to have been followed in the "Lesco" lamp holder, the defects pointed out by Mr. Turnbull do not exist in the "Scot" holder, the barrel of which is in one piece.

My patents were granted between February, 1917, and May, 1919, between which dates Mr. Vernon Hope and others (the promoters of Lesco, Ltd.) entered into prolonged negotiations with me for a licence to enable them to construct lamp holders under my patents. These negotiations were,

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however, broken off by the said promoters towards the end of May, 1919, and a few weeks later provisional patents, under which the "Lesco" holder is manufactured, were applied for by Mr. Hope.

I write in order to avoid the possibility of any confusion between the "Lesco" and the "Scot" lamp holder, and I will be pleased to send a sample of the latter holder to anyone interested.

A. Peden Rutherford.

Leith.
January 12th, 1920.

We read with interest the correspondence regarding the "Lesco" holder, which no doubt is ingenious. We do not think there is anything against the weight-carrying parts, as the indentations should carry any shade intended for the ordinary C.G.S.C. holder.

As regards the corrosion which Mr. Turnbull quotes, this is liable to happen to any metal holder, and if these are overlooked in damp positions, one can only expect falling shades, &c. A little grease and attention will remedy this point.

Now we come to the interior, and from the sample supplied to us we find that the contacts being on the one spring do not adapt themselves to the lamp contacts, as is the case with the ordinary holder, in which the separate plungers will make contact with any uneven contacts of the lamp. If the Lesco holder had these plungers we think it would be an advantage.

Ardwick, Manchester, **H. Wogan & Co.**
January 17th, 1920.

LEGAL.

Hodges *v.* Webb.

[The E.T.U. and the N.A.S.E.]

(*Continued from p.* 76.)

Further evidence was given on Tuesday, January 13th, the cross-examination of Mr. Tyler being continued by Mr. Cunliffe, K.C. He said that the E.T.U. would not accept the code of rules arranged by his society, and the men went out on strike. That was in 1914.

Mr. Banister, the hon. secretary of the N.A.S.E., was the next witness called, and in the course of his examination by Mr. Hughes, said that the N.A.S.E. was not formed with a view to interfering in trade disputes, but it became a trade union in 1918, since which period it had power to take part in trade disputes. The Society had 17 hon. members, five of whom were contractors, but they were not allowed to attend any of the meetings except the educational lectures.

In cross-examination by Mr. Cunliffe, witness said that the N.A.S.E. did not support the masters in 1914. It was not then a trade union.

The plaintiff next gave evidence generally bearing on the counsel's opening statement in regard to the occurrences on October 13th. Until then, he said, there had been no dispute and no complaints had been made by the men.

In cross-examination, the witness said that when he went to Watford on the job, he asked one of the Watford men whether Watford was in the London district, and what were the local rates, and the man to whom he had spoken wrote them down on a slip of paper and handed them to him. He had not seen the defendant before October 13th, and there was no reason why the defendant should have any ill feeling against him.

Mr. Cunliffe, in opening the defendant's case, submitted that there was nothing for him to answer. The right of a man to dispose of his labour as he pleased was merely the correlative right of other men to dispose of their labour as they pleased, and there was nothing to prevent their refusing to work with other men, if they so desired. The words alleged to have been used by the defendant, if they were used, were merely a statement that the plaintiff would lose his livelihood, and there was no threat. It was, said counsel, obvious that the N.A.S.E. if not really a masters' union was protecting the interests of the masters. Men had a perfect right to refuse to work with non-unionists, and the defendant was entitled to do as he had done, even if there had never been any dispute as to working hours.

The defendant, in the course of his evidence, said that the first he had heard of any dispute at Delectaland was when a deputation came from the Watford branch to the London District Council and made complaints. They made three complaints about the terms on which Messrs. Tyler & Freeman's men were employed. When he went to Delectaland on October 13th he had a talk with the men before he saw Hodges, and they joined the E.T.U. When Hodges came down he (defendant) asked him whether he was a member of the E.T.U., and he said that he was not, but that he was a member of the N.A.S.E. He (witness) thereupon pointed out to him that the N.A.S.E. was not a recognised trade union, and asked him to join the E.T.U., which he declined to do. Upon that he (witness) went back to the other men, and told them that Hodges had refused to join the E.T.U., and that under the circumstances he had no option but to call them out.

On January 14th the defendant was further examined in chief, and in reply to counsel, said it was untrue that he adopted a dictatorial attitude or endeavoured to intimidate Mr. Hodges. Nor did he shake his finger in Hodges's face. He might, however, have made an "oratorical" gesture. He tried to persuade him to join the E.T.U., and so avoid further trouble, and he did tell him that if he was not prepared to join he (defendant) would have no option but to withdraw the union members from the job. He had never seen or heard of Hodges before, and bore him no animosity. He was sent to Watford to investigate complaints as to the employment of non-unionists, as to hours, and rates of pay, and to try and make peace. There were over 50,000 members of the E.T.U., and he could fill a book with reasons why the E.T.U. could not recognise the N.A.S.E.

In cross-examination by Mr. Hughes, defendant said that he did not tell the plaintiff that he would have to get off the job unless he joined the E.T.U., but he did explain that his refusal to join might result in his having to leave the job. He told the man "not to be an ass." Plaintiff said that he had an old E.T.U. ticket at home, and on being asked why he had joined he replied "Compulsion." He was not in the habit of using the expression to men who refused to join the E.T.U.—"I'll take away your livelihood."

Counsel read a letter from the witness to a foreman named Branscombe, who had signified his intention of leaving the E.T.U., asking him to reconsider his decision, and stating that if he persisted in leaving the union he would placard his name throughout the districts telling all members of the union to refuse to obey his orders as foreman. He also wrote that is the event of refusal to rejoin he would wherever possible hound him from the trade.

The hearing was continued on January 15th.

Mr. Webb, in further cross-examination, said he had the power to call out E.T.U. men from jobs where N.A.S.E. men were employed. If Mr. Hodges had consented to join the E.T.U. the other matters at issue could have been discussed.

Witness, in reply to a question by the judge, said he was prepared to admit frankly that if the plaintiff joined another firm and still refused to become a member of the E.T.U. the workers belonging to that union would be withdrawn from any job on which the plaintiff was working.

Evidence was then given as to discontent alleged to have prevailed amongst the men working at Delectaland, and with that the case for the defence closed.

Mr. Cunliffe, K.C., addressing the Court on the whole of the evidence, said that in the action there had been a determined and deliberate challenge of the rights of trade unionists to refuse to work with non-unionists. This challenge went to the root not merely of trade union rights and privileges, but also of the rights of every free man in the country. If the action succeeded it would, he contended, be impossible for any trade unionist, or indeed for any man or woman, to refuse to work with any other man or woman without exposing himself or herself to litigation of this kind. The allegation of coercing the employers reminded him, said counsel, of the Irish landlord, who, on his attention being called to a threat by Fenians to shoot his agent, remarked "If these people imagine they can intimidate me by shooting my agent, they are mistaken." He submitted that it was not unreasonable for workmen to object to work with members of the National Association of Supervising Electricians, an association which consisted of managers, and had as honorary members masters pure and simple. The E.T.U. refused to recognise Mr. Hodges's society as a genuine workmen's society. They regarded it as a society which was seeking federation with the E.T.U., when it was in point of fact a satellite of the Masters' Association. At the time of the trouble at Watford there had been an active and continuing dispute as to the working hours and rates of pay, as well as in regard to working with non-unionists. The latter was the chief question with which the Court was concerned, and he contended that the defendant was rightly justified in what he had done.

Counsel then proceeded to deal at length with the various authorities recording decisions bearing upon the point in question, and argued that his Lordship had to decide whether there had or had not been a trade dispute within the meaning of the provisions of the Act of 1906. It would, he said, be enough if it had only been a dispute as to the employment of trade unionists. But it went further than that, as a meeting had been called to decide whether unionists should be compelled to work with non-unionists. It was a dispute in regard to the particular class of individuals of whom Hodges was one.

His Lordship said that the dispute referred to in the Act meant that there must be a dispute with the employers, but in this case there was no dispute between Mr. Tyler and the union, because at the time of Mr. Webb's visit they had not approached each other.

Mr. Cunliffe said that there was a dispute immediately the strike was called. There was a controversy going on as to whether unionists should be compelled to work with non-unionists, and everyone knew about it. It was not essential that there should be a strike or even a dispute at a particular place. His submission was that the dispute was not only a dispute between employers and workers, but a dispute between workmen and workmen, inasmuch as it was a dispute between members of the E.T.U. and the N.A.S.E. The Act was undoubtedly intended to give the widest conditions of

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protest to workpeople as to the terms of their employment, and the question was whether compelling a man to work with a non-unionist was a condition of employment contemplated by the Act. He contended that the dispute that was going on at the Watford works was a trade dispute within the meaning of the Act. It could not be said that defendant was coercing the masters by what he had done, as when he went to Watford there was undoubtedly a dispute going on between Mr. Tyler and his men. Whatever test was to be applied, whether it was a test of there being a broad and general dispute as to the working with non-unionists, or a dispute as to the working of the E.T.U. with the N.A.S.E., it was enough for his purpose if he was able to establish that there was a dispute going on between the masters and men, and it was impossible to say that what Mr. Webb had done was not an act done in furtherance of a dispute existing at the time. It was said that he had done something which interfered with the right of the plaintiff to dispose of his labour as he willed.

His LORDSHIP: An interference with his employment.

Mr. Cunliffe said that both meant the same thing, but there really was no interference with his employment, as Mr. Tyler was entitled to give him notice, and he did so.

His LORDSHIP: Supposing a man induces an employer to break a contract of employment by means of a threat to shoot him if he does not do so, would that come within the Act and not be actionable?

Mr. CUNLIFFE said that so far as the threat to shoot was concerned he could get an injunction, but not because the object was to bring about a breach of contract. The man could be punished for threatening. As a criminal offence he could be brought before a Criminal Court, but so far as the civil remedy was concerned the Court might be asked for an injunction to restrain the man from repeating the threat. His submission was that the act of the defendant was in furtherance of a trade dispute, and that no action could be brought.

At the conclusion of the learned counsel's speech, which had occupied two days, the hearing was adjourned.

The hearing was continued on Monday and Tuesday, when counsel for Mr. Hodges summed up the plaintiff's case on the facts and the law. He (Mr. Purchase, in the absence of Mr. Hughes, K.C.) argued that if the case were decided against the plaintiff it would put an end to all liberty of action on the part of workmen, who would simply be as putty in the hands of a secretary of a powerful trade union. He denied the suggestion of Mr. Cunliffe, on behalf of the defendant, that the N.A.S.E. was not a genuine workmen's trade union but a masters' union. The evidence, he said, showed that it was not a masters' union. As to the allegation of the existence of a trade dispute, he argued that in face of Mr. Tyler's evidence that in other works in which he was engaged there were N.A.S.E. working with E.T.U. men, it could not be said that there was an active dispute in existence on the question whether N.A.S.E. and E.T.U. men should work together. The plaintiff, he said, had a common law right to dispose of his labour as he pleased, and he submitted that the defendant had interfered with him in that right, and that he had suffered loss in consequence. What the defendant had done was actionable before the passing of the Trade Disputes Act, and that Act did not protect him now. There was no evidence in this case that there was a trade dispute within the meaning of Section 3 of the Act, and even if there had been there was no evidence that what was done had been done in furtherance of the dispute. In conclusion, he characterised the action of the defendant as a "malicious vendetta" against the plaintiff, because he refused to renounce his rights and privileges in the N.A.S.E. and join the E.T.U., and said that defendant by calling out the employés had coerced the employers.

His Lordship reserved judgment.

PROSECUTION UNDER THE FACTORY ACTS.

AT Glasgow on January 15th, Grindley, Ross & Co., Ltd., electrical engineers, Bridgeton, Glasgow, were charged at the instance of Mr. W. D. Kirkwood, H.M. Inspector of Factories, with having failed to efficiently protect electric wires used for lighting supply in the premises of James Allan, Senior & Sons, Ltd., Lambhill Iron Works, Glasgow, in consequence of which John McKay, 16 years of age, was killed on August 13th last. A plea of "Not guilty" was tendered. From the evidence submitted it appeared that a temporary installation had been carried out to give light to two punching machines. Owing to the presence of a crane, overhead lighting was not feasible, and the respondents' electrician placed the cable on the ground between the machines. The voltage was, roughly 240 A.C. On August 13th McKay, while walking to one of the machines, stepped on to some iron plates which were on top of the electric wire and received a shock from which he died. Two other workers also sustained shocks, one of them being thrown off his feet and rendered insensible for a time.

The respondents' representative stated that after the accident occurred he disapproved of the way the job had been done. The wire should have been overhead or laid in conduits underground. Had he known how it was placed he would have had the wire removed. Whether temporary or permanent, it was dangerous.

For the respondents, an agent argued that the firm having employed a journeyman electrician on the work the fault did not lie with them. Their employé had no authority to break the regulations.

The SHERIFF expressed sympathy with this view, but said the mere fact that respondents chose to perform their contract through a workman would not relieve them of responsibility. The fault was entirely with their employé, who had betrayed an utter recklessness of the lives of fellow workmen. So far as the respondents were concerned, their's was a technical offence. He imposed on them a fine of £15, with £5 expenses.

BRITISH INDUSTRIES, LTD. *v.* SIMPSON.

IN the King's Bench Division, on January 16th, plaintiffs, of Wandle Bank, Wimbledon, brought an action before Mr. Justice Rowlatt to recover the sum of £141 17s. 9d. for dry batteries and torches sold and delivered to Mr. Ralph Darlington Simpson, of Leadenhall Street, under contract during August and November, 1918. Defendant's case was that the plaintiffs failed to perform their contract to deliver batteries with the cases, and he counter-claimed for £299 odd as damages. The evidence was mainly directed to the question of accounts between the parties, and his LORDSHIP, in giving judgment, said the case really fell into two parts arising mainly out of the counter-claim. One of the items was for the non-delivery of 2,000 bull dog torches and refills, and it was quite clear defendant was entitled to some damages for that, as there was a profit to be made on these things. He thought the defendant had been very hardly treated, as he got cases but could not get batteries for them, and therefore suffered serious loss. He had to make guess at the damage suffered, but the result of his judgment was that plaintiff was entitled to £133 9s. 9d. on the claim, and defendant must have judgment entered for him on the counter-claim for £150.

GRAHAM *v.* HOLME ELECTRIC LIGHTING CO.

AT the Holmfirth County Court, on January 14th, Messrs. J. W. & R. Graham, electrical engineers, Huddersfield, sought to claim from the Holme Electric Lighting Co. for work done in connection with the company's electricity undertaking, and there was a counter-claim by the company for £36 15s. for breach of contract. Messrs. Graham alleged that they had carried out certain work in connection with the installation of electric lighting at a village near to Holmfirth, where the plant is driven by water power. This work was not in the contract.

The Holme Electric Lighting Co., in their counter-claim for breach of contract, alleged that the plaintiff company had not carried out their contract. Messrs. Graham denied liability, and paid a certain sum into court. Defendants contended that they had been relieved of certain work by the chairman of the company.

His HONOUR, in giving judgment, found for the plaintiffs for £1 11s., in addition to the £37 6s. 8d. which they had paid into court, and disallowed the counter-claim.

BRITISH THOMSON-HOUSTON CO., LTD. *v.* CORONA LAMP WORKS.

THIS case, in which plaintiffs ask for an injunction restraining defendants from infringing Letters Patent No. 10,918, and asking for damages or an account of profits and delivery up of any infringing articles, was commenced before Mr. Justice Sargant in the Chancery Division on Tuesday. The defence was a denial of infringement.

French Railway Conversion.—A few months ago we referred to the return to France of a Technical Committee dispatched by the French Government to the United States, in order to study the systems of electric railway working in that country. The Committee reached the definite conclusion that the direct-current method at 2,400 volts was the most suitable for adoption on the different railway systems in France. In this connection M. Mauduit, who was one of the Committee, recently delivered a lecture on the subject before the Société Industrielle de l'Est. He is reported to have stated that the 2,400,000,000 KW.-hours, which in 20 years will represent the energy necessary for the working of the electrified railways, would replace 4,000,000 tons of coal per annum. The total length of the lines to be converted to electric traction was 5,480 miles, of which 4,992 miles were in operation, 218 miles in course of construction, and 270 miles projected.

Power Station Wages at Johannesburg.—According to a Johannesburg report appearing in the *Cape Times* for December 18th, a demand for £9 17s. 4d. per week was being considered by the artisans at the power station in place of £8 2s., and it was hoped to gain the support of all branches of the municipal service in order to make this amount apply all round. "It is said that a little uneasiness prevails in committee circles over the proposed demand. The municipal employés have been told that if it is insisted upon the town's finances will not be able to bear the strain. Indeed, it is asserted that they have been warned that if such a demand is made, the Labour Party will resign on the plea that it cannot carry on under such increased financial responsibility, inasmuch as it will not be able to meet the pledges given to the ratepayers."

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BUSINESS NOTES.

The Moulders' Strike.—The moulders are taking another ballot this week. The result may be announced before this issue is in print.

Travelling Exhibitions for Overseas Trade.—In a recent speech, Sir Hamar Greenwood referred to a scheme that the Department of Overseas Trade was preparing for touring exhibitions. The *Board of Trade Journal* now gives some particulars. The tour is being organised to exploit the present splendid markets for United Kingdom goods in the great overseas Dominions. It is designed to be the cheapest and most comprehensive vehicle for the display of Home products. Samples will be packed and carried in specially designed show-cases and exhibitions erected in the industrial cities of the Empire. The Dominions Governments have promised all possible support, and all the Chambers of Commerce consulted have expressed the conviction that the tour will be a success. The proposed itinerary and approximate time-table (leaving the United Kingdom, May 1st, 1920), is as follows :—

City.	Arrive.	Depart.
Durban..	May 21st, 1920.	July 12th, 1920.
Johannesburg.. ..	July 14th, 1920.	September 11th, 1920.
Cape Town	September 14th, 1920.	November 12th, 1920.
Perth	December 3rd, 1920.	January 21st, 1921.
Adelaide	January 25th, 1921.	March 22nd, 1921.
Melbourne	March 23rd, 1921.	May 18th, 1921.
Hobart	May 20th, 1921.	July 1st, 1921.
Brisbane	July 7th, 1921.	September 1st, 1921.
Sydney	September 2nd, 1921.	October 28th, 1921.
Christchurch	November 2nd, 1921.	December 28th, 1921.
Auckland	December 31st, 1921.	February 25th, 1922.
Vancouver	March 18th, 1922.	May 13th, 1922.
Winnipeg	May 16th, 1922.	July 11th, 1922.
Toronto	July 14th, 1922.	September 8th, 1922.
Montreal	September 8th, 1922.	November 4th, 1922.
Halifax	November 6th, 1922.	December 25th, 1922.

Arriving in Liverpool in January, 1923.

The aim of the Department of Overseas Trade will be to make the tour self-supporting, the exhibitor having to pay simply for the cost of freight, rents, and show-cases. Estimating on a basis of 500 exhibitors, the tour can be run under present conditions at a maximum cost of £200 per firm or unit. A half-unit would cost £120. Should the surplus allow, the tour might be extended to the West Indies, or the balance refunded to the exhibiting firms. In conjunction with the actual samples, it is designed to tour cinematograph films showing an extensive field of British productions, especially in the heavier goods, which are too expensive to tour by sample.

We are informed that the regulations and conditions relating to the tour will be published in pamphlet form, and will be obtainable from the Intelligence Stall at the British Industries Fair, or subsequently from the Department of Overseas Trade.

Women in Engineering Works.—*The Times* states that some 5,000 firms in Great Britain have been asked by the Women's Industrial League for a statement of their experience of women as industrial workers. Over 1,400 replies have been received, covering a wide field in engineering and other trades. In the main they may be regarded as satisfactory by a league whose object is to secure equal opportunity for employment in all occupations to men and women. The replies, as scheduled, show that 1,422 firms were employing 79,700 women at the end of May, 1919, as compared with 43,200 before the war and 245,300 during the war. Of 382 firms who employed women before the war, 67 propose to increase the number, in consequence of the larger experience of women's work gained by them; while of 764 who employed women for the first time during the war, 228 proposed to retain them. These firms do not comment on the present labour situation. A further 97 firms state that they would be willing to retain women but for Trade Union opposition. Taking all the figures, the estimate is that over 60 per cent. of those who have tested women's work are ready to continue employing them. Nor, for various reasons, must it be assumed that the remaining firms are necessarily unwilling to use women's labour.

The Packing of Machinery for South America.—A mechanical engineer with many years of experience on the West Coast of South America has given H.M. Commercial Secretary at Lima the following note on the packing of machinery, particularly electrical machinery, for South America :—

"All engineering plant should be packed in strong, braced, open cradles of deal, and these cradles should again be packed in a heavy deal packing case, fitted with battens and, if possible, with diagonal braces. Machines must, under no circumstances, be bolted down to one side of the case. There is no objection, however, if the opposite side of the machine is bolted to the case, too. It is much better, however, to pack the goods in a cradle and to make the cradle fit the case exactly, so that, even if the case is dropped, the stress is distributed equally all over the case, and not on any one side or end.

"All such small fittings and projections as handles, levers, valves, pressure gauges, &c., should be detached and packed tightly with wood wool into a small strong wooden box, firmly screwed on to the inside of the main case or cradle. Any moving parts (as armatures of electric motors) must be wedged tight relatively to the fixed portion, to prevent oil rings being sheared off, bearing shields broken, and other damage occurring.

"Any case containing machinery should be capable of being dropped 15 times from a height of one metre on to a concrete floor without injury to case or contents. This represents the average history of a case of machinery leaving England or America, and arriving on site at final destination. So few breakages have occurred with this system of packing over a large number of consignments that insurance against it is not really necessary. The cost of the packing is 30 per cent. above that of ordinary heavy cases."

A sketch illustrative of the above instruction may be seen on application to the Latin America Section of the Department of Overseas Trade.—*Board of Trade Journal.*

Bankruptcy Court Appointments.—Consequent upon the appointment of Mr. E. S. Grey, Senior Official Receiver attached to the High Court in Bankruptcy, to be Controller of the Clearing Office for Enemy Debts, the President of the Board of Trade has appointed Mr. W. P. Bowyer to be Senior Official Receiver, Mr. D. Williams, hitherto Senior Assistant Official Receiver, to be Official Receiver, and Mr. F. T. Garton, Assistant Official Receiver, to be Senior Assistant Official Receiver.

Charges of Stealing.—At Leeds, on January 13th, the charges against V. W. T. Bradshaw, of Sunderland, for the alleged theft of electrical appliances from the Barnbow Filling Factory, near Leeds, and G. E. Pearson, of Pearson & Sons, Ltd., Farsley, for an alleged like offence as bailee, were again investigated. Pearson was committed for trial at the Assizes on the charge of stealing an electric motor, and on the other charges he and Bradshaw were further remanded, bail being allowed.

Horace Collins (26), an electrician and demobilised soldier, Pendlebury, was at Manchester County Police Court, on Saturday, charged with stealing from Messrs. J. Gerrard & Sons, Ltd., builders and contractors, of Pendlebury, some time between December 11th and 18th last, eight electric lamps and four electric switches, valued at £4 12s. Defendant, it was stated, had been employed as an electrician by the prosecutors for two months, and in the course of this work had access to the storeroom. With the property he had stolen, it was alleged that he had entered into a contract to fix electric fittings in the Unitarian schools at Pendlebury, which he did. Defendant, who pleaded guilty, said the reason he did it was to augment his money, as he could not follow his work regularly. Collins was fined £5.

George Davies, electrician, of Kilmarnock, has been sent to prison for three months for the theft of three watches and a diamond ring from a shop where he had been sent by his employer to do some repairs.

The E.D.A.—We have received a quantity of advertising matter recently published by the ELECTRICAL DEVELOPMENT ASSOCIATION, Hampden House, 84, Kingsway, W.C. 2. These latest indications of the Association's activities present many interesting features. The chief aim of this form of propaganda is to educate the non-technical public up to a proper appreciation of the value of electricity in the home. For instance, one of the leaflets ("Fuel Waste : the Remedy") graphically illustrates the inconvenience and discomforts of the use of coal in the home, and favourably compares the cleanliness, cheapness and convenience of an electrical installation. This pamphlet also illustrates the work done in various ways by a unit of electrical energy, stating, for instance, that the unit will drive a fan for 10 hours or illuminate a 25 C.P. lamp for 30 hours. Another leaflet ("Where Light means Business") depicts by means of actual photographs the correct and incorrect methods of shop-lighting. The efforts of the E.D.A. should go far to popularise electricity and increase the sale of appliances.

Industrial Problems.—A series of lectures dealing with Industrial Problems is to be delivered at the Carpenters' Hall, Throgmorton Avenue, under the auspices of the Industrial League and Council. Sir George Paish, financial expert, has promised to give a lecture, almost as soon as he returns from America, on "A Defence of Capitalism." "The Industrial Situation" is the title of an address to be given by The Rt. Hon. W. Adamson, M.P.; Mr. G. J. Wardle, C.H., M.P., Parliamentary Secretary to the Minister of Labour, will give an address on "Industrial Unrest and Whitley Councils," and Mr. T. E. Naylor will lecture on "Trade Unionism and Output."

Board of Trade.—The Board of Trade announce that the Scientific Instruments, Glassware, and Potash Production Branch, and the Mineral Resources Development Department, have now removed from 7, Seamore Place, Curzon Street, W. 1, to the new public offices, Great George Street, S.W. 1 (Telephone number, Victoria 9800). The office of the Controller of Trading Accounts has also removed to Great George Street from Gwydyr House Annexe, Whitehall, S.W. 1.

Edison Swan Electric Co. and Philips's Lamp Works.—The Edison Swan Electric Co., Ltd., announces that Dr. G. L. F. Philips and Mr. A. F. Philips, of Philips Glowlamp Works, Ltd., Eindhoven, Holland, have joined the board of directors of the company.

The *Financier* stated, on the 17th inst., that an important Dutch firm "which possesses a monopoly in the manufacture of a particular kind of half-watt lamps" had acquired approximately one-eighth of the issued capital in the Edison Swan Co., and that the latter would acquire the sole rights of sale and manufacture in Great Britain of the lamp referred to.

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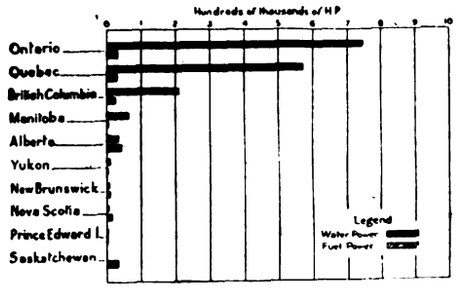
Copper and Lead Prices.—MESSRS. JAMES AND SHAKESPEARE report January 21st, English pig lead £48 5s., a reduction of 5s. No changes are reported in copper.

Strike in Swedish Engineering Industry.—A Reuter dispatch from Stockholm stated that the efforts to end the disastrous strike in the Swedish engineering industry had not yet been successful. On the 16th inst. the arbitrator in the dispute informed representatives of the employers and the strikers, that at present he was unable to submit a proposal suitable for mediation. He also informed the Government of this fact, and suggested that the Government should appoint a special committee to continue his efforts to bring about a settlement. Subsequently, representatives of both parties to the dispute conferred with the Minister of the Interior, who had expressed a desire to learn the real facts of the case with regard to the strike. Nine thousand more workmen at various factories were on strike, as were also the electrical fitters.

Book Notices.—"Central Electric Stations in Canada, Part I—Statistics." 74 pp. Price 10 cents. Canada: Dominion Bureau of Statistics.—This interesting publication, compiled from statistics obtained by the Census of Industry, 1917, presents fully the state of the Canadian electrical industry as far as the generation of power by central stations is concerned. Reports were received from 666 central stations, 196 of which were purchasers and sub-distributors of energy. The whole of the volume clearly illustrates the overwhelming preponderance of hydro-electrical generating stations which produced 89·6 per cent. of the total generated. The number of generating sets reported was 983, developing an aggregate of 1,844,571 H.P. Of these totals, it is shown that 619 were operated hydraulically, and developed 1,652,661 H.P., 251 were steam-driven units with a capacity of 180,200 H.P., while the remaining 113, producing 11,710 H.P., were gas and oil engines. The Province of Ontario employs water-power in the development of no less than 95·7 per cent. of its total energy, which in 1917 was 604,024 K.V.A. Yukon, chiefly on account of the power used in



mining, showed a larger percentage still—97·4. Quebec and British Columbia show percentages of hydraulic production to totals of 94·9 and 89·8 respectively. Saskatchewan, consisting for the greater part of prairie land, possesses no hydro-electric central stations. A graphic illustration of the position occupied by hydro-electric plant is reproduced from the report (fig. 1). The statistics relating to steam-driven plant show that turbines are generally used, the proportion of reciprocating engines being very small. The amount of coal of all descriptions consumed during 1917 is given as 448,200 tons; coke, 46,370 tons. The oil consumption was 17,529 gallons. The financial statistics indicate that a total of $356,004,168 represents the capital invested in lands, buildings, and machinery, up to the end of 1917. Revenue from the sale of energy is given as $44,536,848. The total of the wage-bills of all the concerns was $7,777,715—the number of employés of all classes being 8,847, which represents an average per employé of a trifle over $879. Among the facts mentioned in the report, it is calculated that there was 221 H.P. of generating plant per 1,000 population throughout the Dominion at the end of 1917. Part II, a separate publication, is a directory of the Canadian power undertakings, issued by the Department of the Interior (252 pp., and map), giving complete details of the stations summarised in Part I.

"Overhead Electric Power Transmission Lines." 80 pp. 10s. 6d. net. Johnson & Phillips, Charlton, S.E. 7.—This work, printed on art paper and well illustrated, describes in detail methods of deciding routes for overhead transmission lines, and calculating quantities and strength (electrical and mechanical) of the necessary materials. The first few pages are devoted to extracts from Board of Trade Regulations governing the erection and maintenance of overhead lines, and also notes for the guidance of applicants for consent to the erection of such lines. Subsequent sections deal with:—(i) Conductors—their size, strength, and properties; (ii) Poles—wooden, steel, and ferro-concrete; (iii) Insulators—giving a table of dimensions and "spark-over" voltages, and also dealing with terminal boxes; (iv) Guarding—various methods of protecting lines and persons; (v) Line disturbances and protective devices; (vi) Telephone wires on power lines; and finally a small note on switchgear, transformers, &c.

"The Power Facilities of Sheffield." 27 pp.—A booklet issued by the Development Committee of the Sheffield City Council as one of its series of pamphlets giving information about the city's industries and developments. Details are given of the power undertaking, and among the many illustrations are reproductions of several that appeared in our columns in January, 1919, when we published a descriptive article of the Sheffield plant.

"The Dyeing Industry" (third edition of "Dyeing in Germany and America"). By S. H. Higgins, M.Sc. 189 + 22 pp. Price 8s. 6d. net. London: Longmans, Green & Co.—The original edition of this work appeared in 1907. It is devoted to a survey of the industry, and gives details of the many processes involved. The book has been brought up to date by the addition of a chapter on the progress made during the war period.

"The Turret Lathe and Its Work." 46 pp. Alfred Herbert, Ltd., Coventry.—This is a profusely-illustrated production describing various classes of work which can be performed on turret and capstan lathes. The examples given are chiefly aero engine parts, cylinders, crank-cases, crank-shafts, &c. Space is also afforded to a description of an automatic turret lathe, which stops upon the completion of a cycle. Messrs. Herbert state that a copy of this publication will be sent post free to anyone interested in the subject.

"The Electrical Engineer's Diary, 1920." 474 pp. and diary. 7s. 6d. post free. London: S. Davis & Co., 30 and 31, St. Swithin's Lane, E.C.—The twelfth annual issue of this valuable publication has been thoroughly revised and brought up to date, especially the list of British electrical undertakings. Two new sections have been added, dealing with electric motor control, and the installation and maintenance of cables.

"British Trade with Brazil." Hints for manufacturers and exporters. Compiled and issued by authority of the British Chamber of Commerce, of Brazil (Inc.), by Arthur Abbott, secretary, March, 1919. Second edition. Rio de Janeiro: 51-53, Avenida Rio Branco.

Manchester Steam Users' Association. Memorandum by Chief Engineer (Mr. C. E. Stromeyer), for the year 1918-19.

"The Ericsson Review." January, 1920, 20 + vii. pp., 3d. net. A magazine for the employés and friends of the British L.M. Ericsson Manufacturing Co., Ltd.

"*Proceedings* of the Physical Society of London." Vol. XXXII, Part 1. December 15th, 1919. London: Fleetway Press, Ltd. Price 4s. net.

"Post-Office Electrical Engineers' Journal." Vol. XII. Part 4. January, 1920. London: THE ELECTRICAL REVIEW, LTD. Price 2s. net.

"Diesel Engine Design." By H. F. D. Purday. Pp. xvi + 301; 271 figs. London: Constable & Co. Price 21s. net.

German Iron Industry.—An office is being set up in Berlin for the organisation of the entire German iron industry, including both import and export, under an Imperial Commissioner of the Ministry of Economy.—*The Times.*

The Housing Subsidy.—The Ministry of Health has issued regulations governing the payment of the new building subsidy. The object of the subsidy, on which the expenditure of £15,000,000 for the United Kingdom is authorised, is to secure the erection of 100,000 houses during the next 12 months. The regulations accordingly indicate that the subsidy is only to be earned by houses completed within 12 months of December 23rd, 1919 (the date on which the Act authorising it became law) or within such a further period, not exceeding four months in all, as the Minister may in a special case allow. In the case of houses completed within this longer period the Minister may, unless he is satisfied that the delay has been unavoidable, subject the grant to a reduction of one-twelfth for each month in which delay has occurred. The subsidy is to be £160, £140, or £130 per house, according to the number of rooms and the extent of floor area. In calling upon the Ministry of Health to pay the grant, the builder must have two certificates; one issued by the local authority authorising the houses to be constructed in accordance with plans previously submitted; the other by the local authority, declaring their completion in a proper manner. The builder will forward these certificates to the Ministry of Health, together with a written application for the money to which he claims to be entitled. The Ministry of Health, when satisfied as to the correctness of the claim, will pay the amount due. There are provisions for an appeal to the Ministry of Health in the event of either of these certificates being refused by the local authority. There is a schedule of regulations and a simplified specification based generally on the Ministry's specifications for houses built by local authorities under the main housing scheme of the Government.

Australia and Enemy Traders.—According to the Sydney correspondent of *The Times*, the Australian Federal Government has issued a special *Gazette* forbidding imports from, and exports to, Germany, Austria, Hungary, Turkey, and Bulgaria.

Trade with Russia.—It is announced that the Allies have decided to grant facilities to Russian co-operative organisations to import goods in exchange for certain commodities. It is also stated that the British Government has approved of a scheme for insuring British traders against any loss in re-opening trading relations. Agricultural machinery and machinery of all kinds is greatly needed. M. Litvinoff says that Russia has vast quantities of flax, hemp, hides, &c., waiting for export, also a large amount of platinum or platinum wares.

For Disposal.—*Surplus*, the official organ of the Surplus Government Property Disposal Board, seems to be bulkier than ever. No. 16, for January 15th (3d. net) contains a large section devoted to plant and machinery, while railway material, mechanical transport, office equipments, factory and miscellaneous stores, are in great variety.

Arc Welding.—THE ALLOY WELDING PROCESSES, LTD., inform us that "A.W.P." electrodes have been approved by Lloyd's Register of Shipping and by the British Corporation for the Survey and Registry of Shipping.

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Electrical Business in South Africa. — The *South African Mining and Engineering Journal* (December 19th) stated that the Belgian Congo, the railway, and the municipalities were buying all electrical material very freely.

Calendars.—THE CITY ELECTRICAL CO., of 1, Emerald Street, London, W.C. 1, have sent us a wall calendar for 1920, with small monthly slips beneath a picture which sets you "Wondering." It is accompanied by an expression of good wishes and appreciations, and of gratitude to the trade Press for the invaluable assistance rendered by it to manufacturers during the difficult five years of war. Such messages soften the asperities of trade journalism in times when our production problems are as troublesome as ever.

THE NATIONAL X-RAY REFLECTOR CO., of Chicago, have issued a large wall calendar, with monthly date-sheets, each of which bears a large illustration showing some particular application of their reflectors.

MESSRS. JOHNSON & PHILLIPS, LTD., of Charlton, S.E., have again sent us one of their admirable blotting-pads, with interleaved diary, date indicator, and memoranda slips. Having used its predecessor for the whole of 1919, we know and appreciate its value and convenience.

MESSRS. ALFRED HERBERT, LTD., of Coventry, have circulated a finely executed calendar for 1920. The monthly sheets, which are perforated for tearing off, will probably be preserved for the excellent portraits that they give of kings, presidents, statesmen, and naval and military leaders who led the Allies to victory.

THE D.P. BATTERY CO., LTD., of Bakewell, Derbyshire, have not lost their appreciation of nature's scenery, which years ago stamped their calendars with a special character of their own. The one issued for 1920 has a charming coloured picture of sunshine and shadow, running water, and nature's freshest greenness, cool and restful on a summer's day, a glen in which to dream and to write poetry—not to be practical and write "Business Notices."

A desk calendar, with monthly cards, has been received from the BRITISH RAWHIDE BELTING CO., LTD., of Hythe Road, Willesden, N.W. 10.

THE BRITISH THOMSON-HOUSTON CO., LTD., 77, Upper Thames Street, E.C. 4, have issued a vest pocket calendar card for 1920. Electrical contractors can have quantities over-printed.

Catalogues and Lists. — CREDENDA CONDUITS CO., LTD., Chester Street, Aston, Birmingham. — Leaflet No. 103, dealing with "Creda" electric toasters, sterilisers, &c. Priced and illustrated. Illustrated and priced leaflet of the "Creda" pedestal fire.

THE LEA RECORDER CO., LTD., 28, Deansgate, Manchester.—Leaflet "T," users' comments on the "Lea" recorder, and Efficiency Diagram, M 3, showing the heat efficiency of a boiler when evaporation per lb. of coal is known.

THE BRITISH THOMSON-HOUSTON CO., LTD., Rugby.—"Descriptive List No. 2,250 A," a 52-page catalogue of D.C. motors. Details of construction and capabilities are given very fully, and the list contains many illustrations.

CHARLES MAYFIELD, 19, All Saints' Road, Clifton, Bristol.—Leaflet relating to a business-control-chart system.

THE OVERSEAS ENGINEERING CO., LTD., 75, Curtain Road, E.C. 1.—Catalogue No. 125 (19 pp.), and Price Sheet No. 145, giving priced and illustrated information regarding small electric lighting outfits.

THE BRITISH RAWHIDE BELTING CO., LTD., Hythe Road, Willesden, N.W. 10.—Leaflet illustrating various rawhide manufactures, pinions, belting, mallets, &c., also a blotting card advertising these products.

Italian Electrical Companies.—The Società Italiana per Conduttori Elettrici Isolati, of Leghorn, has decided to increase its capital from 3,500,000 lire to 7,000,000 lire in order to be ready to take a large share in the supply of plant for the new inter-urban telephone extensions, and electric railway conversions, projected by this State.

There has been formed at Milan the Società Anonima A.B.G.D., with a capital of 1,000,000 lire, for the development of electro-mechanical patents and kindred apparatus.

The Società Ligure Pugliese Esercizio Imprese Elettriche has decided to write down its capital from 1,000,000 lire to 100,000 lire in consequence of the loss shown at the end of 1918, and to increase its capital by the issue of shares to 100,000 lire.

Safety First.—The British Industrial Safety First Association, 2 and 3, The Sanctuary, Westminster, S.W. 1, has recently published a poster setting forth the conditions under which the Gallant Conduct Award can be gained. This award is a silver medal designed and executed by the Goldsmiths and Silversmiths Co., Ltd., London.

New French Undertakings.—The Société d'Etudes des Forces Motrices du Haut-Daubs, with a capital of 300,000 frs., has been formed at Paris. It has for its object the development of the power of the Upper Daubs River.

At Grenoble, the Société Hydro-Electrique de Verdon-Moyen has been formed. The capital of this undertaking is 1,000,000 frs. The project is the derivation of power from the falls on the Verdon, near Castellane.

The Société d'Equipement des Voies Ferrées, recently floated in Paris, for the building and equipment of electric railways, has a capital of 1,300,000 frs.

For the manufacture and sale of "Idealith," "Mecanite," and other insulating articles, there has been established, at Corbevoie, the Société pour la Fabrication des Isolants, with a capital of 300,000 frs.

New Swedish Cable Company.—A new company has recently been formed in Halsingborg, with the title of the Aktiebolag Halsingbergs Kabelfabrik, to manufacture electric and other cables.

Trade Representatives Overseas.—The following further appointments have been made by the Executive Committee of the Federation of British Industries :—

CUBA.—Mr. G. C. Musgrave has been appointed as a representative of the Federation in Cuba. He will be sailing at the end of this month.

MEXICO.—Mr. Antonio Gibbon, of 7A. Naranja 179 Mexico D.F., has been appointed as a Federation representative.

HOLLAND.—Arrangements for a permanent secretary are being made.

The Birmingham Fair.—It is expected that there will be heavy demands upon the accommodation that Birmingham is able to offer visitors during the run of the British Industries Fair, which opens on February 23rd. In order that the hotels may be as far as possible left free for buyers who are in attendance, it is suggested that exhibitors should avail themselves of apartments which the general manager will undertake to reserve for them and their assistants, if they will immediately intimate their requirements to him at the Chamber of Commerce, Birmingham.

Trade Announcements.—MR. ARTHUR IRELAND, for 20 years with the Electric Supply Corporation, has commenced business as a wiring and general electrical contractor at 12, Vicarage Road, Chelmsford.

MR. SIDNEY J. GOODSON, engineer and manufacturers' agent, has removed to 70, Wallingford Avenue, North Kensington, London, W., 10.

The Herne Bay Welding Co. (MESSRS. E. BROWN and D. T. FITZGERALD) have commenced business as electrical engineers, &c., at 8, High Street, Herne Bay.

The style of MESSRS. TURNERS & MANVILLE, LTD., has been changed to "Asbestos and Electrical Fittings Co., Ltd." There is no alteration in the constitution of the company or the conduct of the business.

MESSRS. PETO & RADFORD are removing their London headquarters from 12, Heddon Street, W., 1, to 50, Grosvenor Gardens, S.W., 1. New telephone number : "Victoria 3667" ; telegraphic address : "Concentration, Sowest, London."

Bankruptcy Proceedings.—W. J. MCCOMBE, tramway manager, Kingston-upon-Hill.—Trustee (Mr. W. G. Hall), released December 30th, 1919.

W. MELLON (H. B. Wallis & Co.), electrical engineer, Chiswick.—First meeting, February 5th, at 14, Bedford Row, W.C. ; public examination, February 24th, at Brentford.

Liquidations.—HERBERT FROOD & CO., LTD.—Winding up voluntarily for reconstruction purposes. Liquidator, Mr. J. Bell, 5, Clarence Street, Manchester, who is authorised to consent to the registration of a new company, Ferodo, Ltd., and to enter into an agreement with the new company. Meeting of creditors to-day at Manchester. Particulars of claims must be sent to the liquidator by March 25th.

ALEXANDER DUCKHAM & CO., LTD.—Winding up voluntarily for reconstruction purposes. Liquidator, Mr. L. A. Anderson, 2, Broad Street Place, E.C. Meeting of creditors, January 26th.

HOLME ELECTRIC CO., LTD.—Particulars of claims to be sent by February 10th to the liquidator, Mr. J. Alderson, Holme, near Holmfirth, Huddersfield.

ALFRED HERBERT (FRANCE), LTD.—Meeting of members called for February 20th, at The Butts, Coventry, to hear an account of the winding-up from the liquidator, Mr. D. M. Gimson.

A.E.G. ELECTRICAL CO. OF SOUTH AFRICA, LTD., 6, Old Jewry, E.C.—Last day for proofs for dividends to non-enemy creditors, February 2nd. Liquidator, Mr. H. de V. Brougham, Senior Official Receiver, Carey Street, W.C.

RADIUM, LTD.—Liquidator (Mr. H. de V. Brougham, Official Receiver) released January 5th.

BROLT, LTD. — Winding up voluntarily for reconstruction. Liquidator : Mr. E. Bosley, 120, Colmore Row, Birmingham. Particulars of claims to be sent to the liquidator by March 1st. Meeting of creditors, February 3rd.

NEW ST. HELENS AND DISTRICT TRAMWAYS CO., LTD.—Claims must be sent by February 28th to the liquidators, Messrs. H. P. Conibear and E. H. Edwardes, generating station, Howe Bridge, Atherton, Lancs.

CONNOLLY BROS., LTD.—Liquidator : Mr. J. McD. Henderson, 2, Moorgate Street Buildings, E.C.

LIGHTING AND POWER NOTES.

Aberdeen.—EXTENSIONS.—The electrical engineer recommends additions and extensions, costing £60,000, to meet increased demands. The proposals include the erection of two sub-stations and a considerable extension of distributing cables. During November last a total of 2,500,000 units was generated at the Dee Village Road station, an increase of 172,740 on the corresponding period of 1918.

Ammanford.—LIGHTING CHARGES.—The Council has been warned by Mr. Herbert, proprietor of the electric lighting undertaking of the town, that, unless it agrees to an increase of

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50 per cent. in the charges, he will refuse to continue the supply. In the event of such an occurrence, the Council says it will apply for a Court injunction.

Arbroath.—STREET LIGHTING.—The Lighting Committee has agreed to accept the offer of the Arbroath Electric Light and Power Co. to re-install the public lighting system, at a cost of £6 10s. per lamp, for the period to Whit-Sunday this year. After this date the charge will be £16 per annum, subject to the taking over by the Town Council of the existing equipment at the price of £700.

Ayr.—INADEQUATE PLANT.—A Special Committee has been appointed to consider the electrical engineer's report that it is now impossible to supply further demands as the plant will not take a larger load. Demands have increased by 40 per cent. during the past year. The suggested scheme of extension and additions will cost £27,000. Among other things it is proposed to install new stoker gear and a rotary converter.

Barnet.—PROPOSED PRICE INCREASE.—The Town Council is opposing the application of the North Metropolitan Electric Lighting Co. for sanction to increase charges for electricity.

Barnsley.—EXTENSIONS.—The Town Council has approved a scheme of extensions and additions to the power undertaking, involving an expenditure of £40,000. One item is the erection of a sub-station at Town End, the cost of which will be about £1,200.

Blackburn.—EXTENSIONS.—The Town Council has received a number of applications from cotton-mill owners for a supply of power. This will involve the laying of new mains, as will also the projected wiring of the Blackburn Union Workhouse buildings.

Bradford.—EXTENSIONS.—The Electricity Committee has authorised extensions of mains in various parts of the city area, at a cost of £3,854

British Guiana.—HYDRO-ELECTRIC SCHEMES.—Not the least important of the schemes for the development of British Guiana is the utilisation of the waterfalls, with which the Hinterland abounds, for the purpose of hydro-electric energy. A preliminary survey of the Cuyuni, Essequebo, Demerara, and Potaro rivers has recently been made. The Conjoint Board of Scientific Societies, to which the report of the preliminary survey was referred by the Secretary of State for the Colonies, has recommended that automatic gauging stations should be erected on the rivers named, as well as the employment of an engineer, specially trained in hydro-electric work, to examine these localities in greater detail. Meanwhile, the preliminary report has been entrusted by the Committee to one of its members, who has had long experience of water power, with a view to getting further expert criticism. The Committee has also undertaken to co-operate with the Colonial Office in the selection, for the detailed examination, of an engineer whose reputation would be a guarantee of the value of his recommendations. The Combined Court has lost no time in authorising the expenditure to give effect to the recommendations of the Conjoint Board of Scientific Societies, and it will, therefore, be practicable for the Government to embark on the undertaking early in the coming year.—*Financier.*

Bromley.—SUPPLY FAILURE.—Due to a breakdown at the electricity works, Bromley, Chislehurst, and district were in darkness for several hours on Friday night, last week.

Canada.—RESTRICTIONS.—The excessive demands of power consumers have led to the imposition of severe restrictions by the Niagara Falls (Ontario) Commission. All signs and outside lights are forbidden, and power users are ordered to return to "daylight saving," starting earlier in the day and closing down at 4 p.m. Domestic supplies are also curtailed. These restrictions are calculated to reduce the load by 40 per cent.

Carlisle.—LOANS.—The Town Council has applied for loans of £5,000 for high-tension mains; £600 for services; £3,000 for transformers; and £1,500 for sub-stations.

Carmarthen.—PRICE INCREASE.—The Town Council has acceded to an application by the Electric Light Co. for leave to increase the charge for electric light for domestic purposes from 7d. to 9d. per unit, and for public lighting by 20 per cent.

Cheltenham.—LOAN.—As the existing plant has been found inadequate, the Town Council is to apply for sanction to borrow £29,000 for additions.

Clacton-on-Sea.—LOAN SANCTION.—Loans amounting to £5,500 have been sanctioned for the extension of mains, and for the conversion of the street lighting system from gas to electricity.

Continental.—HOLLAND.—The Low-Tension Network Installation and Working Co. (Mij tot Aanleg en Exploitatie van Laagspanning Netten), of Groningen, has just offered for subscription 6 per cent. bonds for 2,000,000 florins. The company was formed in 1913, the shareholders being the province of Groningen and the towns situated within the concession area of the provincial electricity works in Groningen and Drente.

AUSTRIA.—The coal shortage at Vienna is so critical, that in order to maintain even a scanty lighting in the streets and houses, from January 16th the electric tramway service in the city was to be completely suspended. Neither gas nor electricity may be used for industrial purposes, and shops, offices, and banks must not be lit after 3 p.m. All places of amusement must close, and the use of lifts is only permitted in hospitals.

Dartmoor.—HYDRO-ELECTRIC SCHEME.—The Dartmoor and District Hydro-electric Supply Co. has deposited its Bill for incorporation and powers to erect five stations on the banks of the Rivers North Teign, Lan, Tavy, Dart, and Erme.

Fife.—STREET LIGHTING.—The Kinghorn Town Council is considering a proposal to substitute electricity for the present system of gas lighting.

Eccles.—PROPOSED EXTENSIONS.—Although the charges for power and lighting have been advanced 75 per cent. above pre-war rates, applications from prospective consumers have so increased, that extensions are contemplated.

Hull.—REMOVAL OF RESTRICTIONS.—The restrictions placed upon the use of electricity for motive power have been withdrawn, but the ban on display lighting and the use of energy at kinema halls remains.

India.—WATER POWER.—A temporary Public Works Division has been constituted, with headquarters at Lahore, to be known as the Sutlej River Hydro-Electric Project Division, and Lieut.-Colonel B. C. Battye, D.S.O., R.E., has been posted to the charge of it.

Java.—HYDRO-ELECTRIC WORKS.—The Government of the Dutch East Indies is proceeding with a scheme for the erection of large hydro-electric works in West Java, to supply energy for the electrification of the railways and tramways, and for lighting and power purposes to municipalities. With a view to ensuring that the supply shall be afforded to the towns concerned at as low a charge as possible, the Government is endeavouring to bring together all the parties interested, including the Ned. Ind. Gas Co., of Batavia, which possesses the exclusive right to supply electricity in the town of Batavia until 1953. The Municipal Council of Batavia has, however, asked the Government to exclude the gas company from the proposed combination, the object apparently being to induce the Government to expropriate the company, which it can do in 1923 under the terms of the concession.

Knottingley.—The Board of Trade has revoked the 1914 Electric Lighting Order.

Loughborough.—EXTENSIONS.—Extensions providing an additional 6,000 KW. to the town's plant capacity, at an estimated cost of £150,000, are suggested. Mr. C. H. Wordingham, O.B.E., has been appointed consulting engineer for the scheme.

Lyme Regis.—INADEQUATE LIGHTING.—The Town Council has decided that it cannot pay the County of Dorset Electric Supply Co. in respect of street lighting for the quarter ended December 21st last. The reasons given for this are the ineffectiveness of the system, the length of time taken in repairing defects, and the inconvenience caused by roads still being up. The Council also states that, unless there is an immediate and substantial improvement, it will have to consider other means of lighting when the present agreement expires in May next.

Mexborough.—NEW STATION.—The erection of a 10,000-KW. generating station in the Adwick district at a cost of £500,000 is being contemplated. An arrangement between the Mexborough Council and the Yorkshire Electric Power Co. proposes to place the station under the control of a Joint Board.

Middlesbrough.—NEW STATION.—The Cleveland and Durham County Electric Supply Co., has expressed its regret at the Corporation's decision to augment the town plant in view of the negotiations proceedings between the two bodies for an additional supply of electricity to the town. The company asserts that, in conjunction with allied undertakings, it is erecting a power station at Haverton Hill, chiefly to meet the demands of Middlesbrough consumers. The station will have a capacity of 32,000 KW., and it will be necessary to lay a new high-tension network. The total cost, it is stated, will be considerably over £1,000,000.

The borough electrical engineer reported that the price quoted for a producer gas plant was very much in excess of his estimate and it has, therefore, been decided to continue taking a supply from the local gasworks for the present.

Monasterevan (Co. Kildare).—STORM DAMAGE.—During the recent storms the electricity company's pumping station was completely wrecked, and the majority of the power station plant put out of action, putting the town in darkness.

Monmouthshire.—FLOODED MINE.—Owing to the failure of the power supply and the consequent stoppage of the pumps, the Ellea Colliery, Pontnewyndet, was flooded, and work stopped for about three days.

Montrose.—PROPOSED PRICE INCREASE.—The Town Council is allowing the proposed increase of charges for electricity to 8d. per unit to stand over for a month, pending investigations into costs of production, &c.

Otley.—ELECTRIC SUPPLY.—The District Council is urging the Board of Trade to grant the necessary permission to the Yorkshire Electric Power Co. to install electricity in the town as soon as possible.

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Stafford.—EXTENSIONS.—The Town Council is asking that the application for sanction to borrow £30,000 may be amended to provide for a sum of £65,000. It is proposed to install two 1,250-KW. sets, with accessories, one rotary converter, and transformers. New buildings will have to be erected.

South Shields.—YEAR'S WORKING.—The borough electrical engineer's report for the year ending March 31st, 1919, shows that the total income of the undertaking for this period was £42,169, and the expenditure £30,744, leaving a gross profit of £11,425. After the payment of loan interest, &c., however, the result was a deficit of £7,287. The total number of units generated was 5,766,398, and the maximum simultaneous load during the year was 2,709 KW.

Sunderland.—SUB-STATION.—The Electricity Committee has received permission from the Town Council to erect a transformer sub-station in St. Paul's Road. The total cost of the building, including equipment and site, is estimated at £3,325.

Tasmania.—HYDRO-ELECTRIC DEPARTMENT.—The fifth annual report (1918-19) of the Hydro-Electric Department shows that the revenue for the year amounted to £35,767, and the total working expenses to £25,087, leaving a gross profit of £10,680. The Department's total capital expenditure to June 30th, 1919, was £771,506. Extensive surveys have been made of the available water power, and a great deal of new construction is contemplated.

United States.—WATER-POWER BILL.—After a fight which has lasted for 10 years, the Senate has passed the Water-Power Bill, which provides for the creation of a commission for the licensing of water-power projects for a period of 50 years, at the expiration of which they will revert to the Government. They may, however, be re-licensed if it is deemed desirable. The Bill will now go before the House of Representatives.

TRAMWAY AND RAILWAY NOTES.

Bolton.—IMPROVEMENTS.—The Tramways Committee has recommended various improvements in the track, and also the acquisition of new cars.

Bradford.—CONTRACTORS' INCREASES.—Contractors for the supply of gear wheels for the Corporation tramways asked for a 20 per cent. increase on contract prices owing to the increased cost of production. The Committee has agreed to bear half of this extra cost.

Continental.—SWITZERLAND.—An avalanche fell near the Goppenstein-Loetschberg railway line late at night on January 11th, destroying the overhead electric railway equipment and interrupting traffic between Italy and Berne. Till the line was cleared, passengers were conveyed to Goppenstein by steam trains, but were obliged to make a detour on foot to join the electric railway further along the valley.

Leeds.—PARCEL SERVICE.—A net profit of £300 has been made during the past financial year on the parcel service of the tramways. Between April, 1918, when it was inaugurated, and September 30th last, the department dealt with 97,728 parcels, and of this total, 58,633 were carried during the six months ended September 30th. There is now a working arrangement for the carriage of parcels between the Leeds and Bradford tramways authorities, and between November, 1918, and September 30th, 1919, 23,000 parcels were carried between the two cities.

London.—ACCIDENTS.—A car on the District Underground Railway became derailed at Whitechapel about 10 a.m. on Monday, and both lines between Bow Road and Aldgate East were temporarily closed.

Due to an accident in the Chiswick High Road on Saturday morning last, the front of a L.U.T. tramcar was damaged, and a P.O. letter-box was knocked down.

A stoppage of 40 minutes was caused on the Bakerloo tube by a defective shoe on Monday.

Newcastle.—YEAR'S WORKING.—The report of the engineer and general manager of the Corporation tramways for the last financial period showed a total revenue of £472,094, or 18·94d. per car-mile, as compared with 16·82d. for the previous year. Working expenses increased by £58,096 to £306,490. Rates and taxes amounted to £34,427. During 1918-19 the number of passengers increased to 101,631,660 from the previous year's figure of 91,648,545.

Plymouth.—EXTENSIONS.—To enable the Corporation Tramways Department to deal with the requirements of the travelling public, it is proposed to double the power supply. Twenty additional cars are to be put on, the tramways are to be extended on seven different routes, 30 omnibuses are to be provided, and a parcel-carrying system is to be established.

Salford.—EXTENSIONS.—The Tramways Committee has again been requested to extend its lines to Irlam, about four miles away, to serve the population of this growing industrial locality.

Swansea.—TRANSPORT.—Strong opposition was offered at a ratepayers' meeting to clauses in the Corporation Bill providing for the establishment of motor-bus services in lieu of tramway extensions. It was pointed out that the cost of the latter was now "prohibitive," the estimate being £30,000 per mile, and that if the deletion of the clause referred to was insisted on, it would deprive important areas of transport facilities. Alderman T. J. Richards said the interests of 150,000 people in the outside areas had to be considered. The proposal to delete the clause was defeated, but a second amendment, deleting clauses relating to the provision of transport facilities for any district outside the borough, was carried.

Tyneside.—TRAMWAY PURCHASE.—The proposal of the Newcastle Corporation to purchase the Tyneside tramway undertaking is being opposed by Wallsend and Tynemouth.

Wolverhampton.—FARES.—The Tramways Committee is strongly opposed to the reinstatement of penny fares. The manager states that, although operating costs had increased from 6·551d. per car-mile in 1913-14 to 12·356d. in 1918-19, only a halfpenny had been added to the original penny fares. The Committee has, however, decided to reduce the price of workmen's tickets.

TELEGRAPH AND TELEPHONE NOTES.

A New Wireless "Calling-Up" Device.—A new wireless "calling-up" system intended mainly for saving life at sea, has been devised by the Marconi Co., and was recently demonstrated at Chelmsford. The device will enable a ship in distress to automatically ring alarm bells on board any vessels within range, and will do away with the necessity for an operator to be always on duty. The apparatus consists of an automatic transmitter, which will send out a special signal with accuracy, and a reliable receiver which will respond to this signal, and this signal only. It will ensure general and immediate attention being given to emergency calls, such as "S.O.S." and "T.T.T.," the ice warning. The device was used, it is stated, during the war for exploding mines, and its action was illustrated at the Marconi Works on January 15th, gunpowder being fired by wireless from a station 30 miles away.

Federated Malay States.—The *Times Trade Supplement* announces that large sums are being expended to improve the telephone and telegraph systems of the Federated Malay States. A trunk telephone line between Perak and Selangor is to be laid. Much material is required in connection with these developments.

India.—The telephone trunk connection between Lucknow and Allahabad was established on December 8th. It is hoped to have automatic telephone exchanges established in Lucknow and Cawnpore by the end of the cold weather, and a central battery system installed in Allahabad.

Strikes.—At midnight, on January 13th, a general strike of postal, telegraph, and telephone employés was put into execution throughout Italy, and all these services were suspended. The telegraph offices were guarded by troops. The men asked for increased wages, higher bonuses, and higher overtime pay; the Government seemed disposed to meet the demands, but the men struck suddenly against the advice of their leaders. A few men remained at their posts in Rome, and a few urgent telegrams and Press messages were dealt with; the telephone service was maintained for newspapers within an immediate radius of Rome, and a similarly reduced service was maintained in other large towns. The naval wireless stations have been placed at the disposal of the public whenever possible. The strike is complete in Northern Italy, less so in Central Italy, and only very limited in Southern Italy, Naples, Sicily, and Sardinia. At Palermo, Catania, and nearly all Sicily, in the Abruzzi, at Molise, Foggia, and other places, the employés refused to obey the order to strike, and the public services continue. In Rome 30 per cent. obeyed. During the night telegraphic and telephonic communication was re-established for Government and Ministerial purposes, with many centres in Northern Italy. The foreign telegraph service was, however, completely suspended.

It is reported that numerous telegraph lines in the West of Germany were wrecked by the workers during the recent strike and other riots. Telegrams from Berlin to England, France, and elsewhere are subject to several days' delay owing to the damage done to the wires in the west and south-west by the recent storms.

In Belgium the postmen's strike tends to increase, and has extended from Brussels to Antwerp, Mons, Charleroi, and other places. The strike coincided with the gales, which suspended telegraphic and telephonic communication in many directions.

A strike has been declared by the telephone operators at Oporto, who belong to the same Union as the telephone operators who are on strike in Lisbon.

Masked and armed persons entered the central telephone exchange at Lisbon at night, and removed a number of indispensable instruments. The telephone service had for a time to be suspended.

United States.—After exhaustive investigations and long experiment, the New York Telephone Co., has developed a machine-switching central-office system of automatic telephones that has proved so satisfactory in a number of practical trials as to warrant its use in several places, says the *Electrical World*. Installations at Dunkirk, Ithaca and Geneva were expected to be completed early this year. In New York City it is proposed to place this apparatus in three new central offices, but none of these installa-

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tions can be completed before the end of this year. The Telephone Co. is carrying out a reconstruction and expansion programme to meet the heavy demand for service that continued throughout 1918, and to regain the ground lost during 1917 and 1918, when no telephone work other than that needed for Government purposes was permitted. In 1918, in addition to the large increase in the volume of traffic from existing stations, there was a net gain in new stations installed since January 1st, 1918, of 100,000 in New York City and its immediate vicinity. The new system will not do away with the need for operators; in New York City the operating force was increased by 2,000 new workers in the last nine months of 1918, and 1,000 more are expected to be engaged in the first few months of this year. There will be no curtailment of this force, which soon will number 12,000. Experience has shown that the best method of changing from one type of apparatus to another is to use the new type on all larger replacements and for taking care of growth so that the most modern types of equipment can be gradually brought into use with the least amount of disturbance to the service and loss of time, and without any radical effect upon employés or upon the financial situation. The different types of equipment will interconnect without difficulty. The system is extremely simple to operate. Instead of telling the desired number to an operator, the subscriber indicates it himself by manipulating a dial attached to the regular telephone instrument. This dial is equipped with 10 finger holes, each carrying one of the 10 numerals. In some cases the dial will be marked with certain letters of the alphabet. In addition to the development in New York, installations of the new system are understood to have been made also in several cities in the territory of other Bell companies.

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the ELECTRICAL REVIEW *in which the "Official Notice" appeared.)*

OPEN.

Aberdeen.—January 31st. Electricity Committee. Two water-tube boilers, with superheaters, economisers, steel chimney and accessories. (January 9th.)

Aldershot.—February 17th. Urban District Council. Electricity Department. Geared turbine and generator, condensing plant, pumps, water-tube boiler and superheater, cables, &c. (See this issue.)

Australia.—SYDNEY.—March 1st. Municipal Council. Supply of 2,000-K.V.A., 5,000 to 10,000-V. transformers. Electric Lighting Department, Town Hall.

March 10th. City Council. Supply of 6,600-V. switchgear for sub-station switch houses, &c., and of six 250-K.V.A., three-phase transformers. Specifications from City Electrical Engineers' Office, Melbourne.—*Industrial Australian and Mining Standard.*

Belfast.—February 14th. Tramways Committee. Tramway stores, including electrical accessories, cable, lamps, carbon brushes, trolley wire, &c. (See this issue.)

Bray.—January 30th. Urban District Council. Electricity Works. One 200-B.H.P. Diesel engine, direct coupled to a 135-K.V.A. single-phase alternator and exciter. (January 9th.)

Bradford.—January 28th. Corporation. Two electric battery locomotives. (December 26th.)

Colne.—Electricity Department. New or second-hand 1,250-KW. to 2,000-KW., 6,600-V. turbo-alternator, with condensing plant. (January 16th.)

Edinburgh.—February 9th. Electricity Supply Department. One overhead travelling crane. (January 16th.)

Greenock.—February 3rd. Corporation. Electrical installation work at 114 houses. Particulars from Mr. A. Nimmo, Town Clerk.

Ilford.—January 27th. Urban District Council. Electricity Department. One 1,000-KW. converting plant, cooling tower, motor-driven air compressor, L.T. cables. (January 9th.)

London.—ISLINGTON.—January 28th. Electricity Committee. Stores, including cables, meters, electric lamps, &c., for 12 months. (December 19th.)

New Zealand.—AUCKLAND.—September 1st. Harbour Board. 12 5-ton (and alternatively 12 3-ton) semi-portable balanced jib level Luffing electric cranes. Specifications from the Agents of the Board, Messrs. W. & A. McArthur, Ltd., 18/19, Silk Street, Cripplegate, E.C.

Pontypridd.—January 30th. Urban District Council. Electricity Department. Rotary converter, transformer and switchgear. (January 9th.)

Stockton-on-Tees.—February 5th. District Fund, Gas and Electricity Committees. Articles and stores for six months. (See this issue.)

Warrington.—February 10th. Electricity and Tramways Committee. Two water-tube boilers; two mechanical stokers (underfeed type); water softener. (See this issue.)

Whitby.—January 30th. Urban District Council. Turbo-alternator, condenser, air and circulating pumps, water-tube boiler, rotary converter, transformer, A.C. switchboard, E.H.T. cables. (See this issue.)

CLOSED.

Barnsley.—Electricity Committee:—

H.T. switchgear.—Ferguson, Pailin, Ltd., £292.
L.T. cable.—B. I. & Helsby Cables, Ltd., £595.
1,800-KW. turbo-alternator, complete with condensing plant, air filter and recording apparatus.—English Electric Co., £23,879.
Water-tube boiler, stoker, economiser and induced-draught fan.—Babcock and Wilcox, Ltd., £8,545.
One turbine boiler feed pump.—Mather & Platt, £446.

Bradford.—Tramways Committee:—

87 standard-type car trucks, £19,140; 124 electrical tramcar equipments, £48,059.—English Electric Co., Ltd.
20 tramcar bodies, £29,300.—English Electric Co., Ltd.

Electricity Committee:—

Three 150-K.V.A. and two 60?-K.V.A. transformers.—Ferranti, Ltd.
Three 250-K.V.A. tranformers.—Brush Electrical Engineering Co., Ltd.
Two 400-K.V.A. transformers.—British Electrical Transformer Co., Ltd.
A.C. "B1" switchgear, Bolton Road sub-station (including gear for two additional rotaries and Merz-Price protective gear).—A. Reyrolle & Co., Ltd.

Belgium.—The Belgian State Railway Authorities in Brussels recently invited tenders for the supply of a large quantity of electric cables. There was keen international competition for the orders; among the British firms tendering being the Enfield Cable Works, Ltd.; Henley's Telegraph Works, Ltd.; the Metropolitan-Vickers Electrical Co., Ltd.; and the B. I. & Helsby Cables, Ltd. The last-named concern submitted the lowest tenders for several of the lots, totalling 168,000 metres of cables of different kinds.

Dublin.—The Port and Docks Board is purchasing from the Dublin Dockyard Co. three electrically-driven winches for £550.

Epsom.—Urban District Council:—

Repairs to Diesel engine at the electricity works.—Banks, Warner & Co., £918.

Sheffield.—The Birmingham *Post* says that Labour representatives have raised strong objection in the Sheffield Corporation to the practice of that body in placing large contracts for engineering material without disclosing details of prices. The recommendations of the Electricity Committee, relating to certain contracts for machinery and material, were, in consequence, sent back for fuller information. It was stated that in one case the amount involved was over £60,000, but that fact was not disclosed in the minutes.

Sunderland.—Electricity Department:—

Metering gear.—General Electric Co., Ltd.
Service cable.—Pirelli-General Cable Works, Ltd.

FORTHCOMING EVENTS.

Electrical Power Engineers' Association (West Yorks. Section).—Saturday, January 24th. At the Y.M.C.A., Albion Place, Leeds. At 6.45 p.m. Lecture on "The Legitimate Sphere of Trade Unionism," by Mr. F. Kirkley.

(Derby and District Section).—Saturday, January 31st. At the Albert Hotel, Nottingham. At 7 p.m. Address by the President.

Institution of Civil Engineers.—Tuesday, January 27th. At Gt. George Street, S.W. At 5.30 p.m. Further discussion on papers on "Whitby, Blyth and Sunderland Harbours."

Illuminating Engineering Society.—Tuesday, January 27th. At the Royal Society of Arts, John Street, Adelphi. At 8 p.m. Discussion on "Colour Matching by Natural and Artificial Light," to be opened by Mr. L. C. Martin.

Institution of Electrical Engineers (South-Midland Centre).—Wednesday, January 28th. At the University, Birmingham. At 7 p.m. Paper on "Failures of Turbo-generators and Suggestions for Improvements," by Mr. J. Shepherd.

(North-Eastern Centre).—Monday, January 26th. At the Armstrong College, Newcastle. At 7.15 p.m. Paper on "Failures of Turbo-generators, and Suggestions for Improvements," by Mr. J. Shepherd. Friday, January 30th. Annual dinner.

(North-Western Centre).—Tuesday, January 27th. At the Engineers' Club, Manchester. At 7 p.m. Paper on "Transformers for Electric Furnaces," by Mr. J. L. Thompson.

(Students' Section).—Friday, January 30th. At the City and Guilds Engineering College, Leonard Street, Finsbury, E.C. At 7 p.m. Discussion on "Quantity Production as a Panacea," to be opened by Major K. Edgcumbe, R.E. (T.)

Edinburgh Electrical Society.—Wednesday, January 28th. At 8 p.m. At the Philosophical Institution. Discussion on the I.E.E. "Regulations for the Electrical Equipment of Ships," introduced by Mr. D. S. Munro.

Wireless Society of London.—Thursday, January 29th. At the Institution of Civil Engineers, Gt. George Street, S.W. At 6 p.m. Illustrated lecture on "A Portable Valve Set and some Properties of C.W. Circuits," by Mr. R. C. Clinker.

Royal Institution of Great Britain.—Friday, January 30th. At Albemarle Street, W. At 9 p.m. Lecture on "The Gyrostatic Compass," by Mr. S. G. Brown, F.R.S.

Saturday, January 31st. At 3 p.m. Lecture on "The Astronomical Evidence Bearing on Einstein's Theory of Gravitation," by Sir F. W. Dyson F.R.S.

Junior Institution of Engineers.—Friday, January 30th. At 39, Victoria Street, S.W. At 7.30 p.m. Paper on "The Manufacture of Hydrogen Gas by the Silicol Process, for Airships and Commercial Purposes," by Mr. G. E. Lygo.

Royal Photographic Society, Russell Square, W.—Exhibition of prints lent by the Röntgen Society. Open till February 7th.

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NOTES.

Concert.—The Sheffield Electrical Social Union held a grand Bohemian concert at the Royal Victoria Hotel, Sheffield, on the 15th inst. The proceedings, which were very successful, lasted from 7 to 11 p.m. Messrs. F. H. V. Hooper and F. Leng acted as musical directors. Mr. A. Lucas is president of the Union, and Mr. A. Walker, of 15, Cleveland Street, Sheffield, fills the office of secretary.

Ramsay Memorial Fund.—The Sloan Electrical Co., Ltd., acting upon instructions received from Messrs. Philips' Glowlampworks, Ltd., Eindhoven, Holland, has forwarded a donation of £500 to the Organising Secretary of the Ramsay Memorial Fund.

Accident.—While Edward Owens, an operator at the Larbert (Stirlingshire) Picture Palace, was doing some repairs to the electrical connections which control the action of the kinema machine, his pliers came in contact with a live piece of steel, with the result that he sustained a 400-volt shock, causing severe burns to both hands. At last news he was in a serious condition.

Wireless Telephones for the Yukon.—Recent gold discoveries in British Columbia have resulted in a call for telephonic communication over snow-bound land, where no roads have yet been cut. A Yukon member of the Overseas Club has written to the Overseas Trade Bureau, asking to be put in touch with a firm which can supply wireless telephone outfits to connect Dawson and a camp 200 miles distant.—*Daily Chronicle.*

Electric Refrigerators.—In order to determine accurately the best type of machinery to install in a new refrigerating plant, a firm of consulting engineers of New York made a detailed analysis of the initial and operating costs. This plant was to have a total capacity of 600 tons based on a brine temperature of − 15° F. (− 26° C.) with a suction pressure of 3 lb. (0·2 kg.) gauge and a condenser pressure of 155 lb. (11 kg.). Consideration was given to the following types of installation:—(1) Absorption machines; (2) Steam-driven compressors with Corliss engines; (3) Steam-driven compound compressors; (4) High-speed simple compressors driven by synchronous motors; and (5) High-speed compound compressors driven by synchronous motors. The cost of equipment for these various methods of operation was found to be $277,113, $238,728, $237,728, $158,165, and $157,165 respectively, making the motor-driven high-speed compound compressor installation cheapest. The operating expenses under the five methods of operation considered are about as shown in the accompanying table. Again the cost is less for motor-driven compound compressors. As a result of these estimates four refrigerating machines were installed, each to be driven by a synchronous motor. The other electrical equipment consists of six 500-KW. transformers which convert energy from 7,830-volt, three-phase, 61½-cycle to 1,950-volt, two-phase energy.—*Electrical World.*

OPERATING EXPENSES.

Type of plant.	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.
Cost of plant	$280,000	$240,000	$240,000	$160,000	$160,000
Power or fuel per year (tons and KW.)	8,730	5,075	4,475	5,758,700	5,026,700
Cost power or fuel per year	*$27,500	$15,986	$14,100	$45,000	$41,250
Staff	13,475	13,475	13,475	10,505	10,505
Maintenance	8,750	6,800	6,800	4,000	4,000
Oil, waste, ammonia, water, &c.	10,000	7,530	7,350	4,000	4,000
Total operating expense	59,725	43,791	41,725	63,505	59,755
Interest, 6 per cent.	16,800	14,400	14,400	9,600	9,600
Depreciation, 3½ per cent.	9,330	8,000	8,000	5,330	5,330
Insurance	280	240	240	160	160
Total plant expense	$86,135	$66,431	$64,365	$78,595	$74,845
Deduct rental for space released by use of electrically-driven plant	—	—	—	14,000	14,000
Total net plant expense	$86,135	$66,431	$64,365	$64,595	$60,845

*Coal at $3·15 per long ton and energy at 0·00825 per kilowatt-hour.

"Eda" becomes "Beda."—On January 17th there was egistered at Somerset House the British Electrical Development Association, a company limited by guarantee, to promote and protect electrical industry and enterprise in the British Empire, and to develop the demand and uses of electricity.

Tube Improvements.—A correspondent of the *Daily Telegraph* suggests a scheme for the relief of the present congestion on the London underground railways. This is the provision of a central platform for in-going passengers only—the existing side platforms being used for unloading passengers. Trains would thus have a platform on either side. The cost is not likely to recommend the scheme to the serious attention of the railway companies, although no doubt the result would justify the expenditure from the travellers' point of view.

Fuel Research.—The Lord President of the Council has approved the appointment of Colonel Sir Frederic Nathan, K.B.E., late R.A., to be Power Alcohol Investigation Officer under the Fuel Research Board of the Department of Scientific and Industrial Research. Prof. Pierce Purcell, who was secretary of the Irish Peat Inquiry Committee, has also been appointed to act as Peat Investigation Officer under the Fuel Research Board. The duties of the Peat Investigation Officer will be to keep the Board informed of all progress in connection with research into the utilisation of peat, to continue and extend experiments on the mechanical cutting and winning of peat, and to make arrangemen to ca eful tests of the use of peat as a fuel under boilers,

Water-Hammer in Pipe Lines.—In *Le Génie Civil* of January 3rd, there appears an article by M. A. Causse on the phenomenon of water-hammer in the pressure conduits of hydraulic power installations. The author points out that with a view to economy of capital in modern practice, the speed of the water has been raised from 2 or 3 metres per second to 5 or 6 metres, with the result that water-hammer has greatly increased in importance. The phenomenon is exceedingly complex. The author deals with the problem analytically and shows that the shocks due to water-hammer can be predetermined, the calculated values agreeing well with experimental results.

Scientific Management.—With a view to educating the public, particularly those people engaged in commercial activity, in this subject, the Industrial League and Council has organised a series of lectures to be given in the Conference Hall of the Central Hall, Westminster. Among the speakers, together with their subjects, who are due to give lectures, are:—Mr. J. F. Butterworth, "Modern Methods in Industry"; Major E. A. Pells, "Conditions the Workers May Control"; Mr. W. J. Grosart, "Evolution of Modern Methods in Industry"; Mr. H. Atkinson, "Economical Production and Prevention of Waste"; Mr. F. C. Laurence, "The Effect of Modern Industrial Methods on Employment and Wages"; and Mr. J. F. Butterworth, "Results Achieved in Industry by Modern Methods." Anyone desirous of attending the conferences can obtain full particulars from the Secretary to the Industrial League and Council, at 66, Victoria Street, S.W. 1.

Electricity Supply Act.—The *London Gazette* for January 20th, publishes the following notice issued by the Ministry of Transport:—"That it is proposed to issue an order in council, under the title of 'The Ministry of Transport (Electricity Supply) Order, 1920,' whereby the 23rd of January, 1920, will be fixed as the date from which the duties of the Board of Trade in relation to the matters specified in the Act will be transferred to the Minister of Transport."

Inquiries.—Makers of "Limpet" plugs are asked for.

Educational.—UNIVERSITY COLLEGE, UNIVERSITY OF LONDON.—An appeal has been issued for £100,000 for the purpose of erecting new engineering laboratories for the College. The School of Engineering was established as long ago as 1828, and has to its credit the names of many distinguished engineers; the present buildings were opened in 1893, and are totally inadequate for the accommodation of the students already in attendance, to say nothing of those who seek admission. One important feature of the new scheme is an hydraulic laboratory, to be called after the late Mr. Charles Hawksley. Lord Cowdray has given £10,000 to the fund, with a conditional promise of another £10,000. Donations may be sent to Prince Arthur of Connaught, 42, Upper Grosvenor Street, W. 1, or to Sir Ernest Moir, at the College. We commend the scheme to our readers, especially those who are old students of University College.

Fatalities.—An inquiry was held on January 8th by the Manchester City Coroner (Mr. C. W. W. Surridge) into the circumstances attending the death of a seven-year-old child named Florence Pearson, who was knocked down by a tramcar when crossing the street and died a few minutes later. The driver of the car said he sounded his gong and applied the brakes, but could not bring the car to a standstill in time. The safety device in front of the car could not pick her up owing to the peculiar manner in which she fell. If she had been a bigger person she would have been automatically placed on the safety frame, but as she was very small, the body was dragged under the lifting portion. A verdict of "Accidental Death" was returned, the Coroner stating that no blame was attached to the driver.

Found lying in an outhouse with her hair caught in the engine of a plant for lighting the house by electricity—which her brother, aged 20, had fitted up, and taught her to control—Doris Little, 15, of Tottenham, died in hospital from scalp wounds. At the inquest, on January 14th, it was stated that she was very proud of being able to start the engine. She had told her mother that she was turning off the switch so as to save current.—Verdict, "Accidental Death."

The Hvid Engine.—A recent issue of *Power* describes, in detail, a little-known internal-combustion engine for which it is claimed that it possesses all the advantages and none of the disadvantages of the Diesel type. The Hvid engine is designed to run on paraffin, and is of the four-cycle type. Its chief features are the elimination of ignition devices and the use of compressed air, as both principles are embodied in the operation of the engine itself. Briefly its action is as follows:—On the first (suction) stroke a charge of air is admitted to the cylinder, and at the same time a fuel valve opens and fills a small cup. On the compression stroke, the air is subjected to a pressure sufficient to raise it to a temperature high enough to ignite the more volatile elements of the oil in the cup. This causes a small explosion which forces the rest of the oil into the compression chamber. The heated air in this chamber causes rapid combustion to take place, and the piston is forced back. The exhaust stroke then drives out the products of combustion. In addition to the advantages previously mentioned, the fuel consumption is small, and the engine will operate on any oil that flows. It has been produced in sizes as low as 1½ H.P. The article contains curves showing the relative fuel consumption of the Hvid engine and other types. At 8 B.H.P. the consumption of the Hvid is given as ·44 lb. per B.H.P.-hour, as compared with ·61 for a paraffin-driven engine with throttling governor, and ·74 for a petrol engine with a "hit and miss" governor.

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Prize Awards.—The French Academy of Sciences has awarded part of the Plumey prize (1,500 fr.) to M. Maurice Poincet, for his researches on the blades of steam turbines; the Kastner-Boursault prize to M. Maurius Latour, for researches on electric motors; the Gaston Planté prize to M. E. Brylinski, for work in applied electricity; the Hébert prize to M. Raymond Jouaust, for work on magnetism, electrical standards, photometry, and wireless telegraphy; the Hughes prize to M. Henri Chaumat, for work on ozone, indigo and other dyes, and electrotechnics; the Pierson-Perrin prize to M. Georges Sagnac, for work on secondary X-rays; and the Clément Félix foundation to M. Charles Féry, to enable him to continue experiments on the production of a small dry accumulator.

Appointments Vacant.—Assistant sub-station attendant (77s. 1d.), plumber-jointer (98s. 3d.), jointer's mate (78s. 2d.) for the Stoke Newington Borough Council electricity department; junior mains assistant and draughtsman (£4) for the Cheltenham Corporation electricity department; meter repairer (mechanician) (39s. + 33s. 6d. + 12½ per cent.) for the Lancaster Corporation electricity works; overhead linesman (79s.) for the Burnley Borough electricity department; cable jointer for the Bacup Corporation electricity department; E.H.T. plumber-jointer (94s.) for the Swansea Corporation electricity department. See our advertisement pages to-day.

Naval Telegraphist Ratings.—It is officially announced that in future all telegraphist ratings who have passed as telegraphists, and are otherwise qualified for entry, may be enrolled in the Royal Fleet Reserve.

Radiographic Exhibition.—An interesting exhibition of X-ray photograms is being held by the Röntgen Society, at the Russell Square Rooms of the Royal Photographic Society. The progress achieved in this art is evidenced by a comparison between the first radiogram from a human hand made in London 24 years ago, with 20 minutes' exposure, and one taken last month with an exposure of $\frac{1}{100}$ second.

Liverpool Electricians' Lock-Out.—On Monday a lock-out was declared by a number of Liverpool employers in the electrical contracting industry, the National Federated Electrical Association having adopted the following resolution:—"In consequence of the action taken by the Electrical Trades Union in withdrawing their members from certain firms in the National Federated Electrical Association, owing to the non-ratification of the new rules by the National Joint Industrial Council, this Association declares a lock-out of all Electrical Trades Union men employed in the Building Section (other than staff hands), as and from 5.30 p.m., January 19th, 1920." It is stated locally that the new working rules had been agreed by the District Joint Industrial Council, but had not been ratified by the National Joint Industrial Council, which put forward a number of amendments. The Union, however, admits the National Council's right to veto, but as it had not done so, claims that the rules should be in operation. A number of men ceased work last week-end to enforce recognition of the new rules, and the employers responded by the declaration of a lock-out. It is understood that some 400 men have ceased work in Liverpool and district.

The "Electrical World" of New York.—We congratulate our contemporary upon having emerged from the difficulties occasioned by the strike in the printing trades in New York. The issue of December 27th, just to hand, states that the paper was then returning from its temporary home at Buffalo, where nine issues had been published, to its home quarters in New York.

Appointments in India.—In its issue of November last, *Indian Industries and Power* refers to the growing demand for engineers in India, and for skilled men in most industries, and quotes with approval the letter of Mr. W. T. I. Turner, which appeared in our issue of September 26th. Our contemporary says:—"There is a great deal in these warnings. Although the rupee has risen over 2s., there has been a corresponding rise in the cost of living, and in Bombay a single man will have much trouble in getting accommodation at Rs. 150 a month. The average in the hotels would be Rs. 300 per month, and there is difficulty in getting a room even at that price. In private boarding houses the charges have risen with the great demand. With the Japanese elbowing the European out of the residential districts and the dearth of hotels and boarding houses in Bombay and Calcutta, we may say that the position has grown worse. Firms bringing out new men must find accommodation for them, and to do this they had better devote their early and prompt attention to the suburbs, and purchase what bungalows are available, or arrange to build. Further, it would be advisable to give the new-comers a full and frank statement of the conditions and the cost of living. We would like to see every firm handle this subject in a similar manner to that employed by the Tata Co. Their booklet on the living conditions at Jamsedpur is one of the fairest and most explicit we have seen. It might be improved by a few illustrations, but that is a detail. It prevents a man from feeling that he has been brought out here under false pretences, and tends to make him have confidence in his firm and his prospects. Employers of European labour in India do not give sufficient attention to these matters, and very often find their staffs discontented and unhappy in their surroundings. The European engaged for work in India is entitled to careful consideration, and if he is a married man, his case has a special claim, for the outlook for a married man with a small family is distinctly gloomy."

The Accident to Submarine "K.13."—One of the most thrilling and absorbing war stories that we have seen was contained in an address by Mr. Percy A. Hillhouse, B.Sc., to the Greenock Association of Engineers and Shipbuilders, which was reproduced in *The Channel* for November, 1919.

It will be remembered that "K 13" was one of two submarines ordered from the Fairfield Co. late in 1915; she was no less than 330 ft. long, displaced 2,600 tons, and was fitted with water-tube boilers and turbines for surface propulsion; for under-water work she had the usual battery and motor equipment. Her normal crew numbered 52. After preliminary trials, including successful submergences, on January 20th, 1917, she dived in the Gareloch to 83 ft. for two hours, and was accepted as satisfactory. A second short dive was undertaken, with 80 persons on board, including representatives of the Admiralty, the builders, and various contractors; amongst these were Messrs. D. Renfrew and S. R. Black (Kelvin, Bottomley & Baird), W. V. Hancock (Admiralty electrical overseer), E. J. Skinner, manager, and his assistant, F. Neate (electrical department, Fairfield Shipyard), and the author (naval architect, Fairfield Shipyard). The dive commenced, but almost immediately it became evident that something was wrong, and the ship sank rapidly; water was found to be pouring into the boiler room, and the watertight doors were closed. A jet of water through a voice pipe caused short-circuiting on the switchboard, blowing fuses and setting the cables on fire; attempts to smother the flames with wet sacks resulted in shocks, until means were devised to avoid that trouble, and the pungent smoke was highly irritating. Every effort was made to rise by blowing out water and letting go the drop keels, without effect. Fortunately the batteries were fully charged, and energy was available for lighting, pumping, and compressing air. The situation appeared desperate, and all felt that there was no hope of escape. The unusual appearance of the dive had attracted attention on the surface, and the work of rescue was immediately put in hand. On the ship, 48 persons were gathered in the forward portion, including all those named above except Mr. Neate, in a space of about 12,000 cu. ft., and it appeared that the supply of oxygen would last for about six hours; actually the prisoners were entombed for 42 hours, in an atmosphere in which a match would not inflame. The compressed air store was drawn upon gradually, but breathing became painful and difficult. All the while, the danger that the salt water would reach the batteries and generate chlorine gas was present. How the two commanders, Herbert and Goodhart, took the desperate chance of leaving the vessel to inform the rescuers as to the conditions, we have not space to tell; the former perished, but Commander Goodhart, who had not intended to make the attempt, was blown out by a fortunate chance and rendered invaluable assistance at the surface. Eventually the bow of the vessel was raised by blowing in compressed air from above; but the danger of chlorine gas was increased by this, as the water could not be pumped out. At intervals throughout the ordeal, fuses blew on the switchboard and the corresponding lights were extinguished. In altering connections to an air compressor a short circuit was made which blew the main fuse, and put the whole ship in darkness for the last six hours. After 55 hours' durance of the vilest, all were released, but next day the ship again sank to the bottom. It was found that the four air inlets to the boiler room had been left open when submerging; the man who forgot them paid for his error with his life. Mr. Skinner was one of those to whom the Admiralty awarded special commendation for their services. The story, which is highly detailed, is of surpassing interest.

Water Power in the U.S.A.—The Secretary of the Department of the Interior in his last annual report, emphasises the necessity for further hydro-electrical developments. The Geological Survey has estimated the total available water power in the States as 54,000,000 H.P. The last official census, taken in 1912, showed that the developed power from this source was only 4,870,000 H.P., about 9 per cent. of the total resources.

Fixation of Nitrogen.—The U.S. Government has introduced a Bill into the Senate and House of Representatives providing for the formation of a Fixed Nitrogen Corporation. The corporation stock will be owned exclusively by the Government. The functions of this body will be the manufacture, production, and development of atmospheric nitrogen, chiefly for military and agricultural purposes. The Bill empowers the Corporation to purchase existing plant, and to take over the hydro-electric undertaking at Muscle Shoals when completed.

Australian Postal Finance.—The Postmaster-General of Australia reports a surplus of approximately £556,804 for the year 1918-19. The total earnings of the postal system were £6,158,029, while the working expenses, including interest, amounted to £5,601,225. The last year's profit was £387,382. Every branch increased its business, and the following advances on last year's earnings were given:—Telephones, £161,314; telegraphs, £81,877; and postal, £140,884. The Postmaster-General states that the year's profit is equivalent to the interest on a £20,000,000 war loan.

An American Electric Car.—The *Light Car* announces that an American concern is contemplating the production of an electrically-driven light car weighing less than 10 cwt. It will carry its own "charging plant" in the form of a small air-cooled engine.

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INSTITUTION NOTES.

Institution of Electrical Engineers.—Arrangements for the second part of the session, 1919-20, are as follows :—

ORDINARY MEETINGS.

February 12th.—Major K. Edgcumbe, R.E. (T.), "The Protection of Alternating-Current Distribution Systems without the use of Special Conductors."

February 26th.—Reginald Morton, M.D., "On the Efficiency of High-Tension Transformers as used for X-ray Purposes." Major C. E. S. Phillips, O.B.E., "The Problem of Interrupted and Fluctuating Currents." R. S. Wright, "High-Tension Transformers." Joint meeting with the Röntgen Society and the Electro-Therapeutic Section of the Royal Society of Medicine.

(At the Royal Society of Medicine, Wimpole Street, W., 5 to 6.45 p.m., and 8.15 to 10 p.m.).

March 4th.—Annual dinner. At the Connaught Rooms (7 for 7.30 p.m.).

WIRELESS SECTIONAL MEETINGS.

February 18th and March 17th.—To be announced later.

INFORMAL MEETINGS.

February 2nd.—Major T. Rich, O.B.E., "Engineering Experiences during the War."

February 16th.—A. B. Eason, "Automatic Telephony for Private Branch Exchanges."

March 1st.—R. E. Dickinson, "The Future of Labour in the Engineering Industry."

March 15th.—J. W. Beauchamp and S. M. Hills, "Industrial Electric Heating."

March 29th.—To be announced later.

April 19th.—G. H. Ayres, "Group *v.* Individual Driving."

MEETINGS OF TERRITORIAL CENTRES.

North-Eastern Centre.

January 26th.—J. Shepherd, "Failures of Turbo-Generators and Suggestions for Improvements."

February 9th.—J. L. Thompson, "Transformers for Electric Furnaces."

February 23rd.—L. H. A. Carr, "Some Magnetic Problems." (Lecture).

North Midland Centre.

February 10th.—E. Cross, "The Rotherham Power Station."

March 9th.—To be announced later.

March 23rd.—To be announced later. Joint meeting with the Association of Mining Electrical Engineers.

North-Western Centre.

January 27th.—J. L. Thompson, "Transformers for Electric Furnaces."

February 10th.—Lieut.-Col. F. C. Aldous, D.S.O., and A. E. Leigh Soanes, M.A., "A Critical Survey of Power Supply in the Rhine Valley."

February 24th.—Informal discussion on "Electricity Supply Tariffs."

Scottish Centre.

February 10th.—J. L. Thompson, "Transformers for Electric Furnaces."

March 9th.—Major K. Edgcumbe, R.E. (T.), "The Protection of Alternating-Current Distribution Systems without the use of Special Conductors."

South Midland Centre.

January 28th.—J. Shepherd, "Failures of Turbo-Generators and Suggestions for Improvements."

February 11th.—Informal discussion on B.E.S.A. Specification No. 72.

Western Centre.

February 2nd.—To be announced later.

March 1st.—Prof. D. Robertson. "Electric Clocks."

April 5th.—Prof. F. Bacon, "Thermionic Valves."

Association of Mining Electrical Engineers.—At the monthly meeting of the Yorkshire branch of this Association, held at Leeds on January 9th, a paper by Mr. Idris Jones, of the South Wales branch, on "Practical Mining Electrical Notes" was read by the president, Mr. R. Holiday. The notes, originally read at Bargoed in March last, were of a technical nature, and had particular reference to points which arise on E.H.T., A.C. systems in collieries, which are linked up and working in parallel. The items specifically dealt with were load and voltage adjustments, increased forces under fault conditions, and the earthed neutral. The president observed that as yet few members in the West Riding had had actual experience of E.H.T. plant, though several were working in the South Yorkshire coalfield.

Faraday Society.—The symposium organised by the president, Sir Robert Hadfield, on Wednesday last week, was highly successful. The exhibition of microscopes and specimens was exceptionally interesting, and valuable information was contained in the papers that were read. Sir Robert, who presided, and afterwards entertained 150 guests at dinner, pointed out the backward state of the British optical industry at the outbreak of war, and the importance of ensuring that such a condition should not recur. All the requirements could be met by the Anglo-Saxon in the near future.

Liverpool Engineering Society.—The society's annual dinner is to be held at the Exchange Station Hotel, Liverpool, at 7.30 p.m., Thursday, February 12th.

National Association of Supervising Electricians.—On Saturday last the annual dinner of the Association was held at the Holborn Restaurant; the President, Mr. J. S. Highfield, presided, and there were 114 guests. The toast of "The King" was given by the President before the sorbet, and at a later stage Mr. A. W. Beaver proposed the health of "The Association," which, he said, was formed in 1914 mainly for educational purposes, but was registered as a Trade Union in 1918, in order to secure representation on the Whitley Councils; however, owing to the veto of the Electrical Trades Union, the Association was not admitted to the Federation, and therefore was not represented at the Trade Union Congress. The Congress was the loser, for the Association represented the brains of the contracting industry. Mr. R. W. Whitley, chairman of the Council, in reply, said that the Association was the finest of its kind, but ought to be more "pushful," and concluded by reading amusing letters which he had not received from distinguished statesmen. Mr. W. J. Revell, in proposing "The President," said that to know him was to love him, and congratulated the Association on his consenting to retain the post for another year. Mr. Highfield, in responding, expressed his pleasure and pride on being invited to be President for a third year; he said the Association had had chequered times in the past, and was likely to have more in the future, but he was certain that out of the chaos created by the war, would be built the finest Empire that had ever been. The prestige of this country had never stood so high, and it was their duty to light the way for the peoples of the world. They could do that by work, but they ought also to laugh—laughter was better than all the arguments in the world. Mr. C. J. Banister proposed "Kindred Associations," with which, he said, the N.A.S.E. was on very amicable terms; it had recently been affiliated to the Federation of Scientific and Technical Societies, which would help it to secure representation on the Whitley Councils. Mr. W. A. Jones responded, and referred to a proposal to form another Federation which would shortly come before the Association, and which would require careful consideration. Hitherto they had met with some opposition, but that was dwindling, and the Labour Unions were recognising the value of the technical men. Mr. Perks proposed "The Press," for which Mr. A. H. Allen responded, and finally Mr. S. P. Ives gave the toast of "The Visitors," which was acknowledged by Mr. Hogan. A musical programme was provided, in which Mr. Jock Walker was especially successful, and the function was thoroughly enjoyed by the members and their guests.

Institution of Post Office Electrical Engineers.—At the annual meeting of the London Centre of this Institution, held on January 19th, at the Royal Society of Arts, the way in which telephone and telegraph communication was kept up between G.H.Q. and the British Armies, corps, and divisions in France was described. Major H. Brown, who was in charge of the work, explained how what he called the Victory line to Germany was constructed. Whenever there was a forward movement, the Signalling Service was responsible for keeping up communications with the Commander-in-Chief's train close to the fighting units. On the morning of the Armistice an order was received from headquarters: "We want 16 wires to the Rhine; get on with it at once." Arrangements were made that night for sending 400 extra men belonging to telegraphic construction companies to assist in the work, together with the requisite stores, transport, and two Pontoon Parks, consisting of 28 four-wheeled drive lorries and 56 trailers, which were very hard to get started and very difficult to stop when once they did start. Lantern slides were exhibited by Major Turner illustrating the methods by which wire signalling was carried on in the Hellas section of the Gallipoli Peninsula, and Captain Read described the work of laying buried cables in order to avoid damage from shell fire.

Edinburgh Electrical Society.—There was a large attendance of members on Wednesday, 14th inst., to hear a lecture on "Anti-Submarine Defence," by Mr. B. Stark. The lecturer sketched the numerous inventions which were first hurriedly evolved to deal with the menace. He gave interesting particulars of the very perfect electrical locating devices which were finally and effectively applied.

The next meeting of the Society will take place in the Philosophical Institution at 8 p.m. on Wednesday, 28th inst., when there will be a discussion on the newly-issued "Regulations for the Electrical Equipment of Ships." The discussion will be introduced by Mr. D. S. Munro.

The syllabus of this society includes the following :—

February 11th. "Petrol Gas Plant for Electrical Engineers," by Mr. G. Plucknett.

February 25th. "Electric Projectors and some of their Uses," with lantern illustrations, by Mr. Alex. Ogilvie, B.Sc.

March 10th. Questions and Answers Night.

March 24th. Visit to Telephone Exchange, Rose Street.

April 7th. Apprentices' Night: short papers on every-day work for Society's prize.

April 21st. "The Telephone," by J. M'Ewan Brown.

April 24th. Visit to Bruce Peebles's Works.

May 12th. Annual General Meeting.

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OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Mr. S. PARSONS, foreman at the Ramsbottom tramways depôt, has been appointed to succeed Mr. J. Wild as manager of the Ramsbottom (Lancs.) U.D.C. tramways.

Messrs. S. C. BARTHOLOMEW and R. M. HOOK, assistant engineers in the engineering department of the G.P.O., have been appointed executive engineers.

The King has conferred the Territorial decoration on the following officers of the London Electrical Engineers: Capt. C. H. R. THORN, M.I.E.E., and Capt. F. H. MASTERS, M.I.E.E.

On leaving Wigan to take up the position of tramways manager at Bury, Mr. F. BUCKLEY, who was formerly tramways manager at Wigan, has been presented with a case of cutlery by the Corporation officials.

The marriage took place on January 12th, at St. Mark's, North Audley Street, of Mr. F. G. BYNG, fourth son of the late Mr. G. Byng, to Madeleine, only daughter of the late Harold Drory and Madame Drory, of Ghent, and Brussels.

Congratulations to Mr. W. V. BALL, O.B.E., one of our esteemed contributors, on his appointment as Assistant Recorder of Leeds.

Corporal (Acting-Sergt.) J. H. POTTERTON, Rifle Brigade, who is now in Spain engaged in the erection of engineering plant for the British Thomson-Houston Co., Ltd., has been mentioned in despatches by Sir Douglas Haig for gallant and distinguished service in the field.

Mr. E. G. BOWERS, M.C., A.M.I.E.E., is leaving the employment of the Glasgow Corporation Electricity Department to take up the position of electrical engineer to Messrs. Bruntons, of Musselburgh.

Mr. A. B. MALLINSON, M.I.Mech.E., has now ceased to act as chief engineer to the group of paper mills controlled from 44, King Street, Manchester. For the present he will carry on his consulting practice from Worsley Street, Salford.

The *Times* states under University Intelligence (Cambridge) that Prof. Sir JOSEPH LARMOR, M.P., Prof. Sir J. J. THOMSON, and Prof. ERNEST RUTHERFORD are among those who have consented to serve as representatives of the University on a joint committee of the Royal Society and the University for the purpose of taking steps to secure an appropriate memorial to the late Lord Rayleigh.

Obituary.—MR. H. T. WAKEMAN.—We regret to record the death of Mr. H. T. Wakeman, surveyor and engineer for the County of Middlesex, which occurred on Sunday night, he having taken hydrochloric acid in mistake for medicine.

The late Dr. C. A. MERCIER, of Bournemouth, left £4,829.

NEW COMPANIES REGISTERED.

English Electric Supplies, Ltd. (162,609).—Private company. Registered January 9th. Capital, £50,000 in £1 shares. To take over the business of the Britannia Lamp and Accessories Co., Ltd., &c. The subscribers (each with one share) are: G. Dickson, 4, London Road, South Benfleet, clerk; F. D. Billett, 7, Trinity Square, Brixton, S.W., clerk. The subscribers are to appoint the first directors. Solicitors: Linklater & Paines, 2, Bond Court, Walbrook, E.C.

Barrett & Wright, Ltd. (162,602).—Private company. Registered January 9th. Capital, £13,000 in £1 shares. To take over the business carried on at 19, Bartholomew Close, E.C., and elsewhere, as "Barrett & Wright," and to carry on the business of electrical and mechanical engineers, manufacturers of and dealers in heating and ventilating machinery, &c. The first directors are: J. Barrett, 5, Woodside Road, Wood Green, N.; R. F. Wright, "Elmhurst," Caversham Avenue, Palmer's Green, N.13. Registered office: 19, Bartholomew Close, E.C.

Oliver Engineering Co., Ltd. (162,770).—Private company. Registered January 13th. Capital, £2,000 in £1 shares. To take over the business of mechanical and electrical engineers and general metal workers carried on by A. H. Oliver and J. O. Dunbabin at 9, Fenchurch Buildings, E.C., as "Oliver & Dunbabin." The first directors are: A. H. Oliver, Campsie, South Avenue, Southchurch, Essex; J. Sulch, 107, Blackhouse Road, Fartown, Huddersfield; F. Lavy, 74, Torbay Road, Brondesbury, N.W.; J. O. Dunbabin, 11, Como Road, Forest Hill, S.E. Registered office: 9, Fenchurch Street, E.C.

Automobile Electrical Repairers, Ltd. (162,841).—Private company. Registered January 15th. Capital, £1,000 in £1 shares. To carry on the business of electrical and mechanical engineers, &c. The first directors are: P. Goldstein, 190, Lordship Road, N.16, engineer; C. F. Collins, 12, Alexandra Road, Southall, electrical engineer. Solicitor: A. Carter, Bedford Row House, W.C. Registered office: 400 Euston Road, N.W.

Telephone and Microphone Co., Ltd. (162,831).—Private company. Registered January 14th. Capital, £10,000 in £1 shares (5,000 cumulative participating preference). To carry on the business indicated by the title. The first directors are: R. Scruby, The Oaks, Benhill Wood Road, Sutton, Surrey; J. R. Scruby, Graigaure, Benhilton, Sutton, Surrey. Solicitors: Rollit, Sons & Compton, 5, Mincing Lane, E.C. Registered office: Throwley Road, Sutton, Surrey.

Renew Lamp Co. (Eastern), Ltd. (162,824).—Private company. Registered January 14th. Capital, £5,000 in £1 shares. To carry on the business of refillers of incandescent electric lamps, &c., and to enter into an agreement with Aladdin Renew Electric Lamp Corporation, Ltd., and J. M. Moore, D.Sc. The first directors are: J. M. Moore, 31-3, High Holborn, W.C.; E. S. Saunders, 69, Lindon Gardens, W.; J. S. W. Milne, 3-4, Great Winchester Street, E.C. Qualification, £100. Registered office: 3-4, Great Winchester Street, E.C.

Hart Collins, Ltd. (162,680).—Private company. Registered January 10th. Capital, £5,000 in £1 shares. To take over the business of Cyril Hart Collins, and to carry on the business of manufacturers of and dealers in motor cars, manufacturers of electrical appliances, motor, electrical and general engineers, &c. The subscribers (each with one share) are: C. Hart Collins, 39, Mayflower Road, Clapham, S.W.9, motor engineer; Mrs. H. M. Collins, 39, Mayflower Road, Clapham, S.W.9. The first directors are: C. Hart Collins (managing director) and Mrs. H. M. Collins. Registered office: 5, Bessborough Mews, Bessborough Street, Westminster, S.W.1.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Litholite Insulators, Ltd.—Satisfaction registered December 2nd, 1919, of all moneys due under charge registered March, 1911. Land registry charge on 57, Hackney Green, Hackney, registered December 2nd, 1919, to secure all moneys due or to become due from the company to Barclay's Bank, Ltd.

Hall & Towns Instrument Co., Ltd.—Debentures for £250, registered November 29th, 1919, charged on the company's undertaking and property, present and future, including uncalled capital.

Lancashire Electrical Engineering Co., Ltd.—Satisfaction registered December 13th, 1919, of charge for £200, registered September 5th, 1917.

Power Engineering Co., Ltd.—Mortgage on land at Westinghouse Road, Trafford Park, Stretford, with buildings, plant, &c., thereon, registered December 4th, 1919, to secure £6,000. Holders: McKechnie Brothers, Ltd., Rotton Park Street, Birmingham.

CITY NOTES.

German Companies.

The report of the *Deutsch-Ueberseeische Elektrizitats Gesellschaft, of Berlin*, whose financial results for the past two years have already been reported (no dividend on the ordinary shares) states that the supply works at Buenos Ayres suffered from an increased extent in 1918 from the effects of the Black List, whilst the difficulties in the supply of coal were greater than in the preceding year. The cost of fuel per kilowatt-hour sold amounted to 0.04 marks in 1914, 0.10 marks in 1916, 0.14 marks in 1917, and almost 0.22 marks in 1918, and the Buenos Ayres undertaking was worked at a loss, coal having been the determining factor in this direction. Concerning the Chilean Electric Tramway & Light Co., the report states that no information had come to hand as to the working results in 1918. The Board of Trade in England had offered for sale the company's holding of ordinary and preference shares, but nothing was known respecting the conclusion of the transaction. An English management had been appointed at Santiago, and had made a legal claim on the German company for the repayment of 16,530,000 Chilean gold pesos, which had been remitted to the latter.

The report of the *Elektrizitats A.G. vorm. Schuckert & Co., of Nuremburg*, whose accounts for 1918-19 were summarised two or three weeks ago, states that the supply works and tramways suffered more seriously than hitherto as a consequence of the effects of the lost war, and the revolution. The possibilities for the construction and working of lighting works and tramways in other countries were closed to German firms for the immediate future. On the other hand, the spirit of enterprise at home was paralysed by the electricity and municipalisation laws coming into existence. The problem therefore arose for extending the scope of activity to new branches; the company made preparations some time ago for this partial transposition, and had entered into relations in various directions which promised to lead to further favourable development. In the case of the foreign investments at Trieste, Petrograd, Barcelona, and Paris, the report mentions that the guiding lines for the settlement of these participations were given in the Treaty of Peace. The company hoped in conjunction with the Siemens-Schuckert works to share in the construction of the Bavarian hydro-electric works which the State of Bavaria had now decided to erect as a State undertaking, and also in the establishment of the works on the Isar.

The report of the directors of *Siemens & Halske, A.G., of Berlin*, for 1918-19 states that only 70 per cent. of the possible working hours was worked by the men after the revolution and the introduction of the eight-hour day. As a consequence the change over from war to peace work was considerably delayed, and it was only possible to satisfy a small portion of the great demand for the company's manufactures both at home and abroad. The conclusion of contracts with long periods for delivery was rendered difficult, particularly abroad, by the fluctuations in German exchange, and the uncertainty in the calculation of the costs of production. The activity of the leading officials was largely withdrawn from productive work by worrying negotiations. The number of workers was increased in the first part of the financial year, but subsequently receded to the former peace-time level; and the number of hours worked declined from 120,000,000 in 1917-18 to 78,500,000 hours last year. Nevertheless the company's expenses for wages and salaries, and those of the Siemens-Schuckert Works rose from 208,000,000 marks in 1917-18 to 254,000,000 marks last year; and these expenses were in course of permanent increase in the new financial year. The gross profits are returned at 15,736,000 marks for

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1918-19, and the net profits at 11,457,000 marks, these comparing with 17,750,000 marks and 13,954,000 marks in the preceding years respectively. It is proposed to pay a dividend at the rate of 12 per cent., being the same rate as in 1917-18. The report states that it cannot be foreseen what development the works will take as a consequence of the Treaty of Peace, the taxation burdens, and the impending legal regulation of labour conditions; but serious times are pending for German industry.

Chatham & District Light Railways Co.—Revenue for the year 1919, £78,840; expenses, £52,615. Rent of Rochester Corporation lines £3,744, interest account £2,172, to reserve for depreciation £6,000. Including the balance brought forward (£3,802), the balance is £18,061. After paying 5 per cent. preference dividend and 4 per cent. on the ordinary shares, £308 is voted to the directors and £3,393 is carried forward. As compared with 1918 there was an increase of £11,497 in revenue and £14,069 in expenses. £3,394 was expended on deferred repairs. Passengers carried 16,197,991, against 14,015,124. Car mileage 979,983, against 790,799.

Liverpool Overhead Railway Co.—Final dividends at the rate of 5 per cent. per annum (less income tax) on the preference shares, and 4 per cent. per annum (less income tax) on the ordinary shares, making 5 per cent. on the preference shares and 3¼ per cent. on the ordinary shares for the year. Meeting, February 24th.

Electrical Utilities Co.—Quarterly dividend of 1¼ per cent. on Preference stock.

Shanghai Electric Construction Co., Ltd.—Second interim dividend at rate of 6 per cent. actual (12s. per share), less tax, in respect of year 1919.

Greenwood & Batley, Ltd.—Interim dividend of 5 per cent. on the ordinary shares.

Montreal Companies.—Quarterly dividends of 1¾ per cent. on the Montreal Light, Heat and Power Consolidated Co. and 2 per cent. on the Montreal Light Heat and Power Co.

STOCKS AND SHARES.

TUESDAY EVENING.

THE Stock Exchange is certainly having the time of its present life. Business does not roll, it pours, into industrials. Nor are gilt-edged issues neglected. Substantial premiums have been established upon various new Colonials, and this has its effect in stiffening purely investment stocks in other markets. The favourable influence produced upon Russian descriptions by the suggested raising of the blockade is another factor in the general situation. In the mining sections, the prices of base-metal shares are better. The rubber market is quiet, its claims overshadowed by the potency of the spell cast by the oil boom over imagination and money.

Mexican affairs are amongst the few disappointments of to-day's markets. Prices were suddenly rushed up a fortnight ago, certainly on flimsy grounds, but with hopefulness eagerly expectant of early return from chaos to order in the country. And nothing has happened. The consequence is that prices are subsiding—rapidly as regards the railways, in more dignified fashion amongst the Utilities. In fact, the reaction in such issues as Mexico Tramways, Mexican Light and Power, Monterey, Pachuca and others of similar character has been very trifling compared not only with the previous rises but also with the setback in Mexican Railway stocks. It is evident that proprietors of the Utility Companies are ready to keep their stocks until such time arrives as will indeed bring peace to Mexico.

British Columbia Electrics are rather better, but the main feature in this department is the further improvement in Anglo-Argentine Tramways. Upon the comments made here last week with reference to the effect which the fare-raising should have on the dividend arrears, the first preference advanced to 4½, seconds to 3¾, while the 5 per cent. debenture stock rose a point to 65½. This last-named may now be considered a sound investment security of the second rank, and it is not surprising that stock should be none too easy to buy. Brazilian Tractions are easier at 59. No particular recovery can be expected here so long as the possibilities of early German sales are worrying the market. Brazil is going ahead rapidly, but Germany and Austria both held Brazilian issues before the war, and the Stock Exchange looks for sales of such securities as soon as international freedom of financial business is restored to pre-war conditions.

The market for electricity supply shares is steady enough, but there is not much change. Metropolitans continue to improve, and at 3 3-16 show 1-16 rise, though on the other hand South Londons at 2⅛ are equally lower. The tendency to exchange from preference shares into ordinary and therefore more speculative issues, continues to be one of the features in the Stock Exchange. This may explain a drop in County preference. Shares changed hands the other day at 8¼, and the nominal price is 8⅞ middle. Considerable activity prevails in Edisons. It is said that some good news or other is on the point of being published which will have the effect of putting up the shares to 30s. at least, but there is no official information so far.

Manufacturing shares as a whole are quite a good market. Callenders are throwing off their recent weakness, and after their jump of 7s. 6d. last week have advanced another 10s. British Insulated at 2 3-16 are ⅛ higher. Electric Constructions at 1 3-16 are also up half a crown. A further rise carried Siemens to 30s., so that anyone who has bought either Siemens, Edisons, or British Insulated on recommendations given here from time to time is not likely to be dissatisfied with the present position of his stocks. Nor does there seem to be any particular hurry to sell unless the holder thinks he sees something more attractive elsewhere. It must be borne in mind that this is the day of big combines, and that the shares of any company likely to form a partner in amalgamation schemes can be held with tolerable assurance of improvement in value. British Aluminiums at 35s. are slightly lower. General Electric preference shed 6d., which was picked up by the ordinary—another minor illustration of the trend of investment nowadays.

The railway market is better, though confidence declines to support stocks to any great extent. Underground Electric income bonds have regained 2½ points. Metropolitans are also stronger, but there is no movement in the other electrical railway issues.

Apart from ex dividend markings, the prices of telegraph and telephone shares exhibit little change on the week. There is a dullish tone about the Marconi group, the parent shares being ⅛ down, and other declines leaving Marconi Marines 2⅛, Canadians 13s., and Americans 30s. 3d. The market is out of fashion for the time being, and rumours lately current with reference to possible agreement-of-interest schemes between some of the subsidiaries have been allowed to fade away, so far as market influence is concerned. Automatic Telephones, too, are quieter, the price remaining about 35s. The rubber share market, as already indicated, fails to make headway against the superior attractions offered to the speculative mind by the vitality of the oil list.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1917.	Dividend 1918.	Price Jan. 20, 1920.	Rise or fall.	Yield p.c.
HOME ELECTRICITY COMPANIES.					
Brompton Ordinary	10	8	5¼	—	£6 16 2
Charing Cross Ordinary	4	4	3	—	6 13 6
do. do. do 4½ Pref.	4½	4½	2⅜	—	8 8 8
Chelsea	5	5	3	—	5 0 0
City of London	8	8	13	—	6 3 1
do. do. 6 per cent. Pref.	6	6	9¾	—	6 6 4
County of London	7	7	9⅜	—	7 9 4
do do. 6 per cent. Pref.	6	6	8¼	—⅛	6 15 2
Kensington Ordinary	7	6	4⅜	—	6 6 4
London Electric	Nil	Nil	1⅜	—	
do. do. 6 per cent. Pref.	5	6	8⅜	—	8 17 10
Metropolitan	4	5	3 3/16	+ 1/16	7 16 10
do. 4½ per cent. Pref.	4½	4½	2¾	—	7 16 6
St. James' and Pall Mall	9	10	6	—	8 6 8
South London	5	5	2⅝	— 1/16	7 12 8
South Metropolitan Pref.	7	7	1	—	7 0 0
Westminster Ordinary	9	8	5⅛	—	7 12 5
TELEGRAPHS AND TELEPHONES.					
Anglo-Am. Tel. Pref.	6	6	89½xd	—	6 14 1
do. Def.	1½	88/6	21½xd	—	7 1 2
Chile Telephone	8	8	6½xd	—	6 8 0
Cuba Sub. Ord.	7	7	10¾	—	*6 18 4
Eastern Extension	8	8	15⅞xd	—	*5 0 10
Eastern Tel. Ord.	8	8	164½xd	—	*4 17 3
Globe Tel. and T. Ord.	7	8	16⅜	—	*4 19 8
do. do. Pref.	6	6	9⅜	—	6 8 1
Great Northern Tel.	22	22	23½	—	9 7 2
Indo-European	18	18	48½	—	6 18 4
Marconi	20	25	4 1/16	— ⅛	5 19 4
Oriental Telephone Ord.	15	10	2 1/16	+ 3/16	4 11 6
United R. Plate Tel.	8	8	7 1/16	+ 1/16	*5 8 8
West India and Panama	1/8	1/8	1⅛	+ 1/16	Nil
Western Telegraph	8	8	17	—	*4 14 2
HOME RAILS.					
Central London Ord. Assented	4	4	58½	—	6 16 9
Metropolitan	1	1½	26½	+ ½	4 18 6
do. District	Nil	Nil	21	—	Nil
Underground Electric Ordinary	Nil	Nil	2⅞	—	Nil
do. do. "A"	Nil	Nil	7/6	—	Nil
do. do. Income	4	5	86½	+2½	*5 15 7
FOREIGN TRAMS, &c.					
Adelaide Sup. 6 per cent. Pref.	6	6	87	—	7 14 10
Anglo-Arg. Trams. First Pref.	5½	Nil	4⅛	+ ⅛	—
do. do. 2nd Pref.	—	—	8⅞	+ ⅛	—
do. do. 5 Deb.	5	5	65½	+1	7 13 8
Brazil Tractions	—	—	59	—1	—
Bombay Electric Pref.	6	6	13⅜	+ ¼	4 7 3
British Columbia Elec. Rly. Pfce.	5	5	60¼xd	—	8 5 4
do. do. Preferrred	Nil	2½	56½	—	4 8 9
do. do. Deferred	Nil	Nil	52½	—	Nil
do. do. Deb.	4½	4½	£4	—1	6 15 0
Mexico Trams 5 per cent. Bonds	Nil	Nil	46	—	Nil
do. 6 per cent. Bonds	Nil	Nil	35½	—1	Nil
Mexican Light Common	Nil	Nil	22½	—	Nil
do. Pref.	Nil	Nil	35	—	Nil
do. 1st Bonds	Nil	Nil	56	—2	—
MANUFACTURING COMPANIES.					
Babcock & Wilcox	15	15	8⅜	—	*4 9 0
British Aluminium Ord.	10	10	1⅜	— 1/16	5 14 3
British Insulated Ord.	25	12½	2 1/16	+ ⅛	5 14 2
Callenders	25	25	9⅛	+ ⅛	6 17 0
" 6% Pref.	5	6½	4⅞	—	7 2 1
Castner-Kellner	25	20	3¼	—	3 15 7
Crompton Ord.	7	10	21/6	—	9 6 0
Edison-Swan, "A"	—	10	1⅜	+ 1/16	7 5 0
do. do. 5 per cent. Deb.	4	5	79½	—	6 5 9
Electric Construction	10	10	1 3/16	—	8 8 8
Gen. Elec. Pref.	6	6½	19/-	—	6 13 6
do. Ord.	10	10	42/-	+1/-	*4 15 3
Henley	25	25	2½	—	5 11 1
do. 4½ Pref.	4½	4½	8⅜	—	6 4 2
India-Rubber	10	10	16	—	*6 5 0
Met.-Vickers Pref.	—	—	21⅜	—	5 14 0
Siemens Ord.	—	10	30/-	+1/6	*6 13 4
Telegraph Con.	20	20	26½	—	*4 10 6

* Dividends paid free of Income Tax.

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THE PHYSICAL SOCIETY'S EXHIBITION.

(*Continued from page* 90.)

The Zenith Manufacturing Co. showed a variety of regulating resistances and rheostats, of the slate and tubular patterns, for use in test rooms and laboratories; these were of improved design, particularly in respect of the arrangement of the end supports and the method of clamping the wire. The support is provided with a clamping ring which

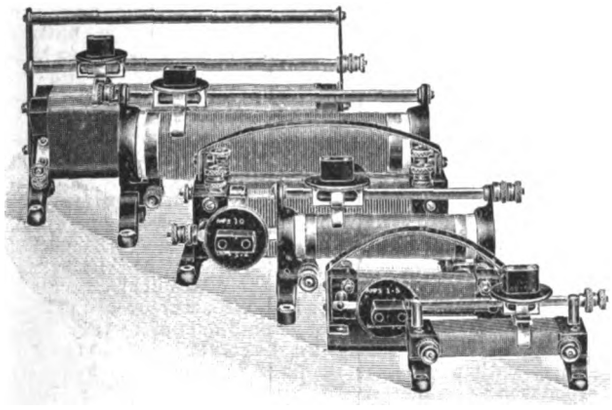

Fig. 5.—Zenith Rheostats.

automatically fits the tube, a recess which prevents end movement, and a projecting lug which definitely anchors the band which surrounds the end turns of the wire, besides rigidly supporting the terminal, and thus making a sound mechanical job. A group of rheostats, of the cruciform and square slate and enamelled-iron tube pattern, is shown in fig. 5.

Another exhibit was an improved type of magnetic vibratory rectifier, suitable for small outputs (up to 75 watts), for charging small lighting and starting battery equipments

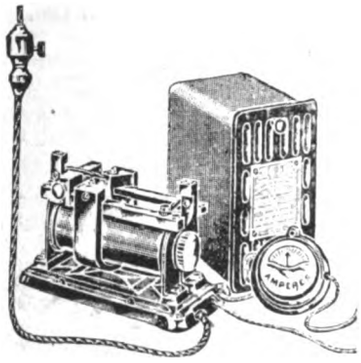

Fig. 6.—Vibrating Rectifier, with Cover Removed.

from A.C. circuits. By the aid of a permanent magnet, the reed is set in synchronous vibration, adjustment being provided to tune the reed; adjustable carbon contacts are fitted, and both half-waves are utilised. The device, which is shown in fig. 6, can be connected to a lamp holder, and needs no attention.

Messrs. Edison Swan Electric Co., Ltd., had on view a series of service valves for wireless reception and transmission, including Marconi valves made by the firm of the V24, Q, Round, and other types of receiving valves, as well as three types of transmitting valves. Scott Taggart-Ediswan double-anode, full-wave rectifying valves for low and high powers, also a continuous wave transmitting valve for use with alternating current without separate rectifiers were to be seen. A high-power rectifying valve for passing heavy currents at low anode potentials which, it is claimed, will pass twice the energy of ordinary rectifiers having the same size of bulb was also exhibited, while in conjunction with Mr. H. W. Sullivan, a receiving set was installed and shown in working order. Finally, a selection of various sizes of tungsten-arc, gas-filled Pointolite lamps, as recently described in our pages, was on view, some of the smaller sizes being alight to demonstrate the method of striking the arc on switching on the lamp.

Messrs. Nalder Bros. & Thompson's exhibit included the "Ohmer," the N.C.S. dead-beat moving-coil paralleling voltmeter, a portable testing set, and a portable sub-standard instrument. The voltmeter shows the difference between the busbar voltage and that of the incoming dynamo, and by means of a key the sensibility can be increased ten-fold, so that great accuracy is attained at the critical moment. The portable testing set comprises two dead-beat m.c. instruments mounted in the same case, together with ammeter shunts and voltmeter resistances, the combination being designed to secure speed and accuracy of measurement, with the maximum convenience in connecting up. The portable substandard is a high-class m.c. instrument in an aluminium case, and is built in accordance with the specification of the British Engineering Standards Association for sub-standard accuracy.

The High Tension Co. exhibited a selection of some of the apparatus it manufactures; for instance, there were to be seen 0.5 and 1.5-kw. transformers and 10-in. induction coils for wireless purposes, as well as a 16-in. coil of improved design with interruption for X-ray and general purposes. This firm prefers to design each coil for the particular purpose for which it is used, and regards them as commercial transformers of energy, and they are, therefore, not labelled with fancy names. If required statements of output and oscillograms of wave form are supplied. All coils are designed to work normally with a frequency of interruption of 50 breaks per second, the time economy being 0.5, that is, when the period of make equals the period of break. An entire absence of inverse is claimed unless the coil is pushed to its extreme limit. The secondaries of all coils are wound by hand and insulated by a patented method; any coil can be insulated with special high melting point wax, such as is demanded for use by the Indian Government, without extra cost. A high-tension transformer suitable for wireless, spectroscopy, diathermy, or testing is shown in fig. 7, while the M.I.R.A. motor-driven turbine interrupter shown in fig. 8 embodies several new features. Being driven from beneath, the jet cone and contact segments are easily accessible by simply raising the lid, which may be of glass through which to view the apparatus while running. The jet cone can be removed at once by unscrewing the milled headed screw holding it in position. The ratio of make to break can be varied by turning the exterior milled ebonite head. The frequency of interruption can be increased from 1 to 80 per

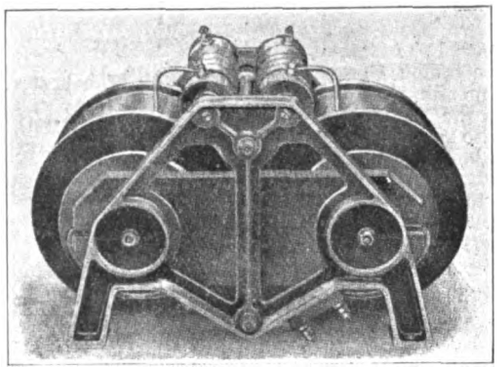

Fig. 7.—High-tension Transformer.

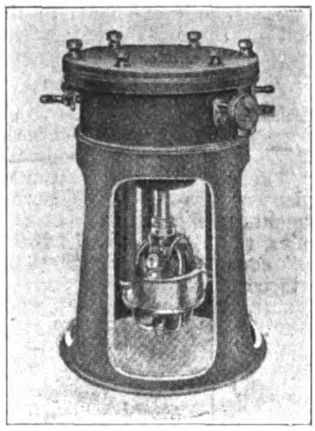

Fig. 8.—Motor-driven Turbine Interrupter.

second with the two-segment, or from 2 to 160 with the four-contact type of apparatus. The maximum current passed should not exceed 40 amperes, but over half this amount may be passed for hours without overheating the break.

The Weston Electrical Instrument Co., Ltd., had a varied show of its well-known standard and portable instruments—ammeters, voltmeters, wattmeters, &c.—in a variety of sizes and patterns. A millivoltmeter of the moving-coil type is designed for use with a standard thermo-couple, giving a full scale deflection with 18 millivolts; a rheostat for compensating for the resistance of the thermo-couple is provided, to keep the total resistance of the circuit constant. The scale can be calibrated in degrees of temperature, F. or C., in addition to the millivolt scale. The combination can be used for any purpose for which an ordinary thermometer is used.

A novel instrument that was shown was the direct-reading microfaradmeter, a type of meter that we had not previously met with; for quickly measuring the capacities of condensers, cables, aerials, &c., this device will have a wide field of utility. It is made for various frequencies and voltages, but is unaffected by wide variations of these factors from the normal. The moving system of the instrument consists of two moving coils wound upon the same staff, and two field coils arranged somewhat similar to a Weston power-factor meter. The instrument also contains a standard condenser and binding posts to which the unknown condenser is to be connected. The current through the standard condenser passes through both moving coils, and also the field coils, thus causing the pointer to deflect 45 deg. to the left of the position shown in fig. 9, or on to the zero of the scale,

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when an unknown condenser is not connected to the instrument. When a condenser is connected to the terminals marked x, the current through it also traverses one winding of the moving coil, and also the fields of the instrument, thus causing the pointer to deflect to the right. The constants of the instrument are so arranged that the ratio of the two currents flowing through the standard and the unknown condenser is substantially the same for any frequency and voltage over fairly wide limits, but for highly accurate work the voltage should not vary more than 15 per cent. above or below normal, or the frequency more than 10 per cent. As

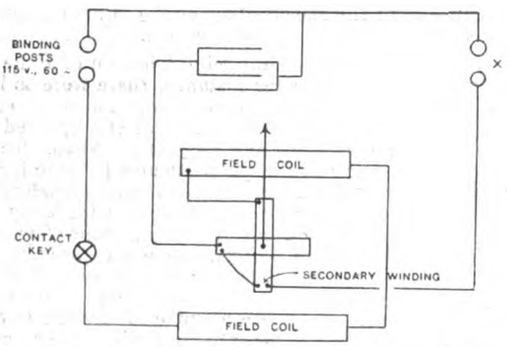

FIG. 9.—WESTON MICROFARADMETER; DIAGRAM OF CONNECTIONS.

the instrument has no springs or similar controlling device the position of the pointer must depend solely upon the ratio of the currents through the two circuits of the movable system, and as this ratio depends solely upon the capacity of the unknown condenser, the instrument must accurately measure that capacity, and is guaranteed to do so within ½ per cent. of the maximum scale reading. Being air-damped, the pointer quickly comes to rest, so that measurements may be made with the same speed and facility as with other Weston measuring instruments. Indeed, with the microfaradmeter a large number of condensers may be measured in rapid succession, in the same manner as dry cells may be tested with a cell-testing voltmeter.

A resistance (not shown in the sketch) is included in the circuit of the instrument, which will prevent an excessive amount of current passing through it in case the binding posts marked x are short-circuited.

MESSRS. ISENTHAL & CO., LTD., showed rheostats of the slider pattern and multiple-stud types, including the new "Post-multiple-stud types was shown, including the new "Post-war" designs. A new feature was the "Phantom" wireless condenser—a variable condenser with a coarse and a fine adjustment, reading directly in wave-lengths with the aid of a vernier, to an accuracy of 1 in 1,000. An auxiliary or "phantom" condenser is embodied in the instrument, which is set to correct for "plate-end" and leakage capacity in the instrument itself, and a simple adjustment is provided for com-

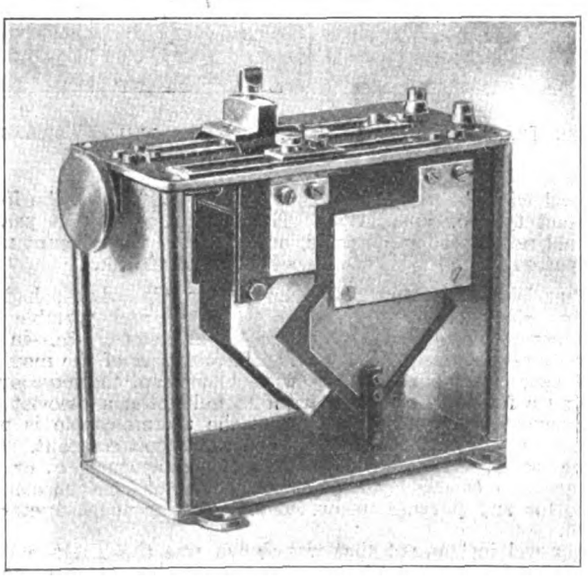

FIG. 10.—ISENTHAL "PHANTOM" CONDENSER.

pensating for the effective capacity of the circuit in which it is used. The instrument (fig. 10) is of the rectilinear sliding type, very accurately made and finished, and is (normally) electro-statically screened by completely enclosing the plates in a metal case, the moving sets of plates being connected permanently to the box. By connecting the moving plates to the screen, capacitance from one set of plates to the other through the screening medium is made a constant quantity, and can be corrected by a permanent adjustment. Error due to the linking electrostatic field between the outside plates is reduced to a negligible quantity by employing a total plate area which is large compared with the area of a single plate. Another error due to additional capacity introduced by the plate edges is reduced to a minimum by the use of extremely thin metal plates, and by the fact that, owing to the shape of the plates, the edge area is always maintained small in relation to the effective capacity of the instrument on any setting. The main and small "phantom" condensers are both variable and connected in parallel. The main condenser plates are square except for one corner of each, a small portion of which is cut off transversely to the diagonal. The plates are mounted so as to be adjustable along their concurrent diagonals, so that their area, and capacity, vary according to the square of the distance traversed by the moving plates, plus a constant due to leakage, and minus the absent area due to the portions cut away. The auxiliary condenser is normally set to correspond with the "absent" area, minus an area representing a capacity equivalent to the resultant leakage effect. After this adjustment has been made the effective capacity of the instrument varies accurately according to the square of the relative traverse of the plates along their diagonal. Square plates traversed diagonally were originally proposed by Tissot. When the instrument is connected to an oscillatory circuit, a small subtractive adjustment is made with the "phantom" plates in order to compensate for the distributed capacity of the coil or coils of the circuit, and the accuracy of the scale is thereby maintained under any conditions of service. Tests made by the National Physical Laboratory give a straight line curve with main scale readings as abscissæ and capacity wave lengths as ordinates. In future instruments the "phantom" scale will be calibrated in micro-microfarads, the scale readings corresponding to the distributed capacity in whatever circuit it is intended to use the instrument in. Once this capacity has been determined, it is only necessary to set the "phantom" pointer to the value obtained. In a series of trials on various wave lengths the actual decrement in a wavemeter due to the present condenser was so small that it was difficult to obtain a reliable series of figures.

(To be continued.)

SCIENTIFIC MANAGEMENT: A SOLUTION OF THE CAPITAL AND LABOUR PROBLEM.

DISCUSSION AT MANCHESTER.

At Manchester, on December 16th, Capt. J. M. Scott-Maxwell's paper, an abstract of which appeared in our issues of December 19th and 26th last, was read, and discussed by the NORTH-WESTERN CENTRE of the INSTITUTION OF ELECTRICAL ENGINEERS.

Mr. H. MENSFORTH disagreed with many opinions expressed in the paper. Science was not going to put industry right. What had been lacking in the past was humanity, and so far as he had read Dr. Taylor's writings on scientific management there was a lack of humanity through them all. The human element must come before any system. Dr. Taylor said that the principal object of scientific management was to produce the greatest prosperity for the employer and the employé. There was another thing that he should have included: it must be to the common good of the community. The whole idea at the back of Dr. Taylor's mind was to set up task work, and however successful he might have been in the States, he (the speaker) did not think scientific management could be established here on those lines. Such schemes as the author had put before them could not be adopted with the present state of feeling among the people. They would not have men who did all the brainwork for them, and left nothing to their intelligence, but expected them to move simply as they were told. Imagine a works where the workmen were responsible to eight different men! It was not possible. They already had shop committees consisting of a combination of trade union representatives and of the management, and if they could get the proper atmosphere (which, to his mind, would not be got with slide rules or stop watches), he believed they could get the output they needed without stultifying the brains, and making beasts of the men who were working for them.

Mr. A. R. STELLING was glad that the Council was encouraging discussion on the question of improved industrial administration, but thought the paper ought not to be called "Scientific Management," but rather "Idealised Taylorism. Since Dr. Taylor's views were brought to this country and studied by employers they had developed a British scientific management which aimed at getting the maximum output from the factory, which was a totally different thing from getting the maximum output from the individual. All through the paper emphasis was laid on the output of the individual. He regretted that there was no mention of the excellent work done by Prof. Kent, by Dr. Vernon Hill, Dr. Collis, and other engineers. British scientific management recognised that Taylor's four great principles were as true to-day as they were 30 years ago. Those principles were: (1) The study of the job. (2) The selection, training, and development of the worker. (3) The hearty co-operation of

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the worker. (4) The adequate division of the responsibility. They started with the study of the human factors, the conditions which surrounded the worker and the management, and generally the condition of the factory. His definition of scientific management was the elimination of all forms of waste, the waste that followed from people rushing about doing things which it was not their business to do, instead of the whole thing being properly thought out and methodically arranged; waste of energy and vitality, men doing work for which they were not fitted or which was too hard for them; waste of skill; waste of time in moving work about the shop. British scientific management would overcome all that by methods which were intensely human and directed by common sense. They wanted a square deal between the men on the one side and the employer on the other, perfect frankness and perfect agreement over what was going to be done. Those were the lines of British scientific management. If capital and labour would come together scientific management would formulate a programme and put it on the table. From that point of view he thought it ought to be studied.

Mr. ALLCOCK said that there was a feeling that, underlying the whole basis of Taylorism was a kind of German regimentation to which they all felt very much opposed. It seemed preferable to work along the lines advocated by the Higher Production Council. The underlying principle was that the whole of the workshops of a particular description would work together. They ought to encourage the team spirit rather than the driving of the individual. He shared the views advanced by Mr. Mensforth about the danger of dehumanising industry. The Higher Production Council quoted as one of the examples in support of its proposal the scheme introduced, he thought, by Priestman Bros., of Hull. They assessed in agreement with their workers the standard output of their particular works. Assuming the standard output was 100 tons per week or per month, if that was increased by 20 per cent., the wage of everyone in the establishment, from the managing director to the office boy, was in the next month increased by the same percentage. That had all the elements of simplicity. There was no room for suspicion on the part of the worker, and he had very tangible results very soon after he had earned them. That was a very important point, because the average working man did not appreciate any scheme for his better pay unless he got it on the Friday night, and every Friday night. He did not appreciate a proposal of profit sharing which might result in his receiving 5 or 7 or 10 per cent. dividend at the end of the year. The only way to increase their output—and output must be increased if they were to maintain the present high wages—was some method of payment by results, and that payment should immediately follow the effort.

Mr. PILLING was in general agreement with the criticisms already expressed on the paper. He very much questioned whether any good was done to an industry by driving men to the utmost possible effort in an almost inhuman kind of way, with the necessary result that very high wages had to be paid. In these days most people were agreed that capital and labour were equal partners after a certain point had been reached. He was not prepared to agree that profit sharing was really unsatisfactory. Workmen, while quite willing to participate in profits when profits were being made, were not prepared to participate in a reduction of the profit when it was a falling profit, and still less when no profit was being made. The question, therefore, arose: Was it possible to have a profit-sharing scheme so arranged as to remove that most serious obstacle? He suggested that in each industry a certain standard profit should be agreed upon—a reasonable profit to the capitalist. When the amount of that profit was exceeded the surplus should be divided into two parts, one of which was to pass to the capitalist at whose works they were made, the other part to the workers who had made them. The distinctive feature of his suggestion was that the profit should not pass to the workers in the place where it was earned, but into a common pool, and the common pool should be held in trust by some administrative board for the benefit of the workers to be distributed in some way to be mutually agreed upon. He would earmark the first distribution for the relief of unemployment. The evil of the present situation was that the workman thought that excess profits were being made by the capitalist, and that he was not getting his proper share of them. Under the system that he had suggested the workpeople in all establishments would benefit to an equal degree in the prosperity of the industry. It would never do to let the surplus earnings go to the workpeople at the establishments where they were earned; they must necessarily be distributed as a common pool, otherwise discontent would be rampant all round.

Mr. SANDS was quite in accord with the views expressed by previous speakers regarding the human side of the business; the psychology of the worker was almost entirely left out. In connection with time studies the author referred to the question of the first-class man. In general the first-class man was superseded right away on repetition work by a girl who had been on the job for two or three months. The portion of the paper relating to scientific individualism *versus* Socialism, to his mind, was grossly unscientific; it developed an irrelevant and unnecessary controversy. The true view of scientific management was that it was the replacement of tradition and rule of thumb by considered methods based upon a study of the problem. He held the average British workman in high esteem, and he did not think it was altogether in keeping with their prestige as scientists that they should start him on scientific management with a scathing condemnation of the present labour leaders. In due course, if they could pursue the right path, as they could do with scientific management, he would be man enough to see it and admit it in the long run.

Mr. A. P. M. FLEMING said that under the Taylor system the selection of men was very rigid and exacting. What happened to the rejects? To those who might not have had occasion to study the literature on the subject he would utter a word of warning against the flood of literature that was being poured out in book form nowadays on the subject, not necessarily under the heading "scientific management" but also under other headings, such as industrial administration and kindred subjects; much of that came from the States, and a large proportion of it was absolute piffle.

Mr. J. G. PEARCE thought that the chief reason why scientific management had relatively failed in the United States was not because the principles were not valid, but that they had been applied dogmatically to all sorts of plant irrespective of local conditions. Some aspects had been grossly overdone; others had been neglected. British employers did not mistake an organisation chart for organisation or a diploma in industrial administration for a qualification for management. Scientific management must be judged entirely by its results. Scientific management was not a code of rules which could be mechanically applied, and Taylor and others by making extravagant claims had done a great deal to hinder the inevitable development of this science of organisation and the recognition of the technique of management as distinct from the practical side. To his mind, Emerson's system was much more elastic than that of Dr. Taylor, and much more congenial to British people. No change in management could be made without the knowledge and willing consent of the workers, and that must be based first of all on confidence. Education, particularly in economics, would do much to establish that confidence. Through industrial research they got that systematic progress in materials, processes, and designs which had been too frequently excluded in the discussion of scientific management in the few fully documented instances that they had of scientific management being applied to factories. They did not know even now to what extent the improvement was due to improved organisation, and to what extent it was due to the employment of better materials and better processes such, for instance, as high-speed steel.

Mr. J. D. PATON thought that Dr. Taylor should have the credit of being the originator of the movement, and that he had handled the subject in a plain honest way. He challenged any manager who had tried to introduce an innovation in his shop to say that he ever got it going on a voluntary basis. Dr. Taylor had handled the problem with judgment and they wanted to handle it in the same way. He had not forgotten the human element.

Mr. G. A. JUHLIN believed that one of the big factors, and one which had not been emphasised sufficiently, was the question of education. It was, to his mind, utterly futile to set up a Board of Scientific Management and to try to impose on an uneducated man certain so-called scientific facts. When labour said quite plainly: "We are not prepared to produce for the profit alone of a certain class," he did not think that scientific management was likely to achieve the desired result.

Capt. SCOTT MAXWELL, in reply, said that the humanising of industry was the one thing he meant to consider, yet he was now told it was the very thing that scientific management could not possibly do. Dr. Taylor said that the attitude of the workpeople was of primary importance. Dr. Taylor recognised that the muscular type of man should have sufficient intelligence to know how to do his work, and he cultivated that intelligence so that the man with less effort could do nearly four times as much work, and he got very much more pay. Could it be said that that was eliminating the intelligence of that man? Anyone who had lived in America must know that scientific management and bad labour conditions had nothing to do with each other. It was because the conditions were so shockingly bad in America, because the employer there was two generations behind the British employer in his attitude towards labour, that it was almost impossible to adopt scientific management. It must not be adopted by any employer who had still the idea in his head that his chief function was to exploit the worker. Mr. Mensforth spoke about taking orders from eight people; but really the workman had to take orders from only one of those persons. Where they had proper planning and everything else, disciplinary orders were not needed to anything like the same extent. The foremen were more like instructors in the works. Taylor doubted the trade unionism in America as he knew it, but he was not opposed to trade unionism, and he wanted to improve the lot of the worker. The employers had given far more opposition to the movement than the men themselves. Mr. Stelling advocated team work and getting the maximum output from the factory rather than from the individual; well, a team was an aggregation of individuals, and if every individual in the factory did his best it seemed to him that they got the maximum output. Scientific management made a square deal possible because it enabled them

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to measure the work done, and when they had measured it a square deal could be made between capital and labour, but they could not while each was trying to bluff the other. Socialists believed scientific management was a good thing, but they would not have it under the capitalist system because if it were adopted there would not be much chance for socialism for many generations to come. His ultimate object was to eliminate waste so that the workers might produce the same amount (or more) with about half the effort. A 30-hours' week was a possibility. He believed that work and the creation of wealth should be so easy that the ownership of wealth would cease to give prestige. Under the present conditions it was impossible for the workers to make enough money or have enough leisure to improve themselves. He wanted the work to be very much shorter and the money to be very much higher. With scientific management driving was absolutely unnecessary. If one went into a factory organised on the Taylor system one would think the men were all very slow. If they eliminated one half the work as useless, they could go fairly leisurely about the remaining half. The only drive was the desire of the men to make more money. They wanted far more education. There was no question about that—not for workers only, but for everyone—but he could not see that that affected the worker. Management in the past had been very inhuman, and scientific management was the first form of management that had really paid very great attention to the worker. Taylor thought the demand for scientific management would come from labour.

FAILURES OF TURBO-GENERATORS, AND SUGGESTIONS FOR IMPROVEMENTS.

By J. SHEPHERD, M.I.E.E.

(*Abstract of Paper read before the* INSTITUTION OF ELECTRICAL ENGINEERS.)

(*Concluded from page* 93.)

The water path is along the shaft from beyond the exciter with helical flow under the cooling support for the end loops, along the hollow teeth to the other end of the rotor, helically under the second support for the end loops. The water discharge could be arranged either at the flanged coupling as in fig. 9, or could be continued through the turbine rotor shaft to the water sealing gland at the low-pressure end of the turbine.

Fig. 6 is a section of the stator with two types of coil supports, one for the end windings and fixed at the ends of the core, and the other built into the core between batches of laminations. The latter support is constructed with the

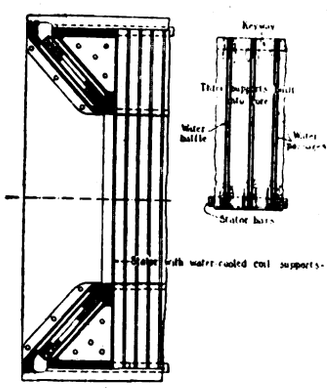

FIG. 6.—STATOR WITH WATER-COOLED COIL SUPPORTS.

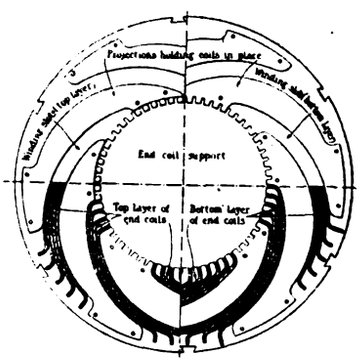

FIG. 7.—DETAILS OF WATER-COOLED END-COIL SUPPORTS.

inner part laminated to reduce eddy currents, and yet of considerable strength to clamp the portions of the stator bars it embraces and gives considerable stiffness to the core teeth. The hollow interior is divided by a diaphragm into flow and return water passages.

The two pairs of end coil supports at the ends of the stator are shown in section with the two layers of end connections clamped between them.

Fig. 7 shows an end elevation of the stator end (inner) coil support, the bottom quadrants of which illustrate respectively the under and upper layers of the end windings. The two upper quadrants show the supports without windings, and with the clamping projections in place, forming between pairs of them the winding recesses for a group of end connections, one bar per slot winding.

Fig. 8 is a part section of such a winding recess, with four end connections in place, supported by the projection on each side. It shows the coils clamped directly over a water-cooling duct cast in the support and enclosed by a metal plate fusion-welded in place. The plate must have considerable mechanical strength and high electrical resistance. Copper-nickel alloys are on the market, which are as strong as high-quality bronze, and have over 20 times the electrical resistance of copper. Their use would reduce the stray currents to a comparatively insignificant loss.

When arranging the water circulating system, due regard must be paid to the risk of corrosion and to the recommendations of the Corrosion Committee of the Institute of Metals, viz.:—

(1) Only clear water to be used.
(2) Water to be free from gases in suspension or solution.
(3) Water must be neutral, or only very slightly alkaline.

To comply conveniently with these recommendations, the cooling water is taken from the condensate of the steam turbine, forced by the extraction pump through the cooling devices of the alternator and discharged into the turbine hot-

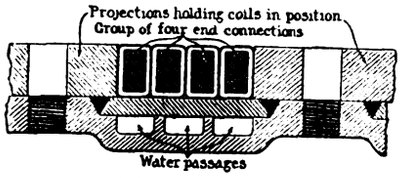

FIG. 8.—WATER-COOLED WINDING SLOT ON END STATOR SUPPORT, With copper tapes as heat conductors.

well. The whole of the heat losses in the alternator would then be utilised. With modern high vacua the temperature of the condensate is from 70 deg. to 80 deg. F., which temperature would then receive an increment of from 13 to 15 deg. F.

The return flow of each water path is shown provided with a thermometer pocket, and by reducing the flow in any particular cooler a close indication of the maximum local temperature can be obtained.

The object aimed at in all the designs described is to interleave the conductors with liquid-cooled supports, thus providing continuous winding slots for the coils, coil loops and end connections, &c., in which the weakest and most frail bar (no matter how thoroughly the bar be laminated) is continuously supported under the most severe short-circuit conditions. At the same time, freedom for expansion is provided, together with low-resistance heat paths to the cooling medium.

As every portion of stator and rotor windings would be enclosed in cool metal winding slots, the cooling would be much improved and the fire risk practically eliminated. The absence of ventilating ducts in the stator would be the immediate gain of solid cores and firm support over the entire surface of the stator teeth.

The problem in the plainest terms is the possibility of constructing stator cooling devices capable of withstanding a water temperature of about 120 deg. F. and a pressure of 50 lb. or less per sq. in., whilst at the same time the devices must have sufficient strength to withstand the short-circuit stresses on the stator. The rotor cooling devices are subjected only to the internal water pressure and stresses resulting from centrifugal forces. Adequate mechanical strength can be given to these devices by the use of suitable material, proportioned in accordance with well-known methods.

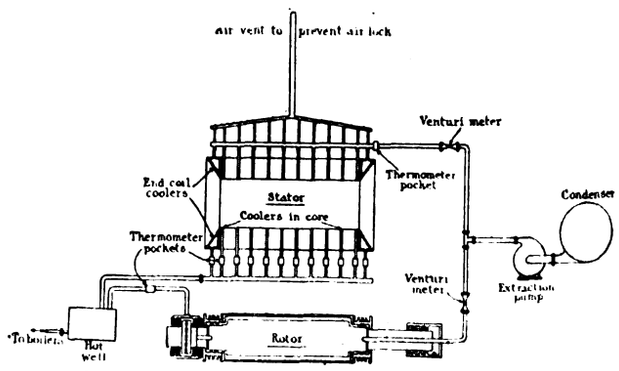

FIG. 9.—DIAGRAM OF WATER-COOLING SYSTEM.

With respect to the prevention of water leakage, all joints can be constructed of a character similar to those used in hydraulic practice, and dealing with pressures of over 2 tons per sq. in., or in accordance with steam practice, with high-pressure superheated steam at 300 lb. pressure per sq. in. and a temperature of 700 deg. F. Fusion welding is now an accepted construction for the more arduous requirements of high-pressure boilers and steam piping. Moreover, the fusion-welded water joints may be designed so that the weld is subjected to no other stresses than those caused by the internal water pressure. Consequently, combining skilful design, stout construction, and reliable workmanship, one can ensure no movement of the coils, no leakage of the water devices, and no overheating of the coils. Under such conditions, failure of machines should be infrequent. Should, however, a short-circuit in a machine occur, the walls of the cooling ducts might become fused, in which extreme case a jet of water

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would immediately flood the machine; but even so, this flooding by water would only occur after a burn-out had happened, and in such circumstances a stream of water playing upon the fire would certainly be better than a fierce blast of air. In all cases, prevention is better than the best remedy, and the improvements suggested are all of a preventive character.

It will be seen, therefore, that whilst water cooling will remove many if not all of the risks inherent in the ordinary air-cooled machine, there is nothing in its application that presents any real difficulty or introduces any method of construction which has not been established in other branches of engineering.

The cooling effect of water is so considerable that without certain precautions, condensation difficulties may arise. If the temperature of the cooling devices falls below the dew point atmospheric condensation upon them will take place. This can be avoided by using cooling water with an inlet temperature higher than the dew point, as by the method shown in fig. 9.

As the output of most machines is rated by ultimate temperature, there are substantial grounds for concluding that water cooling will allow an increase in output for the same total weight and volume of 25 to 33 per cent. Some readjustment of relative copper and iron losses may be necessary, and the result should be a substantial reduction of average temperatures and weight for the same output.

There are, however, a number of cases where water cooling offers advantages over air cooling, quite apart from the improved and more robust construction of machines, *i.e.*, for machines working under the following conditions:—

(1) In hot climates where cool air is difficult to obtain.

(2) In extremely dirty and sulphurous atmospheric conditions.

(3) At high altitudes with reduced air density.

(4) On board ship, where air cannot be freed from salt spray.

As an example of turbo-generators working at high altitudes, the stations on the Rand may be cited. At an elevation of 6,000 ft. and a barometer of 24.5 in. the air density would be 82 per cent. of normal, and a standard turbo-generator frame of 10,000 K.V.A. would only be suitable for an output of approximately 8,500 K.V.A. air cooled. The same frame if adapted for water cooling would probably give an output of 12,500 K.V.A.

Consequent upon the higher ambient temperature of the South African climate, water cooling would have the further advantage of a much lower average temperature of windings.

SHIP PROPULSION.

The field for the electrical propulsion of ships is practically virgin and immense in size. The one great difficulty is the presence of salt water. It is difficult to see how the cooling air can be collected in large volumes free from salt spray.

The air ducts are of considerable dimensions, and it is doubtful if any shipowner would sacrifice valuable carrying space to accommodate them. In fighting ships the problem is more difficult, as the powers to be developed are higher and the space is enormously costly. The objections might be so serious as to outweigh any advantages of electric propulsion.

With water cooling, the difficulties of collecting and conveying the cooling medium disappear, and its use presents neither the difficulties of large ducts nor the trouble of filtration.

Proposals have been made to re-circulate the air through a closed pipe system with air coolers; the sizes of air ducts are so considerable that room for them could not be found with the present allowance of engine-room space. There is now usually considerable difficulty in finding room for the comparatively small steam pipes and valves.

Watertight windings would be a great advantage. A substantial seal of vulcanised rubber could be "cured" in place over the insulated joints, using the cooling devices as heaters, by passing low-pressure steam through those which embrace the ends of the stator bars. This waterproof treatment of the stator joints would be of advantage if surface condensation took place. The ideal alternator for marine purposes should be capable of being cleaned down with a hose pipe.

If electrical propulsion is to progress, the problem must be attacked in a thoroughly practical way, as electrical methods will be in opposition to establish interests and in competition with thoroughly sound and well-tried steam plant evolved after years of practical sea experience.

CONCLUSION.

Whether we like the idea of liquid cooling or not, the question has to be faced in the immediate future, and the full consideration of its uses gives an opportunity of considering alternator design from a new point of view.

Having regard to the necessarily few moving and wearing parts of a turbo-generator, viz., journals, bearings, and slip-rings, there appears to be no sound reason why it should not have as long a physical life as the low-speed plant it has superseded, provided it be possible to construct machines which do not overheat, the coils of which are efficiently and continuously supported against all stresses and vibration, and that the fire risk be removed.

If the arguments put forward in the paper are sound, machines can be constructed embracing those features, and with machines so constructed a much longer physical life may be anticipated. With dear money and expensive plant, longer physical life will be an economical necessity of the immediate future.

THE ELECTRICITY SUPPLY ACT 1919.

THE following is a summary of the provisions of the Electricity (Supply) Act, 1919, which was published last week. The Act can be obtained from H.M. Stationery Office, price 4d. net:—

1. For promoting, regulating, and supervising the supply of electricity there shall be established a body to be called the Electricity Commissioners, not exceeding five in number, who shall act under the general directions of the Board of Trade. Three of the Commissioners shall be whole-time officers; three of the Commissioners shall be selected for practical, commercial, and scientific knowledge and wide business experience, including that of electrical supply. The Commissioners may act by two of their number.

2. The Board of Trade may exercise through the Electricity Commissioners any of their powers and duties relating to the supply of electricity.

3. The Commissioners may conduct experiments for the improvement of the methods of electric supply or of the utilisation of fuel or water-power, and incur such expenditure as may be necessary.

4. The Commissioners may appoint an advisory committee.

5. The Commissioners may provisionally determine that any district in the United Kingdom shall be constituted a separate electricity district for the purposes of this Act, and, if any objection be made, shall hold a local inquiry. Where it appears that the existing organisation for the supply of electricity in a district should be improved, the Commissioners shall hold a local inquiry, and shall give authorised undertakers, county councils, local authorities, railway companies, large consumers of electricity, and other bodies within the district an opportunity to submit a scheme for effecting such improvement, including proposals for altering the boundaries of the district, and, where necessary, the formation of a joint electricity authority for the district. If no such scheme is submitted within the time allowed, or if no scheme submitted is approved by them, the Commissioners may themselves formulate a scheme, publish it, and shall hold a local inquiry thereon.

6. A scheme under the last-foregoing section may provide for the establishment and incorporation of a joint electricity authority representative of authorised undertakers, county councils, local authorities, large consumers of electricity, and other interests within the electricity district, and for the exercise by that authority of the powers of the authorised undertakers within the district, and for the transfer to the authority of the whole or any part of the undertakings, upon such terms as may be provided by the scheme. No such scheme shall provide for the transfer to the authority of any part of an undertaking except with the consent of the owners thereof. The scheme may provide for payment of expenses of members of the authority, and reasonable compensation for loss of remunerative time.

7. The Commissioners may make an order giving effect to the schemes, which shall not come into operation until it has been approved with or without modification by a resolution passed by each House of Parliament.

8. It shall be the duty of every joint electricity authority constituted under this Act to provide or secure the provision of a cheap and abundant supply of electricity within their district, and for that purpose every such authority shall have such powers and duties as are conferred upon them by the scheme under which they are constituted or by this Act with respect to:—

(*a*) the supply of electricity within their district (including the construction of generating stations, main transmission lines, and other works);

(*b*) the acquisition of the undertakings or parts of the undertakings of authorised undertakers;

and powers incidental thereto. Every such authority shall comply with any general directions given to them by the Commissioners as to the exercise and performance of their powers and duties. A joint electricity authority may, with the approval of the Commissioners, establish a scheme for the payment of superannuation allowances and gratuities to any of their officers and servants who become incapable of discharging their duties.

9. A joint electricity authority may, with the consent of the Commissioners, by agreement with the owners thereof acquire any generating station or any main transmission line on such terms as may be agreed.

10. Where a joint electricity authority or any authorised undertakers are authorised to acquire or use any land for the purpose of a generating station, no person shall be entitled to restrain the use of the land for that purpose.

11. It shall not be lawful for any authority, company, or person to establish a new or extend an existing generating station or main transmission line without the consent of the Commissioners (which consent shall not be refused or made subject to compliance with conditions to which the authority, company, or person object, unless a local inquiry has been held); but this restriction shall not apply to the establishment or extension of a private generating station, provided that, in the case of a new station, the owner thereof shall comply with regulations made by the Commissioners as to the type of current, frequency, and pressure to be used; but such regulations shall be so framed as not to interfere with the economical and efficient working of the business for

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which the supply is generated. In the case of a railway company or a dock undertaking regulated by Act of Parliament, consent shall not be refused unless it is proved that a joint electricity authority or authorised undertakers can give an adequate supply of electricity at a cost not greater than would have been incurred by the railway company or dock owners in supplying themselves. Where a group of persons carrying on businesses in which large quantities of electricity are used for purposes other than power or light propose to establish a generating station for the purposes of such businesses; or where a manufacturer, having a business in which electricity can be generated from energy derived from a process of manufacture carried on in his premises, proposes to establish a generating station for the purpose of supplying electricity not only for his own business, but also to other manufacturers whose businesses are associated therewith, the Commissioners may authorise the establishment, by those consumers or that manufacturer, of a generating station, subject to the condition that any surplus electricity shall be supplied to the joint electricity authority, or any authorised undertakers, at such prices as the Electricity Commissioners may think fit and proper.

12. A joint electricity authority shall not supply electricity in any area which forms part of the area of supply of any authorised distributors without the consent of those distributors, except for railway or canal traction or haulage, or for lighting vehicles and vessels for the haulage of which electricity is supplied, or for the purpose of charging electric vehicles not running on rails; or in any part of the area of supply of a power company for any purpose for which the company are therein authorised to supply electricity, without the consent of the company, except to the previous owner of a generating station which has been transferred to the joint electricity authority or for the purpose of charging electric vehicles not running on rails. Where the authorised distributors or power company withhold their consent, the joint electricity authority may appeal to the Commissioners and the Board of Trade on the recommendation of the Commissioners may dispense with such consent if in their opinion it is unreasonably withheld. Sections 2 and 3 of the Electric Lighting Act, 1888 (which relate to the purchase of undertakings by local authorities) shall not apply to the undertakings of joint electricity authorities. The Commissioners may by order, after such inquiry as they think fit, impose on any joint electricity authority an obligation to supply electricity in such circumstances, within such areas, and on such terms and conditions as to price and otherwise as may be specified in the order.

13. Any local authority may, with the consent of the Commissioners, agree with the joint electricity authority of the district for the transfer to the joint authority of the whole or any part of its undertaking. Where any right to purchase the whole or any part of the undertaking of any authorised distributors is vested in any local authority (including a county council), the right may be transferred to and vested in the joint electricity authority, subject to the representation on the joint authority of the local authority from whom the right is transferred. A joint electricity authority with the consent of the Commissioners may at any time acquire the whole or any part of the undertaking of any authorised undertakers not being a local authority, by agreement.

14. The Commissioners may, on the application of a joint electricity authority, by order exclude from the area of supply of any power company any part of that area which is not supplied by the company, and which could be better served by the joint authority. If those interested object to the proposed order, effect shall not be given to the proposals except by special order.

15. The Board of Trade, on the representation of the Commissioners, may by order authorise any joint electricity authority or any authorised undertakers to abstract water from any river or other source, and to utilise and return the water so abstracted, subject to such conditions as may be specified in the order. Where any existing rights will be affected by the abstraction of the water, the order shall be a special order. A joint electricity authority and any local authority, company, or person may, with the consent of the Commissioners, enter into arrangements for the utilisation of water power, waste heat, or other form of energy. The purposes for which a joint electricity authority may be authorised to acquire compulsorily or use land under Section 1 of the Electric Lighting Act, 1909, shall include the development of water-power for the generation of electricity. A joint electricity authority may, with the consent of the Commissioners, erect and renew by-product plant for working up and converting the residual products arising from the generation of electricity.

16. If within five years from the date when under this Act a transfer of any part of an undertaking has been effected, or a scheme has come into operation, any officer or servant who has, before May 8th, 1919, been regularly employed in or about any authorised undertaking proves to the satisfaction of referees appointed by the Minister of Labour that in consequence of this Act he:—

(i) has suffered loss of employment, or diminution of salary, wages or emoluments, otherwise than on grounds of misconduct, incapacity, or superannuation; or

(ii) has relinquished his employment in consequence of being required to perform duties such as were not analogous or were an unreasonable addition to those which before the said eighth day of May he had been required to perform; or

(iii) has been placed in any worse position in respect to the conditions of his service (including tenure of office, remuneration, gratuities, pension, superannuation, sick or other fund, or any benefits or allowances, whether obtaining legally or by customary practice),

and the body to which the undertaking was transferred, or the authorised undertakers who are affected by the scheme, do not show that equivalent employment on the like conditions was available, there shall be paid to him by that body or those undertakers such compensation as the referees may award, including any expenses which the officer or servant necessarily incurs in removing to another locality. Such compensation shall, in the case of an officer employed on an annual salary, be based on but not exceed the amount which would have been payable to a person on abolition of office under the Acts and rules relating to His Majesty's Civil Service in force at the date of the passing of the Local Government Act, 1888, but in computing the period of service of any officer, service under any authorised undertakers shall be reckoned as service under the authorised undertaker in whose employment he is at the time that he suffers such loss or diminution as is mentioned in this section; and, where any such officer or servant was temporarily absent from his employment whilst serving in or with His Majesty's Forces or the forces of the Allied or Associated Powers, or in any other employment of national importance during the war, such service shall be reckoned as service under the authorised undertakers in whose employment he was immediately before and after such temporary absence.

17. A joint electricity authority before incurring any capital expenditure shall submit details, plans, and estimates.

18. It shall be lawful for the Board of Trade, after consultation with the Commissioners, at any time after an electricity district has been provisionally determined and before the establishment of a joint electricity authority for the district, and for two years after its establishment, to construct any generating station, main transmission line, or other works, and exercise any other powers which a joint electricity authority can exercise under this Act. The Treasury may issue to the Board of Trade any sums, not exceeding in the aggregate twenty million pounds, required for the construction of any such works or the acquisition of land, or required for working capital. At the expiration of two years after the establishment of a joint electricity authority for any district, or at any earlier time which may be agreed on, any generating station, main transmission lines and other works, and any land acquired for the purpose thereof by the Board of Trade within the electricity district, shall vest in that authority, subject to the repayment of the advances made by the Treasury, and any interest thereon which may be outstanding. The prices fixed by the Board of Trade for electricity supplied by them from generating stations established under this section, shall be such that their receipts therefrom will be sufficient to cover their expenditure on income account (including interest and sinking fund charges in respect of such advances as aforesaid) with such margin as the Board may think fit.

19. During the period between the passing of this Act and the establishment of a joint electricity authority for a district, any two or more of the authorised undertakers within the locality may, with the approval of the Commissioners, and if so required by the Commissioners shall, carry into effect arrangements for mutual assistance of the one by the other, with regard to the supply and distribution of electricity, the management and working of the undertakings, the provision of capital required, and the division of receipts arising under any such arrangement, on such terms as may be agreed, or as in default of agreement may be settled by the Commissioners. The provision of capital required for giving effect to any such arrangement by loan is authorised.

20. The powers of the Minister of Health and the Secretary for Scotland and the London County Council with respect to the sanctioning of borrowing by local authorities shall be transferred to the Commissioners.

21. Where the consent of the Board of Trade is obtained to the placing of any electric line above ground in any case, the consent of the local authority shall not be required, but the Board of Trade before giving their consent shall give the local authority an opportunity of being heard.

22. A joint electricity authority or any authorised undertakers may place any electric line below ground across any land, and above ground across any land other than land covered by buildings or used as a garden or pleasure ground in cases where the placing of such lines above ground is otherwise lawful, and may enter on the land for the purpose of repairing or altering the line: Provided that, before placing any such line across any land, the joint electricity authority or undertakers shall serve on the owner and occupier of the land notice of their intention, together with a description of the nature and position of the lines proposed to be so placed; and if, within 21 days after the service of the notice, the owner and occupier fail to give their consent or attach to their consent any conditions to which the joint electricity authority or the undertakers object, it shall not be lawful to place the line across that land without the consent of the Board of Trade; and the Board of Trade may, if after giving all parties concerned an opportunity of being heard, they think it just, give their consent subject to such

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terms, conditions, and stipulations as they think just. The Board shall have regard to the effect, if any, on the amenities or value of the land of the placing of the line in the manner proposed. The power of placing lines across land shall include the power of placing a line across or along any railway, canal, inland navigation, dock or harbour, subject to the rights of the owners thereof.

23. A joint electricity authority and any local authority authorised to supply electricity may provide, let for hire, and in respect thereof may connect, repair, maintain and remove (but shall not, unless expressly authorised to do so, manufacture or sell) electric lines, fittings, and appliances for all purposes for which electricity can or may be used. Any electric lines, fittings, and appliances provided by any authorised distributors on consumers' premises, and any lands, buildings, or works held by them in connection therewith shall be deemed to form part of their undertaking.

24. The Commissioners may require any authorised undertakers to alter the type of current, frequency, or pressure employed by them in their undertaking, and the execution of the works necessary to comply with such an order shall be a purpose for which a local authority may borrow under the Electric Lighting Acts. This section shall not apply to electricity generated at a railway generating station existing at the passing of this Act. If, on appeal by any authorised undertakers, the Board of Trade are satisfied that compliance with the order would entail unreasonable expense, they may direct that the order shall not apply to those undertakers.

25. Section 26 of the Electric Lighting Act, 1882 (which contains provisions for the protection of the Postmaster-General), shall have effect as if the words "or the laying of connections with mains where the direction of the electric lines so laid down crosses the line of the Postmaster-General at right angles at the point of shortest distance, and continues the same for a distance of 6 ft. on each side of such point" were omitted, and as if for the words "not more than 28 or less than seven clear days" there were substituted the words "one month, or, in the case of the laying of service lines to consumers' premises, seven clear days."

26. Anything which under the Electric Lighting Acts may be effected by a provisional order confirmed by Parliament may be effected by a special order made by the Electricity Commissioners and confirmed by the Board of Trade, or by an order establishing a joint electricity authority under this Act. A special order made in pursuance of the powers conferred by this section shall be laid before each House of Parliament, and shall not come into force unless approved by a resolution passed by each such House.

27. Joint electricity authorities and authorised undertakers shall furnish to the Commissioners such accounts, statistics, and returns as they may require.

28. Every joint electricity authority shall annually submit to the Commissioners a statement of income and expenditure on revenue account. The accounts shall be audited by auditors appointed by the Commissioners.

29. The Commissioners shall, at the beginning of each financial year, prepare an estimate of their receipts and expenditure during the year, and submit it for approval by the Board of Trade. The Commissioners shall apportion the amount by which the estimated expenses exceed the estimated receipts amongst the several joint electricity authorities and authorised undertakers within the United Kingdom in proportion to the number of units of electricity generated respectively in the preceding year; and every such authority or undertaker, shall pay as a contribution towards their expenses the sum so apportioned. During the first two years after the passing of this Act, the amount of such excess shall be paid out of moneys provided by Parliament, but such payments shall be treated as advances and shall be repaid with interest by the Commissioners by equal annual instalments in the next three succeeding years.

30. Joint electricity authorities or any authorised undertakers may pay reasonable subscriptions to the funds of any association formed for the purpose of consultation as to their common interests and the discussion of matters relating to the supply of electricity, and to the funds of any recognised association conducted on a non-profit-earning basis for developing the use of electricity, and may purchase reports of the proceedings, and may pay the reasonable expenses of attendance of any members or officers at conferences or meetings.

31. Section 4 of the Conspiracy and Protection of Property Act, 1875 (which relates to breaches of contract by persons employed in the supply of gas or water), shall extend to persons employed by a joint electricity authority or by any authorised undertakers in like manner as it applies to persons mentioned in that section, with the substitution of references to electricity for the references to gas or water.

32. Where under this Act a joint electricity authority are authorised to enter into an agreement with any body or person for any purpose, it shall be lawful for such body or person to enter into and carry into effect such agreement.

33. The Commissioners may cause to be held such inquiries as they consider necessary for the purposes of this Act, and may by order require any person, subject to the payment of the reasonable expenses of his attendance, to attend as a witness and give evidence.

34. The Board of Trade and the Electricity Commissioners may respectively make rules in relation to applications and other proceedings before them under this Act, and to the payments to be made in respect thereof, and to the publication of notices and advertisements.

35. A special order made under this Act by the Electricity Commissioners shall not have any effect unless and until confirmed by the Board of Trade. Before any special order, other than a special order which is not valid unless approved by a resolution passed by each House of Parliament, comes into force it shall be laid before each House of Parliament for a period not less than 30 days.

37. This Act shall apply to Scotland, and the Commissioners shall appoint a committee for Scotland.

38. This Act shall apply to Ireland.

39. All the powers and duties of the Board of Trade relating to the supply of electricity shall, as from such date as His Majesty in Council may fix, be transferred to the Minister of Transport, and accordingly references to the Board of Trade shall be construed as references to the Minister of Transport. The power of appointing Electricity Commissioners under this Act shall be exercised by the Minister of Transport with the concurrence of the Board of Trade. The Commissioners shall be solely responsible to the Minister of Transport, and the Minister shall refer to the Commissioners for their advice on all matters connected with the exercise of the powers and duties transferred to him, except the appointment of the Commissioners.

SCHEDULE.

Before the Board of Trade confirm any special order under this Act, they shall publish notice of the proposal to confirm the order, and of the place where copies of the order may be obtained, and of the time (not less than 21 days) within which any objection made with respect to the order must be sent to the Board of Trade.

Where the Board of Trade do not amend or withdraw any order to which any objection has been made, then they shall, before confirming the order, direct an inquiry to be held, and may, after considering the report of the person who held the inquiry, confirm the order either without modification or subject to such modification as they think fit, or may refuse to confirm the order.

NITROGEN FIXATION.

THE Final Report of the Nitrogen Products Committee was published last week. The report (Cmd. 482), which can be obtained from H.M. Stationery Office (4s. net), is a volume of 357 pages, containing a vast amount of valuable information, and is well indexed.

We are devoting more space to this subject in a later issue, but the chief points in the report touching the electrical industry are briefly as follows.

Some of the factors which aided the committee to arrive at its recommendations are:—

(i) The sources of supply of combined nitrogen in the United Kingdom must be increased considerably if the existing and prospective home demands are to be met and the pre-war scale of exportation is to be maintained.

(ii) The existing sources of supply of combined nitrogen in the United Kingdom proved wholly inadequate for meeting the war demands.

(iii) The world's demand for combined nitrogen appears to double every ten years. The increased production during the war has not been more than the normal rate of increase during peace.

(iv) The actual consumption of combined nitrogen for agriculture in the United Kingdom has practically doubled during the war, and there is certain to be a further increase.

PROVISION FOR NATIONAL SAFETY.

The following measures are recommended by the Committee as a *minimum* provision for safeguarding the future and for meeting a portion of the growing home demand for various nitrogen products.

Calcium Cyanamide Process.—The Committee recommends that:—

(i) This process should be established in Great Britain without delay, either by private enterprise (supported, if necessary, by the Government) or as a public work.

(ii) The scale of manufacture should be sufficient to give an output of about 60,000 tons of cyanamide per annum, equivalent on the basis of combined nitrogen to about one-eighth of the present home production of ammonium sulphate.

(iii) The necessary electrical energy should be obtained either from water power in Scotland or from a large steam power station.

The Committee has ascertained from the Water Power Resources Committee of the Board of Trade that there are several sites in Scotland where the necessary water power can be developed at a reasonable cost. If steam power is used, a suitable site for the cyanamide factory might be obtained at one of the capital power stations proposed by the Board of Trade Committee on Electric Power Supply, and the costs given hereunder are based upon that assumption.

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On the basis of pre-war prices plus 50 per cent., the approximate capital outlay at a water-power site would be £1,680,000, inclusive of the capital cost of the hydro-electric development, the latter being taken at £40 per E.H.P. (£53.6 per KW.) of maximum demand. If the factory were erected at the site of a large steam-power station, the approximate outlay would be £800,000, inclusive of the proportionate cost of the power plant. The chemical sections for either site would cost about £445,000 of the above totals.

Upon the same basis (*i.e.*, pre-war prices plus 50 per cent.), the approximate cost, at the factory, of raw cyanamide (19.5 per cent. N.) would be :—

Source of power.	Price of electrical energy. Per KW. year.	Factory costs per metric ton of— Raw product. (19·5 per cent. N.)	Combined nitrogen as raw cyanamide.
	£	£	£
Water	4	6·4	32·8
Steam (with coal at 11s. 3d. per ton)...	5·6	7·0	36·0

The factory costs include interest on the capital outlay for the power section of the plant, but not on the chemical section, and are exclusive of any royalties.

As the result of the action taken upon the Committee's interim recommendations, considerable progress was made with the plans and specifications for a suitable steam-power station designed as the nucleus of a possible capital power station.

The committee suggests that it might prove desirable, in the first instance, to arrange for a certain proportion of the calcium carbide produced as an intermediate product to be utilised as such instead of converting it into cyanamide.

Synthetic Ammonia (Haber) Process.—This process has hitherto only been operated on a full commercial scale in Germany. Nevertheless, as a result of the continuous experiments carried out since the summer of 1916 at the Research Laboratory of the Munitions Inventions Department, the Government decided early in 1918 to erect a large factory at Billingham-on-Tees for the manufacture of synthetic ammonia and ammonium nitrate. This factory, projected as an emergency war measure, did not reach an advanced stage.

The committee recommends that the synthetic ammonia process should be established forthwith on a commercial scale and, extended as rapidly as possible, up to a minimum manufacturing scale of 10,000 tons of ammonia (equivalent to 40,000 tons of ammonium sulphate) per annum. The Billingham factory should be utilised for the purpose if practicable.

The evidence on the question of capital cost is somewhat uncertain, but the outlay for a factory of the capacity indicated, on the basis of pre-war prices plus 50 per cent., would probably amount to £600,000 if ammonia were the end-product, or to £780,000 if the factory were laid out for the manufacture of synthetic ammonium sulphate.

By-product Ammonia Industries.

The following recommendations are made, among others, for conserving and increasing the output of combined nitrogen from existing by-product ammonia industries, for securing the better utilisation of the national resources in coal, and for reducing the consumption of *raw* coal as a fuel :—

Encouragement should be given to facilitate and to ensure the replacement of non-recovery coke-ovens by recovery ovens at a much more rapid rate than hitherto, in order that the reserves of coking coal shall be utilised to the maximum advantage.

Encouragement should be given to all efforts to extend the use of coal gas and coke in the place of raw coal for domestic purposes, for steam-raising, and for other industrial requirements.

A special observation is made to the effect that, as far as the United Kingdom is concerned, nitrogen fixation and allied processes will constitute a new "key" industry, and its initiation and development will require the active support of the Government.

NEW PATENTS APPLIED FOR, 1919-1920.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. Sefton-Jones, O'Dell and Stephens (successors to W. P. Thompson & Co., of London), Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

313-4. "Apparatus for controlling electric currents." C. G. Conrad. January 5th.
339. "Magnetos." J. F. Kebbell. January 5th.
342. "Sparking plugs." Soc. Internationale pour l'Exploitation de la Bougie, Sol. January 5th. (France, July 31st, 1919.)
347. "Inductances for wireless telegraphy and telephony." H. P. Rees. January 5th.
358. "Electrical systems." Domestic Engineering Co. January 5th. (United States, April 6th, 1918.)
363. "Electrolytic cells." W. J. Mellersh-Jackson (Allen Electrolytic Cell Corporation). January 5th.
372. "Electric heaters." J. Haussер-Staub. January 5th. (Switzerland, August 8th, 1919.)
386. "Anti-vibrators for incandescent electric lamps." E. Booth and N. R. Booth. January 6th.
404. "Spark plugs." R. R. Hill. January 6th.
426. "Electrically-operated lawn-mower, &c." G. A. Browse. January 6th.
431. "Telephone transmitters." V. F. Feeny (Magnavox Co.). January 6th.
444 "Electrically-controller combustion system." J. L. Keepmaker d'Orville. January 6th.
452. "Electrically-heated cooking device." C. C. Armstrong. January 6th. (United States, June 27th, 1916.)
461. "Shade-holders for electric light fittings." C. J. Callander and F. Butler. January 6th.
467. "Electric accumulators." J. H. Green. January 6th.
500. "Magnetic clutches." E. T. Caparn and Scotts' Shipbuilding and Engineering Co. January 7th.
502. "Limit switches." E. T. Caparn. January 7th.
520. "Dial switches for automatic telephone, &c., systems." Automatic Electric Co., Automatic Telephone Manufacturing Co., J. Lairn, and S. R. Smith. January 7th.
534. "Device for locating leakages or short circuits on or between electrical conductors." B. Darby. January 7th.
549. "Electrodes for electric welding or fusion-deposition of metals." Quasi-Arc Co. and A. P. Strohmenger. January 7th.
579. "Magneto-electric machines with oscillating armatures." O. Imray (Eisemann Magneto Corporation). January 7th.
600. "Ignition devices for internal-combustion engines." F. A. Smith. January 7th.
602. "Methods of electric power generation and transmission with alternating currents." A. M. Taylor. January 8th.
615. "Means for making and breaking electrical circuits." F. M. Brown and A. E. Davies. January 8th.
636. "Sparking-plug tester." A. D. Alyward. January 8th.
638. "Filling for storage batteries." S. Narayashi (C. A. Allison). January 8th.
654. "Zinc battery elements." S. O. Cowper-Coles. January 8th.
655. "Wireless controlling relay." H. E. Tammelin. January 8th.
673. "Ventilation of dynamo-electric machines." British Thomson-Houston Co. and H. W. Taylor. January 8th.
675. "Electric Heating Units." British Thomson-Houston Co. (General Electric Co.) January 8th.
695. "Incandescent electric lamps." G. Calvert. January 8th.
697. "Generation of electricity by rise and fall of tides." R. I. Ward. January 8th.
707. "Electrical switchgear." W. A. Coates, D. R. Davies, G. E. Gittins and Metropolitan-Vickers Electrical Co. January 8th.
716. "Automatic train stop and track circuit signalling." J. D. N. Molesworth. January 9th.
726. "Electric circuit-breaker." W. H. Illingworth. January 9th.
729. "Mine-signalling systems." Automatic Telephone Manufacturing Co. and C. Remington. January 9th.
730. "Electric circuit-breaker." R. Simpson. January 9th.
736. "Methods for generating and transmitting electric alternating currents." A. M. Taylor. January 9th.
752. "Electric cranes, hoists, &c." J. Bentley and W. H. Scott. January 9th.
761. "Adaptors for electrical connections." J. Strang. January 9th.
766. "Telephonic transmitters." R. J. B. Knight. January 9th.
775. "Electrically heated garments." A. Negromanti. January 9th.
782. "Electric incandescent lamps." J. J. Gowen. January 9th.
788. "Means for supporting electric fuses in operative position." L. Weekes and J. A. Wilding. January 9th.
793. "Electro-magnetic clocks." M. P. Favre-Bulle, B. M. M. Moulin (nés Chenard, legal representative of M. A. Moulin), and M. A. Moulin. January 9th.
805. "Controller for shunt-wound dynamos." J. Hunt. January 9th.
809. "Wireless telegraph calling devices." W. H. Nottage and T. D. Parkin. January 9th.
811. "Electric furnaces." H. Wade (Booth Electric Furnace Co.). January 9th.
841. "Combined keyless lock, electric bell switch and electric light switch." F. I. Kirby. January 10th.
877. "Electric welding." British Insulated & Helsby Cables, Ltd., and L. B. Wilson. January 10th.
878. "Electric plug-connecting appliances." T. W. Jefferson and T. W. Jefferson, Ltd. January 10th.
879. "Electric heating device." Electric Heating and Hardware, Ltd., and F. J. Wineberg. January 10th.
886. "Suction cleaning apparatus." J. Gray (Electric Vacuum Cleaner Co.). January 10th.
887. "Electrical apparatus." British Thomson-Houston Co. (General Electric Co.) January 10th.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1918.

16,865. Electric motor drives for planing machines and the like. F. T. Haggas and W. Haggas. October 16th, 1918. (136,589.)
20,396. Apparatus for determining the direction of arriving electro-magnetic waves. J. Erskine-Murray and V. Robinson. December 9th, 1918. (136,600.)
20,543 Induction coils. M. A. Codd. June 2nd, 1919. (136,601.)
20,686. Electrical fuses. Cable Accessories Co., F. H. Reeves and A. Crawford. December 12th, 1918. (136,605.)
21,053. Electric insulators. J. E. Pollak. (Fabbrica Isolatori Livorno.) December 17th, 1918. (136,627.)
21,283. Electric switches. V. E. Joyce and Park Royal Engineering Works. December 19th, 1918. (Cognate application 13,453, 1919.) (136,650.)
21,417. Transmission and reception arrangements for electro-magnetic signalling. W. E. Barber. December 20th, 1918. (136,654.)

1919.

683. Electrically-heated melting-furnaces. L. C. Harvey. January 9th, 1919. (136,679.)
1,251. Magnetos for ignition purposes. E. A. Smith. January 17th, 1919. (136,683.)
1,873. Electric cable carrying or supporting means. A. H. Lessells. January 28th, 1919. (136,691.)
2,448. Anti-vibration electric light fittings. F. A. Ross. January 31st, 1919. (Addition to 122,707.) (136,694.)
2,484. Ignition-magneto generating devices. E. C. R. Marks. (Splitdorf Electrical Co.) January 31st, 1919. (136,696.)
3,181. Magneto-electric machines for internal-combustion engines. M. S. Conner and C. C. Puckette. February 10th, 1919. (136,705.)
4,149. Transmission system for transmitting high-frequency electric currents. Western Electric Co. February 19th, 1919. (136,712.)
4,630. Method of electrically welding platinum or other metal disks to the ends or heads of metal screws or rods. W. Meacher. February 25th, 1919. (136,720.)
4,841. Induction coils. A. H. Midgley and C. A. Vandervell & Co. February 26th, 1919. (136,722.)
9,187. Apparatus for producing a continuous electrically conducting liquid jet. J. F. G. P. Hartmann. May 11th, 1918. (136,947.)
13,655. Arc generators of electric oscillations. P. O. Pedersen. March 4th, 1919. (136,762.)
22,289. Automatic voltage regulation of variable-speed dynamos. F. Mauron. September 10th, 1918. (132,518.)
22,609. Telephonic arrangement for use by firemen. W. M. Burdon. September 13th, 1919. (136,791.)

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During the War, almost exceptionally among technical publications and periodicals of the character of the ELECTRICAL REVIEW, we have refrained from increasing the price. Owing, however, to the constant increases in cost of paper, printing, engraving and production charges generally, we have reluctantly decided that the price from the beginning of this year must be raised to 6d. per copy. The change will not apply to unexpired subscriptions.

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THE LESSON OF THE MOULDERS' STRIKE.

THE morning papers of January 23rd contained the welcome announcement that by a majority of over 6,000 the moulders had voted in favour of a return to work, the strike having lasted since September 20th, 1919.

All men have a perfect right to refuse to work, or to withdraw their labour, if they consider the conditions of employment unsatisfactory in any particular. We use the plural number because it is lawful to combine together to do this—in short, to strike is lawful.

In all the long history of labour disputes, however, it is improbable that there has ever been a strike more deplorable than the one just ended. Certainly this is true so far as engineering is concerned. The moulders broke away from their Federation, and decided to fight for themselves. The remainder saw that the situation was hopeless from the start, and so stayed at work. They started out on this hopeless business, putting forward demands which failed to produce the desired effect, either on the employers or upon public opinion. With a stubbornness which, in a better cause, would have been worthy of admiration, they fought on, twice rejecting a settlement, until the strike had lasted for 17 weeks. At the end of all this privation for themselves, their wives and families, they have gained nothing but the promise of an inquiry, which, we make bold to aver, would have been assented to and participated in gladly by the employers at the very commencement. The five shillings advance would have been paid to the moulders in common with other engineering workers; and machinery for the avoidance of disputes could, with the men's goodwill, be set up to-morrow, in accordance with many famous examples already in existence — the Building Trades Parliament, recently discussed in these columns, for one.

The cost to the men and their dependents has been great, but it has not stopped there. Many other workers have been unable to earn their livelihood, and it is well known that some of the largest firms were within an ace of having to close down completely, not only their works, but their offices; of having to stop not only their operatives, but their administrative staffs. The cost to the country has been enormous, and even now it will be several months before work can proceed normally. And all this at a time when the one thing needful is to produce the goods of which the poor old world has been deprived for over five years.

There is, as we admitted at the outset, a right to strike. But all rights have their accompanying duties, and in this case the duty is to see that the misery of the resultant warfare falls on the enemy. The whole duty of any individual is so to live his day that the community may be better at the end of the day than it would have been but for his day's effort. If the conditions of employment in respect of reward, circumstances, atmosphere, are such that it would be a shame to perpetuate them, then it is the workers' duty to refuse to submit to them, and so advance the common welfare by sweeping intolerable conditions away. But when this is not the case, then one's duty is to get on with the job. All strikes that have succeeded have been strikes against injustice. Public opinion is, and must remain, the final judge. The public, particularly the British public, has a fine sense of fair play. This sense was roused, to take a famous example, by the Dock Strike in the 'eighties of last century, but it is most emphatically not impressed in the slightest by the moulders' claim for 15s.

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a week increase, with no prospect of finality, and bound to spread in all directions as the Churchillian 12½ per cent. still continues to do.

This strike could, as we have said, have ended on two earlier occasions, if the men had accepted the recommendations and advice of those whom they appoint and pay to act for them. With all allowance for the unworthy prominence of the mere agitator—the gas-bag, in fact—in labour, as in other walks of life, it ought to be possible to assume that these chosen leaders are capable men, who, being in close touch with the other side, will be in a position to offer sound advice. The men have, of course, the right to refuse to follow it, and the moulders have twice exercised that right—with the results we now see! It may be that the very failure of this strike will have a tendency to restore the authority of Trade Union leaders among their rank and file. Surely, if a man is selected as a leader, it is the duty of the rank and file to follow him, or else to appoint someone else. The rank and file have the supreme authority, but that authority is not properly displayed by the continual flouting of direction and refusal to follow advice.

The weapon of the strike is effective, but terrible. Negotiations take time, and inevitably engender impatience. Then comes the temptation to use the weapon unjustifiably, and great strength is better shown by the avoidance of the use of the weapon than by its employment on every occasion, or even the threat of its employment. The drum is an effective instrument, and acceptable in its place in the orchestra, but if the drummer beats it in somebody's bedroom, he will not be praised for a clever drummer, but cursed as an intolerable nuisance.

It seems almost incredible that, in an age so predominantly commercial as the present, we should have failed to get away from brute force for the settlement of industrial and international disputes. In personal affairs it has long since been dropped, and we can all, however aggrieved, repair to an impartial tribunal for the settlement, on just lines, of any conflict. We have not reached the stage of compulsory arbitration yet, but we have industrial courts, and it is probable that already a serious strike at the docks has been avoided by recourse to them. May all parties make free use of them, and may they justify their existence!

Not by the winning or the losing, but by the avoidance, of industrial disputes, shall we be able to get ahead with the work, and to do the right thing by the country and ourselves.

The Commercial Engineer.

AT the inaugural meeting of the new Liverpool Sub-Centre of the Institution of Electrical Engineers, Dr. Marchant, *inter alia*, drew attention to the importance of sound commercial training to the engineer. As he pointed out, the economic efficiency of an undertaking is even more important than its technical efficiency; no matter how admirable a project may be from the latter point of view, it is worthless unless it is a paying proposition, and the engineer who is competent only on the technical side, is not fully equipped to deal with the problems that will confront him in the future.

There is another aspect of the question, to which also Dr. Marchant referred—the fact that the commercial representative who is not *au fait* with the technical side of his subject is equally deficient in training for his vocation, especially when he is called upon to act in foreign countries on behalf of British firms. To meet the competition with which we shall be faced abroad, it is essential that our "trade ambassadors" shall be provided with every weapon that is available, including especially commercial, technical, and linguistic attainments of a high order, and we cordially agree that the admirable movement on the part of our modern Universities towards the establishment of schools of commerce should be fostered, with a view to the equipment of the engineer with the "munitions of war" appropriate to peace conditions. We have often pressed these points upon the attention of our readers, and we welcome the support of so notable an exponent of the fundamental principles of engineering training.

The Trade Contest With Germany.

A SERIES of articles by M. Paul-Genty is being published by a Paris newspaper, dealing with the economic contest between the Allies and Germany. The articles are mostly a record of the progress made during the war in England, France, the United States, and Japan. In the case of the electrical industry, the author states that as compared with France, Germany in pre-war times had a considerable excess of exports of electrical manufactures. Nevertheless, French electrical firms in general were able to meet the demands for electrical equipment during the war, so that no difficulties arose from the cessation of imports from Germany. Switzerland and the United States supplied the products which were lacking, whilst the necessities of the war acted as a stimulus to French industry. A syndicate was formed to combat German competition in the world, concessions in tariffs were demanded, and an increased utilisation of water power was undertaken. Turning to the consideration of the position of the United States, M. Genty states that the electrical exports of that country were doubled during the war. However, the difficulties incidental to ship tonnage, "an insufficient knowledge of the market," the special qualities required for deliveries under war contracts, and the scarcity of labour hampered the development of the electrical industry in the United States. The industry in Japan also made considerable progress, makers passing from machines of ordinary size to those of large powers, which were sold at moderate prices. The availability of raw materials at low prices, such as copper and silk, and of hydro-electric power, facilitated the development of the industry, and the country was soon able to compete successfully with others, especially as current manufactures could be produced very cheaply. It is said that the Government by the grant of export bounties encouraged exports to China and India, and the makers proceeded to increase their productive capacity in the German fashion, so as to be able to carry out large contracts. The author concludes that German competition will be completely ousted by England, France, the United States, and Japan, unless Germany succeeds in outstripping these countries by a solution of labour questions, which are the principal causes that can impede the restoration of the economic life of the country.

A Double-Edged Sword.

AS a result of the apprehensions which have arisen in Germany in recent months as to the possibility of foreigners buying ordinary shares in industrial companies, and securing a majority control over the undertakings, a system has been introduced of creating preference shares which are given up to 20 times the voting powers of the ordinary shares. In other words, a preference share may carry up to 20 votes, as compared with one vote for each ordinary share. It is hoped in this way to counteract any foreign intervention in German industry. The initiative in this direction was taken by the aniline dye combination two or three months ago, and was soon followed by certain shipping companies, whilst many industrial companies have also adopted the same policy. It has occurred to some people, however, that besides averting foreign control, preference shares with many votes can also be utilised for depriving German holders of ordinary shares of their rights by out-voting them in general meeting. Not only so, but the banks are coming to the conclusion that the issue of such preference shares is only justified when foreign influence is directly impending. A solution of the problem is now being sought by the Lloyd Dynamo Works Co., of Bremen, which is seeking the sanction of the shareholders to the creation of preference shares for 200,000 marks, each having 20 votes, so that they would equal in voting power the ordinary share capital, which is being increased to 4,000,000 marks. The preference shares, however, will only be issued if necessary, and the right of emission will lapse with the end of 1925. Should the occasion arise, it will be possible for the directors to issue the preference share capital, and thus check foreign control, especially as all ordinary shares are never represented at any company meeting.

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I.E.E. Progress.

WE have previously referred to the rapid increase in the membership of the Institution of Electrical Engineers; at the meeting last week 284 new members were elected, including 34 Associate Members, 27 Graduates, and 168 Students. That so large a proportion was in the junior class by no means discounts the value of the list—a constant inflow of young blood is essential to the maintenance of the health and vigour of the organisation. What especially interests us on this occasion is the fact that the membership, which at October 1st, 1919, was 7,792, is now well over 8,000—a splendid record.

No doubt many factors contribute to this noteworthy development; but one, we believe, overshadows all the rest—namely, the steady increase in the efficiency and usefulness and the broadening of the interests of the Institution, which, under the effective guidance and driving force of Mr. C. H. Wordingham during his energetic two years in the chair, has become so much more real and human to its members and its critics.

Petrol and Electricity.

CONSIDERABLE agitation is prevalent in the automobile world in view of the threatened increase in the price of petrol, and the probability that the petrol tax will be removed by the Government. On the surface, it would seem that these two factors, being of opposite sense, would tend to neutralise one another, but as a matter of fact the tax will only be transferred from petrol to some other basis, and automobilists do not anticipate any relief in that respect. We are here mainly concerned with the increasing cost of petrol, which will not promote a reduction in the price of benzol or other substitutes, though it will stimulate the movement towards the adoption of alcohol.

Now, the cost of energy for propelling a railless trolley-car is about 1½d. per mile; that of petrol for a motor-'bus is already over 5d., and is going up: when all running expenses are taken into account, the cost of railless traction is about 11d. per car-mile, against 17d. per 'bus-mile, leaving a margin far more than sufficient to pay the capital charges in respect of the overhead construction, even if we assume that the cost of upkeep of the roads, and the life of the vehicles, are the same in both cases—an assumption which errs greatly in favour of the omnibus.

Again, the cost of running a storage battery omnibus is about 10d. per mile. In by-gone days the battery-'bus earned a very unsavoury reputation, but the undoubted success of battery vehicles during the past 10 years has redeemed their character, and there is no doubt that a modern battery-'bus is a commercially sound proposition. The superiority of the electric battery vehicle for municipal sanitary purposes is now so well established that it requires no emphasis.

Thus, it will be seen that the prospects for electric traction on roads are highly favourable, and there is good reason to anticipate rapid developments in this direction. The only obstacle to the more extended use of the private battery car is the lack of charging facilities: this deficiency is being slowly remedied, and it rests with electricity supply authorities to accelerate the provision of charging stations, and to make their existence widely known. We commend the matter to the notice of the Ministry of Transport as one deserving immediate attention.

Electricity Supply.

Now that the Bill, in its abbreviated form, has become an Act, it is worth while to consider its immediate bearing upon the electricity supply industry. In our last issue we gave a summary of the Act, which, in spite of its curtailment, remains a measure of the first importance, and contains many provisions of very great value to the industry. As announced in our pages, the Ministry of Transport took over its new duties on Friday last; it is greatly to be regretted that the Commissioners, with the exception of the Chief Commissioner, Sir John Snell, have not yet been appointed, as there is plenty of work awaiting their attention, and at least two are necessary to form a quorum. Besides, is not the supply world looking forward with keen interest to the disclosure of the *personnel* of its new general staff?

The Commissioners, when they come into existence, will at once become the authority charged with the administration of the Electric Lighting Acts, including the sanctioning of borrowing by municipal authorities; "special orders" made by them and confirmed by the Minister of Transport will take the place of provisional orders, and the mass of routine work which will fall upon their shoulders will give them ample occupation. But one of their first duties will be to organise the country into "separate electricity districts," and to set on foot the preparation of schemes for improving the "existing organisation"—mainly conspicuous by its absence—and, *if necessary*, forming joint electricity authorities. This work has been informally commenced by the Board of Trade as regards certain areas, as will have been gathered from references in our columns during the past two years, and the authorities and companies concerned will do wisely and well if they follow the example of certain provincial areas and get to work on the formulation of co-operative schemes. In their default, the Commissioners have power to formulate and put into force schemes of their own, lacking only the power of compulsory purchase.

A joint electricity authority, when formed, must comply with the general directions of the Commissioners, submit all proposals for capital expenditure (beyond a prescribed limit) for their approval, render accounts of income and expenditure annually, and furnish a report of the year's work. Pending the formation of a joint electricity authority, existing authorised undertakers not only may, but if required by the Commissioners, must, make arrangements for mutual assistance, on terms to be approved, or if necessary imposed, by the Commissioners; and they may be called upon to change their system of supply, subject to the right of appeal to the Minister of Transport.

Private undertakings have now come under the control of the Ministry; no new station or main transmission line whatever may be erected without the consent of the Commissioners, unless they comply with regulations which have not yet been formulated.

On the other hand, if the liberty of the individual is to some extent restricted, valuable compensation is found in the improved facilities for obtaining compulsory wayleaves, erecting overhead mains without the consent of local authorities, using land for generating stations, obtaining cooling water, &c.

It is clear, from the foregoing, that the Act affords abundant scope for the Commissioners, with the collaboration of the authorised undertakers, to accomplish a great deal of valuable work. Whether the clauses that were jettisoned will ever be enacted, remains a moot question; certainly there is no urgent need for them.

A correspondent to-day remonstrates with us on the score of undue severity towards a writer in *The Times Trade Supplement*, who said that under the Act the undertakers retain their autonomy, but under the Bill as it left the House of Commons, their autonomy would at once have been cut short. As we have shown above, their present "autonomy" is by no means unrestricted; but under the complete Bill they would have had precisely the same opportunities to come together and form joint electricity authorities, selling their stations, if desired, by agreement. It is the will of the nation, as expressed by the House of Commons, that electrical undertakings shall join hands with a view to improving the supply of electricity. The original Bill provided compulsory powers to that end; but those powers could not be exercised without holding a local inquiry, and they could not be put in force without approval by resolution of each House of Parliament. To provide the power to do a thing in case of necessity is a vastly different thing from doing it; the police have power to arrest any British citizen, under certain circumstances, but, nevertheless, the British citizen is a free man—perhaps the freest in the world. In the same way, supply authorities, if they complied with the law (as yet unwritten) requiring co-operation, would have nothing to fear from the big stick which was put on the shelf by the House of Lords; and they would not lose the measure of autonomy which they now enjoy.

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THE ELECTRICAL EQUIPMENT OF PALMERS SHIPBUILDING AND IRON CO.'S WORKS.

(*Concluded from page* 101.)

Electrical driving has been adopted generally throughout the whole of the works and steam plant is being almost entirely done away with. At the shipyard the whole of the driving is now done electrically, the largest motors being employed to drive 700-H.P. air compressors for the general supply of compressed air used in the various branches of ship construction.

At the iron and steel works the whole of the overhead cranes, charging machines, main water supply, and hydraulic pumps, are electrically driven, and in addition the rolling mills are being fitted with motors to replace large steam engines, the auxiliary plant necessary for driving live rollers and skids having already been converted for electric driving.

The rolling mill installation has been carried out by the Metropolitan-Vickers Electrical Co. (late British Westinghouse Electric and Manufacturing Co.).

The mill motor (fig. 5) has been designed for, and is dealing with, a torque of 140 foot-tons at a speed of 40 R.P.M., which figure is well above that met with in rolling the particular size and weight of ingot over the time specified; for instance, rolling 4-ton ingots, 20 in. by 18 in. to 6 in. by 6·5 in., an output of over 35 tons per hour is easily obtained.

The stopping and accelerating of the mill motor extremely rapidly is absolutely essential if the maximum output is to be reached. In this connection it should be remembered that with Ward-Leonard control the generator field at the end of every pass is reduced to zero value during the reversal of the mill, and is then built up in the required direction, until the selected speed on the mill motor is obtained. Although the torque due to the inertia of the masses to be stopped or started in the time by the mill motor is small compared with the torque due to the resistance of rolling and friction, the former must be impressed within an extremely short interval of time. Further, in order to effect the rapid stopping of the mill motor against its own inertia and the inertia of the other moving masses,

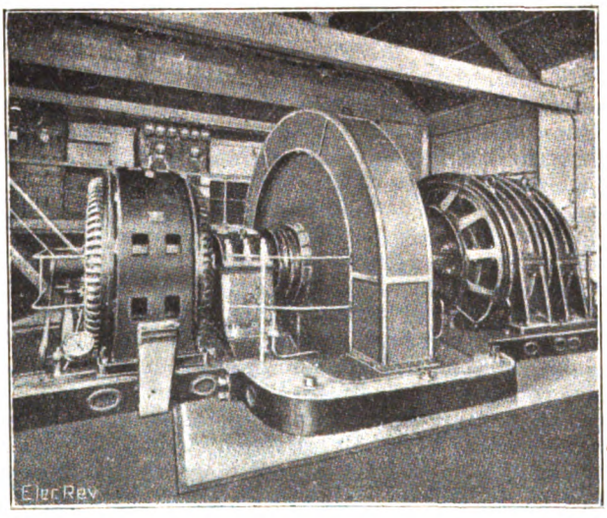

FIG. 4.—MOTOR-GENERATOR.

the generator field is first reduced, and the motor then acts as a generator, returning energy to the line by way of the generator and induction motor. The machine is then brought quickly to rest, and may be reversed in an exceedingly short space of time. Either an electric or a steam plant can be brought to rest in a short space of time, the advantage, if anything, being with the electric plant, as almost any magnitude of momentary negative torque is available for the purpose of decelerating. This being so, it remains to be seen in what manner the electrical equipment is speeded up. It might be thought that, at first glance, the steam engine would have the advantage, and could accelerate the mill, &c., by the operator quickly moving the throttle to full open, thus impressing full available pressure on the pistons. The arrangement of the electric controls and gear by which equivalent results are obtained is illustrated diagrammatically in fig. 6, in which, for the sake of clearness, all switchgear and instruments have been omitted.

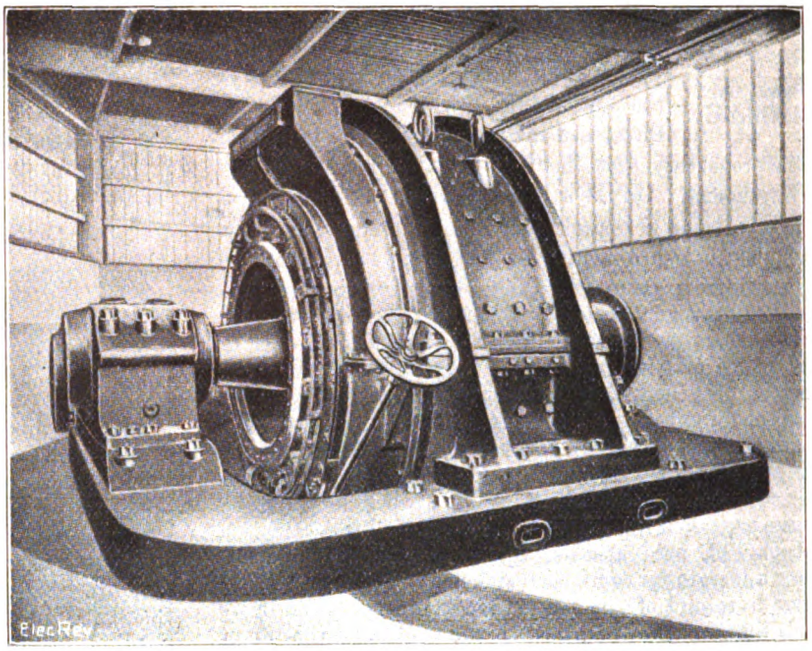

FIG. 5.—AN 8,500-H.P. ROLLING-MILL MOTOR.

The plant consists, it will be seen from figs. 4 and 6 of an induction motor I M, fed with three-phase current, as indicated. The leads to this motor have interpolated in them the slip regulator and starter S R, which is controlled by the torque motor T M. The induction motor drives the generator G G, having mounted on its shaft the fly-wheel F W. The generators supply energy to the mill motor M, an overload circuit breaker O C B being comprised in the circuit. The mill motor is regulated by the controller C, established on the field circuits of the motor M, and of the exciter E. The latter is driven by a motor E M, taking its current from the D.C. circuit, as shown; S D is a safety device, and F F R is a field-forcing relay. The safety device S D consists of a circuit-breaker and no-volt coil placed in and across the generator and exciter field. Should the voltage fail from any cause, a weighted lever is released which actuates the rheostat first to insert resistance into the exciter field, and ultimately to break that circuit. At the same time the main circuit-breaker is opened. The controller C consists of an apparatus by means of which the field strength of the generator is varied between zero and full strength, at the will of the mill operator, thus raising or lowering the voltage in the main which is dependent on the strength of the generator field. The speed of the motor then follows the generator voltage. The controller also reverses the field in order to reverse the direction of rotation of the motor at the end of each pass of the ingot through the rolls. The controller consists of an arrangement of resistances which are either automatically, or by hand, cut out of the generator-field circuit after the first movement of the control lever in either direction.

At the neutral position of the operating lever there is no

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field on the generator, and consequently the motor is at a standstill. When the lever is moved in either direction from the neutral or stop position, the generator field is built up, and the motor speed rises until near the end of the pass, or until the Ward-Leonard limit, or the normal full speed is reached. The time of acceleration may be shortened to any reasonable extent as described below.

If the billet is a long one, the speed of the motor is further increased by another movement of the control lever whereby resistance is inserted into the mill motor field. When near the end of each pass, the generator-field strength is decreased, and the motor and rolls are brought quickly to rest by means of the regenerative braking effect, the motor acting as a generator and driving the generator as a motor. The result is that the fly-wheel which during each pass of the billet through the rolls had dropped in

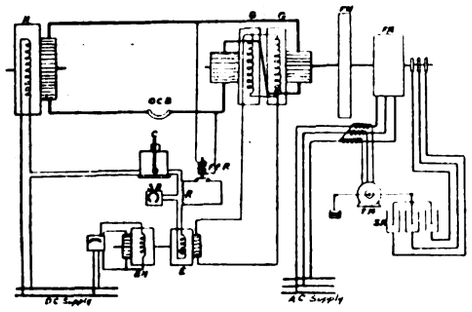

FIG. 6.—DIAGRAM OF MILL CONNECTIONS.

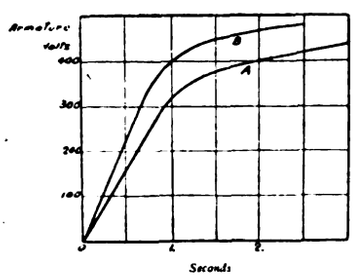

FIG. 7.—FORCED FIELD VOLTAGE AND NORMAL VOLTAGE CURVES.

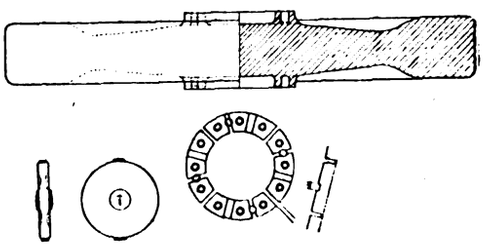

FIG. 8.—DETAILS OF FLY-WHEEL.

without excessive stresses. The wheel is solid throughout.

A complete duplicate system of centrifugal fans, with filters for the forced ventilation of the motor, also duplicate sets of oil pumps with tanks for the forced lubrication of the bearings of the fly-wheel motor-generator set, are provided. With regard to the latter, it may be remarked that, as a test, the set has been run for a long period under observation, without using the forced lubrication. Throughout the test there was no undue rise in the temperature of the bearings, and, indeed, forced lubrication is installed more as a reserve in case of an emergency than as a necessity. One pump is, however, kept running constantly.

A second motor-generator fly-wheel set is at present being erected, together with a similar motor to that here described, designed to drive a reversing finishing mill adjacent to the present cogging mill. The new speed, is again speeded up, and at the same time any surplus energy is returned to the line by way of the induction motor.

It is found with normal voltage suddenly impressed on the field of the generator that the rate of acceleration would be, in most instances, rather slower, owing to the natural lag due to self-induction, than the requirements of reversing mill work might call for. Owing, however, to the adaptability of electrical control, this sluggishness is very easily dealt with, and the acceleration increased to any desired degree, even up to such a rate as would make it impossible to handle the material. This is effected by impressing, through an electrically-limited interval of time, a voltage much higher than normal on the generator fields. It will be observed that F F R, the field-forcing device utilised for this purpose, is controlled by the rise in voltage in the main circuit between generator and mill motor, the exciter field resistance being inserted when a predetermined voltage in the main circuit is reached. It should be noted that the speed of the mill motor corresponds precisely to the changes in voltage. The effect of forcing the generator field in this manner is shown in fig. 7, together with a comparison with a normal field voltage applied to the same field. The curve is, perhaps, remarkable for showing the effect of self-induction on rather a large scale.

The following particulars relate to the equipment described in this article:—Mill motor = 2,500 H.P., R.M.S. rating; 8,500 H.P. peak; 0/40 R.P.M. with Ward-Leonard control; 40/75 R.P.M. with rheostatic control; forced ventilation with filtered air. Generators = two, 1,000 KW., 600 R.P.M. Induction motor = 1,350 B.H.P., three-phase, 40-period, 5,750 volts, 600 R.P.M. synchronous. Supply = three-phase, 40 periods, 5,500 volts. Fly-wheel = 35 tons; peripheral speed about 22,500 ft. per minute.

In designing the fly-wheel, of which full details are shown in fig. 8, the object aimed at has been to secure the greatest possible store of energy in a given weight of wheel

motor-generator set will be coupled to the existing set, although it can, if necessary, be run as a separate unit. Later, an additional pair of generators will also be coupled up, and will operate a third mill motor. Fig. 9 shows, in outline, the whole composite fly-wheel set as it will be when completed. The total overall length will then be about 85 ft., and the set will comprise two induction motors and six generators with two fly-wheels, the whole designed for driving three reversing mill motors.

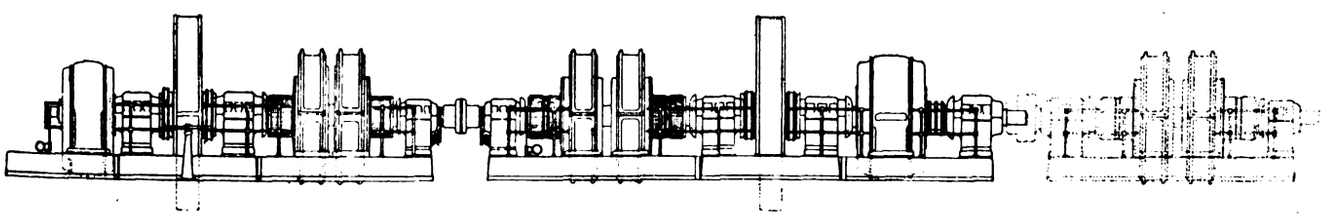

FIG. 9.—ARRANGEMENT OF MILL EQUIPMENT.

In conclusion, our thanks are due to Messrs. Palmers, and the various firms mentioned which have supplied plant, for permitting the publication of the above details and illustrations.

A New Heat-meter.—Difficulty having been experienced in computing the amount chargeable to individual occupiers of houses or flats when these are supplied with heat from a central installation, a new heat-meter has been introduced by Mr. Hans Henrichsen, of Hellerup, Denmark. It consists of three thermo-electric couples in boxes, two of which are attached to the radiator and the third fixed on the wall of the room. The temperature difference between the radiator and the wall produces a feeble electric current which is recorded by integrating mechanism, the radiators from each consumer being connected in series to the integrating meter. Careful trials at the Copenhagen Public Testing Station have shown that the current produced is very nearly proportionate to the amount of heat radiated. The error of the meters submitted amounted in a few cases to 5 per cent., but was frequently substantially less. The meters are carefully made, all thermo-elements being constructed of nickel and copper wire firmly attached to the conducting wires, which have the appearance of armoured cables. The heat elements are enclosed in strong boxes having soldered joints to prevent all interference and a layer of non-conducting material to prevent radiation. The heating elements of the radiators are fixed behind by an ornamental holder and are hardly noticeable. Meters of this type were used last winter in central heating installations in Denmark and were found eminently satisfactory.—*Technical Review.*

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ELECTRICITY IN MINES.

In our issue of January 16th, we gave some extracts from the general report of H.M. Chief Inspector of Mines, regarding the growth of the use of electrical plant in and about mines, and also referred to the fatal accidents, which, unfortunately, increased from two in 1917, to six in 1918, below ground. There was also one fatal accident on the surface, making seven deaths in all from this cause.

It is, however, satisfactory to learn that, in spite of all the difficulties created by the war, the use of electricity did increase by 5·66 per cent., and we have reason to believe that were the coal mines once handed back to the coal owners, very great and costly developments would be put in hand at once, many of which would be in relation to electrical plant. The North of England collieries, especially—where a bulk supply of electricity is available—appear to be gradually, but surely, replacing their old plant with new machinery driven by electricity. At present, however, the coal trade is being strangled with the uncertainty as to what is going to happen; and vast development work, and schemes of reconstruction which would greatly facilitate the better production of coal, are being held up. The great importance of this is recognised by the chief inspector when he says:—"In order to increase output, more machinery of the latest type, especially in connection with mechanical auxiliary haulage, should be introduced to replace the more costly systems by horse and by hand.

"Electrical apparatus and machinery, either not proceeded with at all, or long delayed through the prior claims of the war, should now be readily procured. In this respect it is well worth consideration whether the coal industry should not be given precedence over other industries in order to increase the output of coal." Everyone will, without doubt, cordially agree with these remarks of the chief inspector, especially when one realises that:—

"Development such as boring, sinking, and the driving of tunnels and cross-measure drifts to open out new seams practically ceased during the war, and in consequence, many of the pits will be seriously affected for some considerable time to come. The present state of the mines is necessitating, and will continue to require, a large amount of unproductive labour for a considerable time before the mines are upon a satisfactory peace footing." With regard to haulage machinery, it is important to notice that 62,775 horses and ponies were employed underground during the year, most of which could probably be replaced by electrical haulage machines, with very much greater efficiency, to say nothing of releasing these animals from what must always be a more or less dangerous employment. From this point of view, it may be interesting to note that during the year, 2,812 died either from injury or disease; 2,537 had to be destroyed for the same reasons; 7,992 suffered from injury, and there were 231 reported cases of ill-treatment.

While the use of coal-cutting machines slightly extended, there being, in 1918, 695 collieries where coal-cutting machinery was employed, against 678 in 1917, it is interesting to note that the output of mineral obained by these machines was reduced by no less than 322,840 tons; the output in 1917, from 3,799 machines, being 28,196,486 tons, and in 1918, from 4,041 machines, only 27,873,646 tons. Of these machines, 1,797 were driven by electricity, and 2,244 by compressed air, but of the latter 1,370, or more than half, were "percussive" type machines, which are mainly used in "heading" work. Of the "longwall" machines, by far the most popular appears to be the "disk" type, there being a total of 1,259 machines of this kind, against 595 "bar" type, and 791 "chain" type. Further, of the "disk" machine, 859 were driven by electricity, as were also 468 "bar," and 460 "chain" type machines. Scotland still holds the blue ribbon for coal-cutting machinery, having a total of 1,081 machines, 946 of which are electrically driven. The Yorks and North Midland Division follows with 882 machines, 429 of which are electric; the Northern Division, 860 machines, only 151 of which are electrically driven, but of the remainder 619 are "percussive" compressed-air driven machines: Lancashire and North Wales Division, 691, of which 399 are "percussive," and only 53 electrically driven; South Wales 156, with 58 electrically driven, 98 compressed air, of which 31 are "percussive": and Midland and Southern 371, which includes 160 electrically driven, and 211 compressed-air machines, of which 117 are of the "percussive" type. The following table, however, well illustrates the superiority of the electrically-driven machines, and shows the output obtained by the machines in the various inspection divisions.

OUTPUT OF MINERAL OBTAINED BY THE USE OF COAL-CUTTING MACHINES.

Division.	Total number of machines.	Worked by		Mineral obtained. Tons.
		Electricity.	Compressed air.	
Scotland	1,081	946	135	10,202,131
Northern	860	151	709	4,139,197
York and N. Midland	882	429	453	7,481,218
Lancashire, N. Wales and Ireland ...	691	53	638	2,682,063
South Wales ...	156	58	98	823,804
Midland & Southern	371	160	211	2,545,233
Total in 1918 ...	4,041	1,797	2,244	27,873,646
Total in 1917 ...	3,799	1,739	2,060	28,196,486

It will be noticed that over one-third of the total output was obtained from the Scotch coal mines, which have only 135 machines driven by compressed air, and of these 33 are of the "percussive" type. Also, with regard to the total output, we must notice that the reduction is not due to less "coal" being cut by electrically-driven machines, as this really increased from 16,081,034 tons in 1917 to 16,204,653 in 1918; but from compressed-air machines the output was only 11,118,327 tons in 1918, against 11,545,264 in 1917.

We also note with regard to electric safety lamps, that these increased in the year 1918 by 9,870, making a total of 156,521, of which 142,969 are magnetically locked; and it is also interesting to note that 10,730 fewer oil safety lamps were in use in 1918 than in the preceding year, the total numbers being (in 1918) 590,185; 24,761,030 shots were also fired by electricity.

With regard to output, the Chief Inspector says: "The output of coal was reduced from a total of 287,411,689 tons in 1913 to 227,714,579 tons in 1918; the latter is the lowest output since the year 1902. In 1902, 824,791 persons produced 227,084,781 tons." The total number of persons employed at coal mines in 1918 was 994,317, of whom 210,771 were females employed above ground; 199,551 were males employed above ground; and 783,546 were males employed below ground, 57,688 of whom were boys under 16 years of age.

Prosecutions.—There were two prosecutions under the General Regulations relating to electricity; one in which the manager and electrician of a Nottingham colliery were prosecuted for (1) Under 123 (*b*)—the use of inflammable material in the construction of a motor house; (2) under 124 (*a*)—cable-joint boxes not so installed as to prevent danger, so far as was reasonably practicable; (3) under 120 (*f*) (*i*)—cable in main switch-house at shaft bottom not mechanically protected; (4) under 129 (*f*) (*ii*)—insulating material at cable ends in motor house not efficiently sealed; and (5) under 134 (*c*)—adequate precautions not taken to prevent signal and telephone wires at shaft bottoms from touching power cables. The result of the trials was that the manager was fined on (1), (3), and (4), and charges (2) and (5) were dismissed.

With regard to charge No. 2, the fact was that high-pressure joint boxes were slung from the roof by comparatively thin rope. This is an insecure method of fixing a cable-joint box, for if a box falls there is a risk of a broken joint and a heavy flash, and serious accident to the persons employed. More than 90 per cent. of the joint boxes in the pit were so slung: but the manager, after the hearing of the case, undertook to have all high-pressure joint boxes securely supported from below.

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The manager of a Yorkshire colliery was prosecuted for contraventions of General Regulations 128 (*c*) and 123 (*b*), in that (1) efficient means to prevent danger were not provided for cutting off all the pressure automatically from the part of an electrical system in the event of a fault, and (2) inflammable material was used in the construction of a haulage motor room containing electrical apparatus. It is quite clear that every sub-circuit should have its own separate protection, and in neglecting to provide fuses or cut-outs in the circuit, an underground fire occurred which might have had serious results. A conviction was obtained on the the first charge, and the second was withdrawn on payment of the costs. The fine and costs amounted in all to £19 2s.

Surely it is time the responsibility for electrical apparatus in and about mines was taken off the shoulders of the colliery manager, and given to properly qualified and certificated engineers.

THE TORQUE OF TOOTHED ARMATURES.

BY LAURENCE H. A. CARR, M.Sc. (TECH.)

WITH a toothed, or slotted armature, most of the flux passes through the teeth, and the flux density in the slot itself is low.

This has led to the theory that the torque on the conductors is proportionately lower than would be the case with a smooth-cored armature carrying the same flux, since the product of current and flux density across the conductor is much smaller.

The balance of the torque on the armature is said by the exponents of this theory to be due to the magnetic pull between the teeth and the pole-face, the flux arranging itself with the correct tangential component, due to distortion, to give the observed result.

On the other hand, since there is no transformer action between the field windings and the armature windings, all the power input to the armature conductors (in the case of a dynamo) is mechanical, and this must, by the law of conservation of energy, be equal to the electrical power output (plus losses, if any).

In other words, the full torque of the machine must come on the armature conductors, this torque being that corresponding, not to the flux density at the bottom of the slots, but to the average air-gap flux density. In order to be convincing, however, the apparent paradox must be explained; in other words, the fallacy of the "reduced torque" theory must be fully exposed.

As in all such cases reference must be made to first principles, and here is the crux of the whole question.

There is no fundamental force of attraction between a given current, and a field strength of given flux density which can be defined as a first principle.

Maxwell* states that: "Any displacement of the electric surface (equivalent to a magnetic shell which has previously been considered) will be aided or resisted accordingly as it increases or diminishes the number of lines of induction which pass through the surface in a positive direction."

In other words, the magnetic pull is determined by the rate of change of flux, with reference to change of position, and electromagnetic pull is, and can be only, defined in this manner.

The usual formula for the pull of a conductor carrying current is based on the above definition, and in its simplest form may be written:—

$F = I\,l\,B$, where F is the force in dynes; I is the current in absolute units; l is the length of conductor in centimetres; B is the density of the magnetic field.

From the previous argument it follows that this is only true of a uniform field, since B in the above equation really represents $d\Phi/dx$, the rate of change of flux (Φ), with regard to the change of position of the conductor (x). If this equation be now applied to the toothed armature, it will at once be seen that it is wrong to take the flux density at the bottom of the slot, since the value of B there is no longer equal to $d\Phi/dx$.

Herein lies the fallacy in the "reduced torque" theory. As long as the armature and conductor move together, $d\Phi/dx$ has the same value as it would have in the case of a smooth-cored armature, since the conductor cuts the same total flux in any given time.

If, however, a slotted armature be set stationary in an excited field, and a loose conductor be placed in the centre of a slot, the conductor will not show the full normal torque, for as long as it moves along the bottom of the slot, without moving the armature, the value of $d\Phi/dx$ only corresponds to the actual flux density at the bottom of the slot. Similarly, the E.M.F. generated will only be low, corresponding to the low flux density.

As soon as the conductor moves, or is moved, into such a position that further movement turns the armature core, the torque and E.M.F. immediately rise to their full value, due to the apparent movement of the flux across the slot, which commences as soon as the armature begins to move.

* "A Treatise on Electricity and Magnetism," Vol. II, p. 137.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Electric Welding.

Can any reader give information with regard to the protection of operators' eyes by using goggles instead of screens with electric welding apparatus?

The screens appear to be very clumsy, as they prevent the operator using both hands; also it is impossible to see the job through the screen until the arc is struck.

Are there no goggles on the market similar to those used with acetylene welding plant, through which one can see the job before striking the flame?

R. A. Jones.

Shoreham-by-Sea.
January 19th, 1920.

[Not only the eyes, but also the face, neck, hands, and arms must be protected from the rays of the arc. Inquiries of this kind are usually answered by post; we insert this because it is typical of many such queries relating to matters which have been fully dealt with in our pages. This subject, for example, was discussed in the following issues of the ELECTRICAL REVIEW: November 1st, 1918, p. 414; December 20th, 1918, p. 612.—EDS. ELEC. REV.]

"A Red Rag to John Bull."

You do me the honour to refer to a letter of mine to *The Times* in which I identify world enlightenment with world peace, and express the view that without the one the other is impossible. You kindly exonerate me from responsibility for certain utterances by two American commercial men—Montague and Steenbohm by name—calculated to cause bitterness between British and American manufacturers and traders. You suggest the use of my "newspaper influence" against "indiscretions" inimical to what you generously term my "noble sentiments."

Of course, outbreaks such as those of Montague and Steenbohm—I assume they are correctly quoted—are not preventable. But editors either can refrain from publishing their remarks or can accord them the derision they deserve. If I had any "newspaper influence," or influence of any other sort, I should use it to dissuade editors and all other persons with access to the public mind from playing the game of mischief-makers, and catering to the vanity of fools, by giving the wrong kind of advertisement to what they say.

Montague is reported as foreshadowing the obliteration by Americans of foreign opposition in foreign markets. Who does not recognise on the instant that this is merely ignorant and arrogant bombast? And Steenbohm's idea (note the name) of bleeding the foreigner. Could economic idiocy go further? These gentlemen, unless victims of misrepresentation, appear to have a type of intellect not to be found this side of the Stone Age. England is our best customer, as we are hers. Fine business it would be—would it not—for us to impoverish her, or her us?

I gather from your article, "A Red Rag to John Bull," that certain New Zealanders do not like the Act of the American Congress permitting American trade combinations for purposes of foreign commerce. Such combinations are necessary for such purposes. Britain has many of them, the most experienced and powerful in the world. France has them. All countries who deal largely abroad must have them. As a matter of fact, America is far behind the international procession in this respect.

Do we squeal?

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We do not. We do not begrudge the British peoples a single honest penny they can make. We want to see them prosperous, we want to see France prosperous, we want to see every nation prosperous. And why? Well, for this reason, if for no higher: only in a prosperous world can we be prosperous. Those who think we care for nothing but dollars, if they can believe we are *intelligent*, will realise at once why, far from wishing to cripple other nations economically, we wish them to be abundantly prosperous. Just a free field, and no favour; no jockeying; no arbitrary, forcible, explosion-maturing methods—these are what, and all, Americans want.

Edward Price Bell.

Chicago Daily News,
London Bureau, *January 23rd*, 1920.

Electricity Supply.

I have carefully read your editorial comment with reference to the above, and it appears to me that you are rather hard on the contributor to *The Times Trade Supplement*.

Whilst the portion of the Electricity (Supply) Bill referred to as the second part does not of necessity do away with the autonomy of the companies, it certainly seems to me that it would provide all the power necessary to do so, and, therefore, justifies the contribution which you censure.

Quite apart from the question whether the policy of the original Bill would or would not be in the real national interest, there can be no question but that the District Board proposition is, from the company point of view, quite different from that of the Joint Electricity Authority; in the one case the Board is independent of the companies and set over them, whilst under the present Act the latter become, voluntarily, part and parcel of the J.E.A., and have an autonomy denied in the event of a District Board being imposed upon them.

It seems to me that this is the reading accepted by the Association's representative of the industry. The fight on the Bill, as I understand it, was on this very point, namely, that District Boards did away with the autonomy of the companies (and municipal undertakings also).

As to Joint Electricity Authorities being first allowed, we have to remember that even if they were formed it was possible under the old Bill to substitute District Boards at the will of the Electricity Commissioners.

J. Herbert Edwards,
Managing Director, Stroud, and other Electric Supply Companies.

Stroud, Gloucester, *January 20th*, 1920.

[We refer to this matter in our leading columns.—EDS. ELEC. REV.]

The "Lesco" Lampholder.

In reply to Mr. Hope's letter, may I make it clear that the criticism of the "Lesco" holder, in my first letter, is that the small indentations on the top part of the holder appear to me to be insufficient to carry the weight safely. I intended to say that the top part of the holder should be cast, and I did not refer to the bottom part, which I agree is made on normal lines.

Mr. Hope states that the top part of the lamp is made from a tube, and not from a stamping or spinning. Personally I do not think this makes much difference. If the metal of which the top part is made is too thin, then it does not seem to matter whether it is a stamping, spinning, or a tube. To save possible misunderstanding, I suggest that Mr. Hope gives the thickness of the metal of which the top part of the holder is made—I mean the metal having the small indentations. If Mr. Hope will give this in thousandths of an inch, I will be glad to carry the discussion further.

My own impression is that, if the method of carrying the holder is improved, the lampholder will be made into quite a good one, and my object in starting this correspondence was to bring about this improvement.

I may add that I wrote the manufacturers of the "Lesco" stating that I proposed to initiate a correspondence on the holder in the REVIEW. I have sent a copy of this letter to Mr. Hope, so that I trust that his answer relating to the thickness of the metal will appear in next week's REVIEW.

C. Turnbull.

Electricity Works,
North Shields, *January 22nd*, 1920.

Mr. Turnbull having sent me a copy of his letter to you, desires that I should reply to the same in the same issue of your paper. He narrows his criticism down to the strength of the small indentations in the top part of the holder, which he says appear to him insufficient to carry the weight safely, and he asks me to state the thickness of the metal used in this holder.

The thickness of the metal used is .032 in., and I am now able to give the strength of the indentations in question. The test consisted in adding weights to the bottom portion of the holder to find out at what weight the indentations would give way. The breaking point was arrived at when the holder was carrying 258 lb.; with this weight the projections were sheared off.

I do not think any further comment on my part is necessary, and I think that this test is sufficient to show that Mr. Turnbull's fears are quite groundless.

Vernon Hope.

Manchester,
January 23rd, 1920.

Civil Engineers' Registration.

I am instructed to inform you that an executive committee of the Society of Engineers, appointed to deal with the above matter, passed the following resolution on the 19th inst.:—

That this Society cordially approves the principle of the registration of engineers, but joins with other objectors in opposing the Bill promoted by the Institution of Civil Engineers on the following grounds:—

1. Though in the broad sense in which the Institution of Civil Engineers interprets its charter, professional engineers in all branches would be included in the term "civil engineer," it is nevertheless a fact that the term "civil engineer" is employed in a restricted sense, and is so used and understood by the public, by the universities, by technical schools, and by the engineering world in general. As the usage is at present, the title amounts to a misdescription.

2. This Society objects to the Institution of Civil Engineers being the sole body to determine who are to be placed on the register. The Institution of Civil Engineers, though a competent authority as regards its own members, has no mandate from the engineering profession as a whole to act on its behalf, and the determining body should be representative. Such a body should consist of members elected by the leading engineering institutions and societies, and of certain members nominated by His Majesty, much on the same lines as the General Council is appointed to regulate the qualifications of practitioners in medicine and surgery under the Medical Acts.

Alfred S. E. Ackermann.

Westminster,
January 20th, 1920.

Awards Delayed.

I was very interested in "C. R.'s" letter regarding the L.C.C. tramways and recent awards, but would like to inform him and your readers generally, that nothing else can be expected if the Government itself does not recognise its own awards. The War Office has not yet applied the E.P.E.A. award of last March to members of its power station staffs, neither has it applied the 5s. advance of last November either to members of the A.S.E. or otherwise. Does the War Office think that the cost of living has only gone up to others than its own civilian staffs? It is now 18 months since we received a paltry advance in salary, and all our applications for advances or awards are either consigned to the waste-paper basket or put in pigeon-holes bound up with great quantities of red tape. I maintain that the War Office as part of the Government should be the first to put all awards into execution at once, if only to set an example to other employers.

W.O. Electrical Staff.

January 25th, 1920.

Electric Cast-steel Chain Cables.—With the greatly increased output of ships in America, the shortage of chain cables and wrought iron suitable for their manufacture was necessarily much accentuated. In March, 1918, Lloyd's surveyors at New York reported that an American company had developed the manufacture of electric cast-steel cables, and had submitted samples of four different sizes to very severe tensile and shock tests, the results showing the tensile strength to be from 73 to 93 per cent. over that required by the statutory tests for iron cables, and the resistance to shock being still greater than these proportions. The results being so satisfactory, the surveyors recommended that sanction should be given for the use of such cables, which recommendation was subsequently approved, as a fentative arrangement, with a schedule of tests to be used in the case of cast steel cables of considerably greater severity than those applicable to iron cables, and such cables so tested have since been accepted for use in vessels classed by this society. All cables for British vessels are tested in accordance with the provisions of the Anchors and Chain Cables Act. The Act provides that any test approved by the Board of Trade as a test equal or superior to either the breaking or the tensile test specified in the schedule may be substituted for that test by order of the Board, and the committee has now received an intimation from the Board that the testing procedure above referred to will be sanctioned for application in this country, if the occasion should arise in the near future. An experimental stud-link cast steel chain cable made in Sweden has recently been forwarded to this country for the purpose of being crucially tested at one of the public proving houses under the society's control.

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THE PHYSICAL SOCIETY'S EXHIBITION.

(*Continued from page* 122.)

THE FOSTER INSTRUMENT CO. showed an improved type of fixed-focus radiation pyrometer, with an arrangement for ventilating and cooling the front portion of the receiving tube (fig. 11). It is also fitted with a sighting mirror, enabling the pointing of the receiving tube to be verified, where the working distance is long or the hot body is small. The mirror which receives and focuses the radiant heat is mounted in a special cell which can be removed from the tube. A fixed housing is also provided for use when the pyrometer is to be

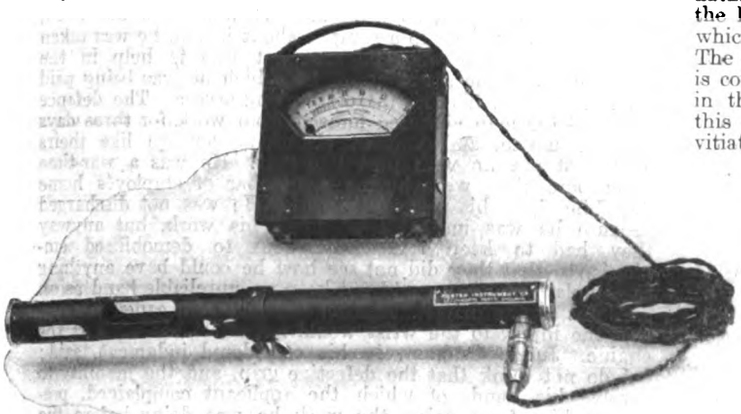

FIG. 11.—FOSTER PORTABLE PYROMETER.

continuously attached to the furnace wall (fig. 12), the standard tube being interchangeable with the housings, so that several of the latter can be provided in different positions. A closed-end refractory tube can be fixed to project into the furnace. Various thermo-couples (of the Hoskins alloy) and pyrometers were shown, as well as impact testing machines.

THE DUBILIER CONDENSER CO., LTD., had on view a selection of high- and low-tension condensers suitable for use in wireless transmitting and receiving. These condensers were similar to those shown at the British Scientific Products Exhibition.

THE CONCORDIA ELECTRIC WIRE CO., LTD., had a show case of bare and covered instrument wires, including copper and resistance alloys covered with various materials for use in electric magnets and other similar devices.

THE IGRANIC ELECTRIC CO., LTD.—This exhibit comprised the "Leesona" electric coil-winding machine, together with sample coils as shown at recent engineering exhibitions, and also samples of a lockout switch or panel, counter E.M.F. starter, electric vacuum flask, &c.

MR. F. HARRISON GLEW exhibited radio-active substances and apparatus for detection and measurement. Demonstrations of the properties and uses of radium were given at intervals, and radium luminous compound, the many applications of which need not be gone into, as well as luminous gun sights and other instruments were on view.

MESSRS. A. GALLENKAMP & CO., LTD., exhibited scientific apparatus for the heat treatment of metals, including new apparatus designed by Mr. C. R. Darling. The furnaces which were shown in operation, being electrically heated, were similar to those seen at the recent engineering exhibitions, and were described in our pages at the time.

THE CAMBRIDGE & PAUL INSTRUMENT CO., LTD.—This exhibit consisted of a selection of finely made and finished scientific instruments. The new electrical CO_2 recorder enables the percentage of CO_2 in flue gases to be determined by an electrical method, which does not involve the use of any chemical absorbent; moreover, while the portion of the instrument through which the gases actually pass can be placed in close proximity to the flue, the recorder may be some considerable distance away. The method employed for measuring the percentage of CO_2 is one devised by Dr. G. A. Shakespear, of the University of Birmingham, for testing the purity of gases. The composition of the flue gas is compared with that of air by means of a katharometer consisting of two identical spirals of platinum wire contained in two cells drilled in a copper block, each of the spirals being connected to form one arm of a Wheatstone bridge circuit. If a fairly large current is allowed to flow in this circuit the two spirals become heated and lose heat to the walls of the cells. The rate of cooling depends on the thermal conductivities of the gases in the cells, so that if the two cells contain gases of different conductivities the two spirals will cool at different rates. The difference in temperature of the two wires will cause a deflection of the galvanometer, the extent of the deflection depending on the difference in conductivity of the two gases. If, therefore, one cell of the katharometer contains a pure gas and the other the same gas mixed with some other constituent, the extent of the deflection will be an indication of the amount of the second gas present, and the galvanometer can be calibrated to show directly the percentage composition of the mixture. The difference in conductivity between air and carbon-dioxide enables the method to be employed to determine the percentage of CO_2 in flue gases. Fig. 13 shows the katharometer and water aspirator, which are enclosed in a metal case with a glass door. H is the katharometer screwed into the chamber K; the open cell of the katharometer communicates with this chamber, through which the flue gases are drawn by the water aspirator E. The other cell of the katharometer, which is filled with air, is connected to the tube F containing water, so that the air in the katharometer cell is kept saturated. The object of this is to prevent the water vapour in the flue gases from vitiating the readings, as it would do if the flue gases were

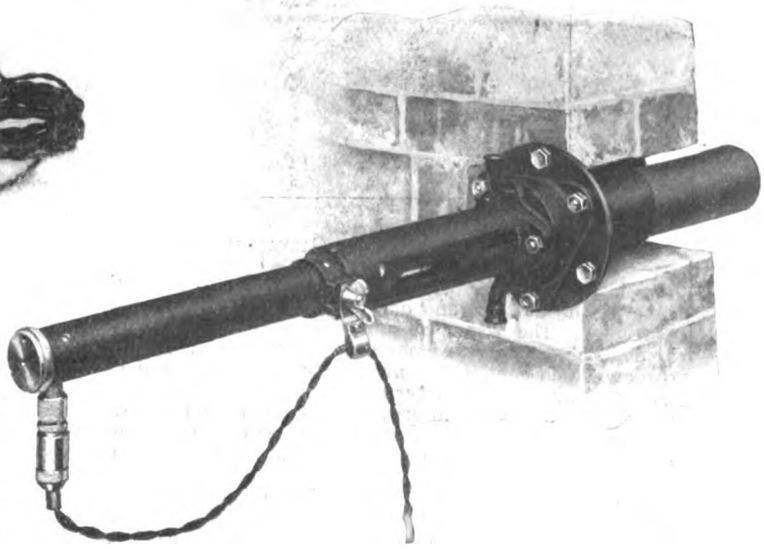

FIG. 12.—FOSTER PYROMETER IN FIXED HOUSING.

compared with dry air. When the gas in both cells is saturated with water vapour the effect of the latter is the same on both sides, and the readings are not influenced. Owing to the nearly equal conductivities of air and carbon-monoxide the presence of the latter gas does not affect the readings. To the screwed plug G is attached a filter box of glass wool

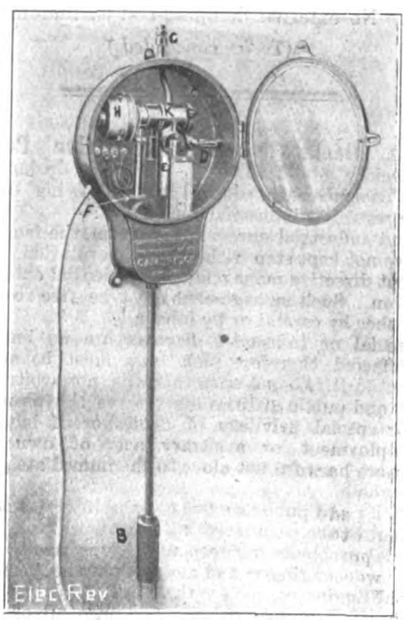

FIG. 13.—CAMBRIDGE ELECTRICAL CO_2 RECORDER.

for cleaning the gas which passes into the katharometer; D is the water inlet to the aspirator, and the pipe carrying the gas from the flue is connected to the tube C. A soot filter should be inserted between the flue and the tube C, and at the lowest point of the pipe a T-piece with its end dipping under water should be provided as a drain for condensed

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steam. The U tube on the front of the aspirator is half filled with water, and when the aspirator is not working the water level in this tube will be quite steady, and will indicate the chimney draught. The water flow regulator B is designed to give maximum efficiency in the working of the aspirator;

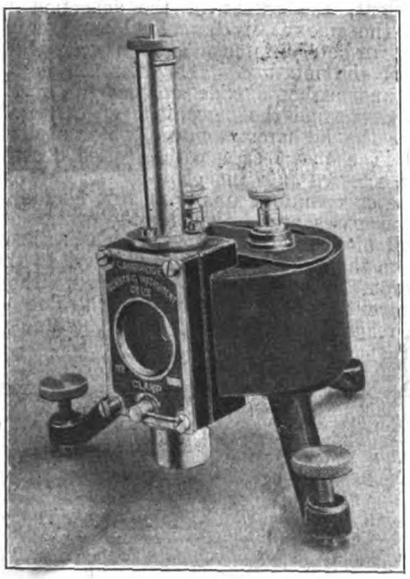

Fig. 14.—Cambridge Galvanometer.

the flow is adjusted until water runs freely out of the fine tube at the bottom, and only trickles out of the wider overflow pipe. The water consumption is about five gallons per hour. The records are obtained by means of a thread recorder, which consists essentially of a suspended coil galvanometer in which the pointer is depressed by means of a clockwork mechanism at intervals on to a thread impregnated with ink, which passes above the surface of a revolving drum carrying a chart. The charts are calibrated to read directly the percentage of CO_2.

The moving-coil galvanometer, shown in fig. 14, has been designed to provide a simple and inexpensive instrument of good sensitivity suitable for general laboratory work and for students' use. The coil is wound with non-magnetic, silk-covered wire on a wood former, suspended by phosphor bronze-strip from a simple torsion head, and can be clamped by turning a handle. The small metal chamber enclosing the magnet poles and the moving coil is made dust-tight. With the standard phosphor-bronze suspension the complete period of the double swing out of the magnetic field is about 6 seconds, and the deflection time when critically damped about 4 seconds. The galvanometers are supplied with the coils critically damped unless specially ordered for ballistic or other work. No external damping coil is, therefore, required.

(To be concluded.)

American Declaration on Productive Power.—The American Society of Mechanical Engineers during its annual meeting on December 4th, adopted the following declaration of principles in regard to industrial conditions :—

"Social and industrial unrest result from the fact that human relations have not kept step with economic evolution.

"Competent directive management of essential enterprises is the logical solution. Such management must be free from autocratic control, whether by capital or by labour.

"Sharp social or industrial disputes are no longer private: Society is affected. therefore such cases must be subject to the decision of authorities based upon intrinsic, not arbitrary law.

"Industry and public utilities must serve the people. There is no room for special privilege of capital or of labour. Strikes, irregular employment. or arbitrary acts of ownership or of management are harmful not alone to the immediate parties, but to society as a whole.

"Productivity and public service are absolutely essential.

"On account of the peculiarly intimate familiarity of engineers with industrial problems, our responsibility is great.

"Therefore, we, engineers and members of the American Society of Mechanical Engineers, declare that the following essentials are established by facts and experience, and urge all of our members to uphold them and invite other engineers to co-operate with us in having them unanimously recognised, viz. :

"Every important enterprise must adopt competent productive management, unbiased by special privilege of capital or of labour, and disputes must be submitted to authorities based upon intrinsic law.

"Credit capital represents the productive ability of the community and should be administered with the sole view to the economy of productive power, that is, it should be granted only to those who are able to render valuable service."

LEGAL.

Workmen's Compensation Cases.

Judge Graham, K.C., gave a considered judgment in the Bow County Court, on January 21st, in the Workmen's Compensation Act claim in which Edward Hanxwell, an assistant engine driver, asked for an award of £1 a week, or £150, from the Charing Cross, West End and City Electricity Supply Co., Ltd. Mr. Barnes appeared for the applicant, and Mr. Ellis Hill was counsel for the respondents. The man was cleaning the engine pit, when the ladder fell, and he fractured his right wrist. At the time, he alleged, he was earning £4 12s. a week, and was paid 25s. compensation. Then he went back to work, but found it most difficult to turn the levers with his wrist so injured. Then he was dismissed, but the union kicked up a rumpus about it, and he was taken on again, but the work he then got was to help in the cleaning out of the street boxes, for which he was being paid £3 10s. a week, his loss therefore being severe. The defence was that the man absented himself from work for three days without notice, and a great electricity concern like theirs could not put up with men like that. He was a war-time hand, and they were having a number of employés home demobilised, so his place was filled. He was not discharged because he was incapable of doing his work, but anyway they had to keep their obligations to demobilised employés, so that they did not see how he could have anything to complain of; they could not keep an unreliable hand as an assistant engine driver. Medical evidence was called to show that the injury to the wrist would not affect his work at the engine. Judge Graham, in his considered judgment, said: "I do not think that the defective grip, and the inability to revolve his hand, of which the applicant complained, prevented him from doing the work he was doing before the accident. In my opinion, he was quite capable of doing it, and Dr. Thompson, the medical referee, agrees with me. The application must therefore be dismissed with costs."

British Thomson-Houston Co., Ltd. *v.* Corona Lamp Works.

In the Chancery Division, on Tuesday, January 20th, Mr. Justice Sargant began the hearing of an action by the British Thomson-Houston Co., Ltd., of 83, Cannon Street, E.C., against the Corona Lamp Works, of Ascham Street, Kentish Town, N.W., for an injunction restraining the defendants from infringing their letters patent No. 10,918, and asking for damages, or an account of profits, and delivery up of any infringing articles.

Mr. Colefax, K.C., Mr. T. Hunter Gray, K.C., and Mr. Whitehead were for the plaintiffs, and Mr. A. T. Kerly, K.C., Mr. R. Frost, and Mr. J. Ewart Walker for the defendants.

Mr. Colefax said the patent was concerned with improvements in incandescent electric lamps, and related to gas-filled lamps in contradistinction to vacuum lamps. It was an invention which had given rise to the "half-watt lamp," and was made and worked out in the laboratories of the General Electric Co., U.S.A. It was found that by filling the lamp with an inert gas, and using either a thick or a spiral filament, a lamp could be produced of a higher efficiency than any previously put on the market. The defendants relied on various specifications of other patents which, they said, disclosed the invention now in question. It was also alleged by the defence that there was invalidity and insufficiency, and infringement was denied. They admitted selling certain lamps which, the plaintiffs said, infringed the patent, being gas-filled and with spiral filaments.

Mr. James Swinburne, consulting engineer, said it was found that the tungsten lamp could not be made commercially under one watt per candle, and the inventor realised that if he put a suitable gas into the bulb it might stop the vaporisation of the filament, and carry away the heat. He also found that under proper conditions with a thick filament the light was increased. The result of the invention was a fundamental change in the process of lamp manufacture, which was of enormous commercial importance.

Cross-examined, Mr. Swinburne said he only knew of a very few lamps on the market without spiral filaments.

Mr. Kerly: Have you ever seen a half-watt lamp with a straight filament?—Oh, yes; but I don't know whether I have seen them commercially.

Have you ever seen any lamps with straight filaments made within this specification?—I don't remember having seen one.

Do the lamp-makers desire to have the filaments as thick as circumstances will allow?—Yes.

On Wednesday, January 21st, Mr. Swinburne was cross-examined further by Mr. Kerly, and agreed with counsel that the only way he could turn a vacuum lamp into a gas-filled lamp for the same candle power and fixed voltage was by reducing the section and also reducing the length of the filament.

The hearing was continued on Thursday and Friday.

Dr. Passmore, consulting chemist, giving evidence for the plaintiffs, said he had considered the plaintiff's specification and the various alleged anticipations. He saw no difficulty

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in comprehending the invention or in putting it into practical use. In the plaintiffs' specification were the words "in concentrated form," and he saw no difficulty in applying that alternative practically. Working in a gas, one knew that the exposure of the surface cooled the mass considerably; one wanted to expose less surface, and one concentrated mass still retaining the filament. Contrasting the filament in a lamp in accordance with the invention with that of the tungsten vacuum lamp, the range of temperature was from 2,000 deg., at which the vacuum tungsten lamp ran, to 2,500 deg.-3,000 deg., at which they could and must run in order to get the increased efficiency of the gas-filled lamp. The specification referred to tungsten or other refractory metal. At the date of the patent there were other refractory metals than tungsten, known as tantalum, osmium, and molybdenum.

MR. EDWARD ALFRED GIMINGHAM, a practical electric lamp maker, in cross-examination, said this was an advance on all previous practice. In each form of incandescent electric lamp the difficulty had been to get a low candle-power with a high voltage. So far as gas-filled lamps were concerned, improvement was still going on, and to-day they could obtain a much lower candle-power on a voltage of 100 volts.

MR. J. H. GRAY, K.C., for the plaintiffs, said sales of the patented lamps in this country could be proved to amount to 5,800,000. Addressing the Court on the conclusion of the plaintiffs' case, Mr. Gray said none of the prior documents relied on by the defendants showed a combination of gas and coiled wire. The suggestion that there was a wonderful combination or ring that controlled tungsten filament lamps had not been proved. There was a large number of patents for tungsten filament lamps, but not one of them approached the combination now invented.

MR. KERLY, opening the defendants' case, said he attacked the patent on two grounds: (1) That the ambit of the monopoly claimed was not indicated with proper definition; and (2) that when it had been ascertained that the alleged invention was as claimed, there was, having regard to the admitted public knowledge and the prior specifications, no such invention.

On Tuesday, when the hearing was resumed, Mr. KERLY said there were two quite distinct branches of the argument that he desired to press on his lordship; in logical order they were (1) meaning of the definition and the sufficiency of the claim; and (2) the subject matter. He attached the greater importance to the subject matter, but the question of the definition was a serious matter for consideration. The question whether the definition was sufficiently precise had two aspects ordinarily: the more important aspect was: had the inventor sufficiently described for a user of the patent what he proposed to do? The other aspect was: had he sufficiently indicated the limits of his monopoly so as to show what ground was left open and uncovered by his monopoly? His lordship would have to answer these questions: Was there a definite invention? If not, there was nothing to define. Was it clearly and definitely stated in the claim so as to show what was left uncovered and free and, incidentally, how to work it? Was the suggested delimitation a fair construction of the claim? Was there subject matter? Had infringement been proved? Counsel quoted law on the subject of definition, and said that for this branch of his case he could assume that there was a good invention here if it had been properly defined. He contended, however, that the inventor had claimed a bigger monopoly than he was entitled to by his supposed invention. He submitted as a general proposition which was sound and also was good law that no definition which depended upon prolonged experiments to be made by a person who desired to find its limits and then only defined the ambit for particular members of the combination claimed could possibly be sufficient for patent purposes.

The hearing was adjourned.

A.S.E. *v.* SMITH, BARKER & WILSON.

HALIFAX Munitions Tribunal, on Monday, gave its decision in this case against a firm of machine tool makers, of Halifax, who were summoned for breaches of the Restoration of Pre-war Practices Act by continuing to employ female labour in turning, fitting, and slotting operations, which before the war were done by skilled labour or apprentices. The main defence, says the *Daily Telegraph*, was that the practice of employing women was not in consequence of the war, but owing to standardisation making the work of a repetitive character. The tribunal considered that the former practice was departed from in consequence of the war; but, believing that the respondents acted in good faith, they imposed a modified penalty of £50. Notice of appeal was given.

FARRANT *v.* COUNTY OF LONDON ELECTRIC SUPPLY CO., LTD.

IN the City of London Court, on January 26th, before Assistant Judge Jackson, this case, already reported in these columns, was mentioned by Mr. W. J. LARK, the applicant's solicitor. The action had been brought by MRS. Elizabeth Farrant, 84, Fame Park Road, Putney, against the respondents, Moorgate Court, Moorgate Place, E.C., to recover £300 as compensation for the death of her husband who was killed on May 31st at the respondents' high power sub-station at Pascals works, Streatham, when in one of the switch rooms. When the case was tried before the Deputy Judge, Sir John Paget, K.C., he found for the applicant for £300 and costs. Mr. Lark said that the respondents had intimated their intention of appealing, and notice of appeal had been lodged. But they had now decided not to appeal, and application was therefore now made for payment out of the £300 to the widow. She was the only dependent. The Assistant Judge granted the application.

LINDSELL *v.* PAIGNTON ELECTRIC LIGHT CO.

AN interesting question with regard to whether a company should charge for electricity supplied to a kinema as for power or for lighting purposes, came before the Divisional Court of King's Bench, composed of Mr. Justice Bray and Mr. Justice Bailhache, on January 23rd, upon an appeal from the judgment of the County Court judge of Paignton.

Mr. Cecil Ince appeared for the appellants, who were the Paignton Electric Light Co., and Mr. Jowitt was counsel for the respondent, who is the proprietor of a picture palace at Paignton.

MR. INCE said that the appeal was from a judgment in favour of the plaintiff in the action which was for the return of alleged overcharge by the electric lighting company, which the plaintiff said he had paid under protest as the charge had been made for lighting instead of for power. The figures were comparatively small, but the question involved was of great importance to electric companies supplying power to kinema halls. The rate for supplying energy for lighting was 7d. per unit, while that for motive power was only 3d. The short point was whether energy supplied to a kinema hall and passed through a transformer which reduced the pressure, and which was then fed to an arc lamp used to throw the picture on the screen was supplied for lighting or for motive power. His contention, said counsel, was that it was supplied for lighting, and should be paid for at the higher rate. The contract was in the application by the respondent for the supply of electricity by the company. If he used it for lighting purposes he was to pay for it at the higher rate of 7d. per unit. The current was led to the transformer at a pressure of 440 volts, and passed out at a voltage of 60, and was used for an arc lamp.

MR. JUSTICE BAILHACHE said that if the current had been supplied direct to the lantern it would obviously have been for lighting purposes, but it was passed through the transformer to make it more useful for the purpose for which the plaintiff required it.

MR. INCE said that only one ampere was used for the film-driving machine, the remainder being used for lighting. It was one out of 35, which was a very small proportion. The company charged the whole to lighting.

MR. JUSTICE BAILHACHE: Then to the extent of 1/35 of the whole they were wrong.

MR. INCE, in reply to questions by his lordship, said that the current used to light the hall did not pass through the converter, and for it there was a separate meter. His submission was that the learned judge of the County Court misled himself by not looking at the whole process.

MR. JOWITT, for the respondent, said that it was a pure question of fact, as to how the electricity which lit the arc lamp came into existence. If it was the electricity supplied by the company used merely in a different shape then it might be said that the electricity used for lighting the arc lantern was supplied by the appellants. But the dynamo created new electricity altogether. It was mere accident that the dynamo was driven by electricity and not gas. The company's energy was used for motive power only.

Their lordships intimated that under all the circumstances it was desirable that they should, before giving judgment, see the report of the expert, Mr. Swinton, upon which the County Court judge was said to have acted.

The hearing was thereupon adjourned for the production of that report.

REVIEWS.

The Coal Consumption of Power Plants. By R. H. Parsons, M.Can.Soc.C.E., Assoc.M.Inst.C.E. Pp. 24, 5 figs. London: THE ELECTRICAL REVIEW, Ltd. 1919. Price 1s. net.

The difficulty of obtaining coal at all nowadays, not to mention the price which has to be paid for it even when it is procurable, is compelling all consumers to take far more interest than formerly in the efficient operation of their boiler plants. The present monograph appears, therefore, at a very opportune time, providing as it does a really practical method of keeping a continuous check upon the efficiency with which coal is utilised for the purposes of steam raising. What the author does, in the first place, is to show engineers how to get a definite answer, and one applicable to their own particular plants, to the following questions, viz., how much coal ought to be burnt for any particular output of energy, and how much water should be evaporated by this quantity of coal? Such knowledge provides criteria against which the actual performance on every shift can be judged, no matter what the output of the plant may be. Thus the effect of any change in operating conditions, whether intentional or

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otherwise, can be immediately detected. This in itself is sufficient to bring about a rapid improvement in the economy of most plants.

The method devised by Mr. Parsons is a graphic one, so that the results appeal to the eye in a manner that mere figures can hardly do. Yet the analytical study of the graphs, as given in the pamphlet, throws a most interesting light upon the operation of a station. It is shown that the constant losses both in the boiler room and engine room can be readily determined, and that the exact quantity of coal required for any additional load that the station may be called upon to carry can be calculated. The merit of the method is that these results are obtained, not by laboriously building up estimates from first principles, but by deducing them directly from the everyday performances of the plant without the necessity of making any special experiments. The reviewer, from his personal experience, can give testimony as to the practical advantages of the method in maintaining a high boiler-room and engine-room efficiency, while the insight into the fundamental conditions of the plant which results from a study of the graphs is greater than can be obtained in any other way.

The latter portion of the pamphlet contains some very practical remarks upon bonus schemes in general, and then proceeds to describe a system of bonus payment to power-house employés in respect of efficiency of operation. Each class of workers is considered separately, and each shift also stands or falls on its own merits, so that the demoralising effect of a general bonus shared equally amongst all employés is avoided. The inauguration of any satisfactory bonus scheme on a power plant depends first of all upon the practicability of devising some method of determining the efficiency of operation of the boiler room and engine room respectively. As the first part of the pamphlet shows how the efficiencies of these departments can be definitely ascertained, the correlation of a bonus scheme with the efficiency obtained is not a difficult matter. Several schemes might be devised, but we doubt if any could be found which would be simpler and more generally applicable than that advocated in the work under review. Briefly, it consists of comparing the operating results with the standards of efficiency of the particular plant, and then increasing the workmen's wages by the same percentage as that by which they may have improved upon the standard. As the latter is essentially the average of the station performances, there is always an even chance of beating it. Moreover, while the bonus is an acceptable amount in respect of such savings as are normally possible, it works out to a limit of "double time"; which any station manager would gladly pay if one hundred per cent. of his fuel could be saved!

The bonus scheme, like the method of keeping a check upon coal and water consumption, is applicable to industrial undertakings of all kinds, and is by no means confined to central power stations. All engineers using coal should, therefore, study the pamphlet in question, for they will find it one of the most interesting and valuable little publications on power-plant economy which has yet appeared, while the experience and reputation of the author are sufficient guarantee that his recommendations are both sound and practical. It deserves, and no doubt will have, a very wide circulation.

F. D. N.

The Thermionic Valve and its Developments in Radiotelegraphy and Telephony. By Prof. J. A. Fleming, M.A., D.Sc., F.R.S. London: The Wireless Press, Ltd. Pp. xv+280. 1919. Price 15s. net.

It is very fitting that the pioneer of the thermionic valve should be the first to publish in this country a comprehensive volume dealing with the applications of a device which, by his genius, was made possible, although its practical development has been very largely shared by others.

As one reads the first chapter of his book, one recognises the same qualities, the same lucidity, the same facility for rendering simple that which is really complex, which characterises Dr. Fleming's previous works on wireless telegraphy.

Its readability and the convincing style appeal first to the reader. He then appreciates the concentrated mass of information supplied.

The objects of the book are, as Dr. Fleming admits, twofold. He desires to collect and present the essential facts connected with the development of the thermionic vacuum tube. He has also found it incumbent on him to explain in detail the early history of the Fleming valve, "on account of the efforts which have been made to depreciate the author's work." This he does in an interesting manner, which embraces the discoveries which led up to the application of the unidirectional conductivity of a lamp containing a cold plate to the receiving of wireless signals. The first half of the present volume is devoted to this object, and an appendix is added, containing in detail accounts of the famous American patent actions dealing with the Fleming valve. A portion of the book is thus given a rather controversial appearance, which, however, is readily excusable. It is not desired here to provide any excuse for a revival of a controversy which perhaps has been influenced just a little by commercial considerations. The wireless community, as a whole, are a little tired of the discussion and the lack of generosity and mutual recognition sometimes shown.

Chapter I is an historical introduction. The discovery and measurements of the electron are fully described, and also the early work in connection with thermionic currents. Prof. Richardson's work is given the prominence due to it.

Chapter II describes the origin of the Fleming valve, its development and practical applications. The author points out that a common mistake is to suppose that the Fleming valve was designed to be operated as a soft valve containing ionisable gas. He remarks that he never specified the degree of vacuum, and quotes his article in *Technics* of April, 1905. He always attributed the action of the valve to electronic emission, and maintains, with considerable justification, that the result of improved methods of exhaustion does not constitute a new invention. While giving generous appreciation to the work of Langmuir, Dr. Fleming considers that the vacuum tubes of the "pliotron" class are merely more highly exhausted Fleming valves. The difference between the two is quantitative rather than qualitative. The last portion of Chapter II contains descriptions of various vacuum pumps including the Geryck, Gaede, Cosmos, and Langmuir pumps. These few pages will be of considerable interest to the technical reader.

Chapter III deals with the three-electrode vacuum tube invented by Lee de Forest. The work of Armstrong, Lieben, Reisz, and others is mentioned. A method of measuring slopes of characteristic curves devised by E. V. Appleton is described.

Chapter IV deals with the valve as a generator of oscillations. It is pointed out that Franklin's "reaction" patent (No. 13,636/13) was applied for three months before Armstrong's "regenerative" patent. Various typical circuits are shown and also methods of using the Dynatron.

Chapter V describes briefly the action of the valve as a detector. A description is given of current limiting devices developed by F. P. Swann and G. M. Wright.

Chapter VI is a very brief account of the use of the vacuum tube in wireless telephony.

Chapter VII deals with modern improvements in thermionic apparatus, and a number of amplifier circuits, continuous wave receivers, and continuous wave transmitters are described. The volume closes with a few quotations from recent theoretical papers.

Throughout the book the author gives innumerable references which are of very great use to the reader who proposes to go further into the subject. The fullest recognition is given to the work of other investigators.

The first portion of the book, especially, is of the utmost value, and one's only regret is that the "severe limitations imposed upon the size of the book" prevented the inclusion of some of the latest circuits and apparatus. The volume will receive a well-deserved success.

The format, printing, and paper of the book are of high quality, and the publishers are to be congratulated on their part in the production of the volume.—JOHN SCOTT-TAGGART.

Foster's Pocket Reference Books. Published by Frank Foster, College Road, Manchester. Price 2s. net each.

No. 1, Mechanical Engineering.—This little book of ninety-odd pages of notes and general information on mechanical engineering will be found to contain a fair proportion of matter not given in other pocket reference books. The information is concise, definite, and in most cases based on up-to-date practice and experience. The range of subjects dealt with is much wider than usual in books of this character, and includes notes and tables on cotton mill machinery, paper making, brickwork, portland cement, timber, gas producers, and a variety of other matters of general interest to the mechanical engineer.

It is rather hard to say to whom this little book would be most useful; the works manager and the consulting engineer will find a great deal of useful, practical, and reliable information. It would be an advantage if the index was enlarged for reference purposes.

No. 2. Iron and Steel Work.—This book contains 110 pages of extremely useful information, both in form of notes and tables. A good deal of the matter is original, and much of the remainder cannot be found in other pocket books. It should be of great use to all those engaged in the iron and steel industry, and can be recommended.

The following subjects are dealt with either in the form of tables or notes: Coke-oven recovery; blast furnaces, design, output, and slags; blast furnace gases; electric furnaces; blowing engines; open hearth furnaces; acid open hearth; basic open hearth; crucible steel; tool steel manufacture. The important subject of rolling mills is dealt with in detail.

No. 3. Foundry, Iron and Steel, Non-ferrous.—Again in this book we find a large amount of information not contained in the majority of pocket books. It deals with a subject of which the average moulder knows very little. The matter is condensed and written in a manner any mechanic can understand. The subjects dealt with include every branch of iron and steel moulding, the most important being: Moulding sands, core sands, pouring sands, moulds, cast iron mixtures, cupola charges, suggested standards for mixtures, steel melting, electric steel furnaces and phosphor bronze mixing. This book deserves a successful sale among all those engaged on the practical side of foundry work.

E. P.

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BUSINESS NOTES.

Our Half-Yearly Index.—The Index to Vol. 85 of the ELECTRICAL REVIEW, which is now ready, will be supplied only to those who, through the post, specially apply for it. To such it will be supplied for 3d., post free. Any reader or advertiser, at home or abroad, who requires a copy for binding, or for other purposes, is asked to make application therefor promptly to: The Publisher, ELECTRICAL REVIEW, 4, Ludgate Hill, London, E.C. 4.

Clearing Office (Enemy Debts).—The Controller states that the pre-war rate of exchange on Germany referred to in the Treaty of Peace, at which debts or claims against German nationals are convertible into British currency is—Marks 20.5075 equals £1—and that the calculation must be made by the creditor or debtor before preferring his claim or tendering payment of his debt. Notice is also given to debtors of German nationals for sums of under £50, who were not required under the Proclamation to register their debts with the Public Trustee, that they are required at once to pay to the Controller at Cornwall House, Stamford Street, S.E. 1, the amount of such debts with interest at 5 per cent. per annum from August 4th, 1914, except in cases where the debtor is liable to pay interest at some different rate or from some other date. Creditors in preferring their claims are requested to comply with the directions in the margin of the form of proof and circular letter which was sent to them by the Controller. It is of importance that two extra copies of the detailed particulars of the account which is endorsed on or exhibited to the proof, should be attached to it when lodged at the Clearing Office. Failure to observe this requirement will lead to delay in payment of the claim.

Spanish Government Contracts.—A translation of a complete list of articles in which foreign competition will be admitted in connection with the Spanish Government Contracts during 1920 may be consulted by British firms on application to the Latin-American Section of the Department of Overseas Trade. The *Board of Trade Journal* states that the list is divided into sections, including machinery, motors, engines and apparatus in general; electrical materials; scientific material for instruction and research purposes; material for building purposes, &c.

Continental Trade Tours.—In order to compete with the permanent samples exhibitions and kindred enterprises now in being or process of formation on the Continent, the Department of Overseas Trade (Foreign Office and Board of Trade) proposes to organise a series of British trade tours in the important commercial cities of Europe. Provided a sufficient number of British manufacturers are willing to participate in the scheme, its organisation can be put in hand immediately, as the necessary preliminaries have been completed. The undertaking would be handled on the lines of a theatrical tour—viz., movable shows visiting permanent buildings at fixed dates advertised in advance. Sites would be secured in the important Continental centres of industry, either by Consular arrangement or with the co-operation of the local Chambers of Commerce. The various trade fairs would then tour these sites, occupying roughly a month at each city, a full fortnight in actual exhibition, and the remainder in erecting, dismantling, packing, and transportation. This period would vary slightly, as shown in the following itinerary and time-table:—

	Open for		Open for
Amsterdam	2 weeks.	Barcelona	2 weeks.
Brussels	2 weeks.	Marseilles	2 weeks.
Amiens	1 week.	Genoa	2 weeks.
Paris	2 weeks.	Naples	2 weeks.
Bordeaux	2 weeks.	Athens	2 weeks.
Lisbon	2 weeks.	Constantinople	2 weeks.

At the outset there will be four exhibitions starting at intervals of four weeks. The work of advertising, publicity, and issuing invitations to the right class of buyers and of the public would be undertaken by our Trade Commissioners and Commercial Secretaries. Particulars of costs and regulations are not yet available, but will be issued shortly.—*Board of Trade Journal.*

The New Italian Tariff.—The proposed new Customs tariff in Italy is now under the consideration of a Parliamentary Committee. It was prepared under the auspices of the late Government, and is of a highly protectionist nature, a special differentiation being made as between goods from late enemy countries and those from Allied and other nations. It cannot be foreseen what alterations, if any, the tariff will undergo under the new Government. As projected, however, the duty on steam marine engines, which in the old tariff amounted to 6 lire per cwt., is put at 9½ lire per cwt. in the general tariff, whereas such engines of German or Austrian origin are to be subject to a rate of 56 lire per cwt. The same rates also apply to steam engines of all kinds.

An A.E.G. Extension.—The Berlin A.E.G., whose cable factory adjoins the Oberschonweide engineering works, proposes to acquire the latter for a sum of 7,500,000 marks. The works, which is closely associated with the Ludwig Loewe group, was formerly known as the German Niles machine-tool works.

Industrial Tendencies in Germany.—*Deut. Allg. Ztg.* states (according to the *Economic Review*), that Messrs. Ludw. Loewe & Co., of Berlin, are increasing their capital by Mk. 5 mill., "in view of the increased costs of production and the decline in the workers' efficiency."

Industrial League: Change of Offices.—The Industrial League and Council has moved into larger premises at Grosvenor Mansions, 82, Victoria Street, S.W. 1.

Prices of German and Swiss Electrical Securities.—The *Deut. Allg. Ztg.* gives the following fluctuations in shares on the Berlin Bourse during December:—

	Dec. 1st.	Dec. 15th.	Dec. 19th.	Dec. 31st.
Deutsch-Ueberseeische Elektrizitätsgesellschaft	812	675	560	915
A.E.G.	240	249·75	230	243
Schuckert	147·60	141	140	151
Siemens u. Halske ...	243	255	255	271

The following falls in Swiss shares on the Zurich Bourse during 1919 are reported by the *N. Zürcher Ztg.*:—

	Dec. 31st, 1918.	Dec. 31st, 1919.
Electrobank, Zürich	880	260
Aluminium Ind. Ges.	2,790	1,790
Brown-Boveri A.G.	1,460	1,220

—*Economic Review.*

Postage on Catalogues.—We mentioned in a leaderette last week the folly of under-stamping foreign trade correspondence and catalogues. The instance there quoted is now followed by a similar error in sending catalogues to Canada. The *Board of Trade Journal* says that H.M. Trade Commissioner at Ontario has received complaint from a Canadian Steel Corporation that United Kingdom firms *continue* to send them printed matter insufficiently stamped. *The Corporation will decline to accept such in future.*

Bankruptcy Proceedings.—*Re* ERNEST BOHM, electric lamp manufacturer, 5, Boxworth Grove, Barnsbury, N.—This bankrupt, who failed in July, 1907, applied at the London Bankruptcy Court on January 22nd, for an order of discharge. Mr. Garton, Official Receiver, reported that the applicant, a German, came to England in 1880, with £15 or £20, and from 1883 till November, 1903, carried on business in London. In 1901 he patented a form of electric lamp, and in November, 1903, he agreed to assign his interest in the invention to a firm of accountants, who had provided money to pay off a mortgage on behalf of a company which they undertook to form to acquire the patents, and in which he was to have received certain shares. The bankrupt was subsequently employed in the manufacture of the lamp at the company's premises till April, 1904, but was then dismissed, and shortly afterwards commenced proceedings for specific performance of the firm's agreement to form a company. In February, 1905, Bohm's Lens Lamp Co., Ltd., was registered by the firm, but the bankrupt never received any shares therein. During August, 1905, in anticipation of an arrangement being come to with the firm, the bankrupt sold his interest in the invention to B.N.C. Syndicate for £683, payable as to £150 in cash and the balance in shares of the syndicate, which undertook to form a company with a capital of £60,000, to acquire and exploit the patents. On the formation of this company, he was to have received £850 in cash, and £17,500 in shares. In December, 1905, Lens Lamp Co., Ltd., was registered, but never went to allotment. During the following April, proceedings were commenced in the Chancery Division against the bankrupt and the syndicate, by Mr. Sheffield Neave (the petitioning creditor), who claimed to be absolutely entitled, in the events which had happened, to the said invention and patents, and as the result of those proceedings, judgment was given for the plaintiffs in November, 1906. During the previous May, the bankrupt had commenced an action in the King's Bench Division against the petitioning creditor and others, claiming damages for fraud and breach of contract, but he was unable to carry through that action owing to lack of funds. He attributed his failure to inability to realise his interest in the invention, to liability for law costs, and to excess of expenditure over income. The offences alleged by the Official Receiver were: (1) Insufficiency of assets to equal 10s. in the £ on the amount of the unsecured liabilities; and (2) omission to keep proper books of account. The bankrupt's solicitor asked for the discharge to be granted subject to judgment for £15. He pointed out that it was a very old case, the receiving order having been made in 1907. The bankrupt was an old man, and wished to be relieved of the stigma of bankruptcy. It was true he was a German, but he had been in this country most of his life; he had married an English wife, and his two sons had served in the Army on the English side. Mr. Registrar Hope granted an order as desired, remarking that the money must be paid into Court before the discharge would become effective.

M. B. MOUNTAIN (Economy Appliances and Engineering Co.), engineer, lately at 66, Victoria Street, London, S.W.—First and final dividend of 4s. 9d., payable by Saher & Davis, 28, Theobald's Road, W.C. 1.

The A.S.E. — The *Daily Dispatch* (Manchester) states that a delegate meeting of the Amalgamated Society of Engineers is being held in London to hear the report of the deputation sent to America to negotiate with the International Association of Machinists on the basis for bringing both organisations together. The proposals to be submitted are that the A.S.E. shall cease to operate as a labour organisation in the United States, and shall transfer into the International Association of Machinists all members enrolled in the books of the American branches; also that the International Association of Machinists shall cease to operate in Canada for a period of 10 years, and shall transfer in a body its entire Canadian membership into the A.S.E.

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Liquidations and Dissolutions.—ACCUMULATORS, LTD.—Winding up voluntarily for the purpose of reconstruction. Meeting of creditors, February 7th, at Maybury Hill, Woking. New company to be formed named Accumulators of Woking, Ltd. Liquidator, Mr. W. J. Matthews, 1, Laurence Pountney Hill, E.C.

PATENT DEVELOPMENT SYNDICATE, LTD.—Meeting called for February 27th, at Broad Street House, E.C., to hear an account of the winding-up from the liquidator, Mr. T. S. Jones.

WESTERN MAGNETO WORKS, magneto repairers, 188, Blythe Road, W. 14.—Messrs. A. H. Clarke, A. C. G. Newcombe, and H. Hills, have dissolved partnership. Debts will be attended to by Mr. Newcombe.

The Times announces that the Court has appointed MR. B. H. BINDER, F.C.A., receiver and manager of the Compania de Electricidad de la Provincia de Buenos Aires.

German Siemens Works Closed Down by Coal Shortage.—The *Economic Review* quotes from the *Köln Zeitung* a Berlin telegram of January 6th stating that, owing to coal shortage, the Siemenswerke and the Siemens-Schuckert A.-G. had stopped work until further notice.

Rand Orders for U.S.A.—The *S.A. Mining and Engineering Journal* for December 20th last stated that it understood that the two big winders—claimed to be the biggest in the world—to be installed at the Randfontein Central deep level shafts were to be supplied by the South African General Electric Co. and made in the U.S.A. The mechanical portion of the work was, however, to be placed with an English firm. Mr. Munro, the chairman of the "J.C.I." said that the new winders would be capable of raising a net load of five tons each from a depth of 5,000 ft. at 4,000 ft. per minute. The Crown Mines winders, which have hitherto held the record, can raise eight tons net some 3,500 ft. at the same speed, so that there is little to choose between them and those to be put in at Randfontein. "Randfontein will also be installing one of the biggest pumping plants in the world soon, and it is understood that the Swiss firm of Sulzer Bros. will be the suppliers. British manufacturers, apparently, are suffering through the attitude of British labour."

Civil Servants' Wages.—A Circular issued by the Ministry of Health to local authorities states that, in accordance with the award dated November 11th, 1919, the Treasury has recently authorised for permanent Civil Servants a new scale of temporary increase of remuneration owing to the abnormal conditions resulting from the war. As regards resident officers, it has been held by arbitrators that the rates of temporary increase should be one-half of the full scale; and emoluments of office of all kinds have been added to the salary received in order to determine the remuneration upon which the sum payable should be calculated. In the case of officers whose remuneration is subject to the sanction of the Ministry of Health, such sanction is given during the currency of the award now in question, and also in the event of any further award being so made.—*Manchester Guardian.*

Calendar. — From MESSRS. THERMIT, LTD., whose offices are now at 155, Church Road, Battersea, S.W. 11, and the whole of whose shares are owned by Nobel's Explosives Co., Ltd., Glagow, we have received one of their pocket memoranda books, with calendar for 1920 and Thermit information.

Lock-Out of Liverpool Electricians.—The lock-out of electricians in the Liverpool contracting industry continues, and the local Secretary of the National Federated Electrical Association has issued a statement, which makes the issues quite clear. The dispute originated with the consideration of a new code of working rules providing for a 47-hour week, 2s. per hour for a fully competent electrician, armature winder, and cable jointer, overtime at time-and-a-half for the first four hours on the first five days of the week, &c., in all, 17 amendments to the existing rules. The men's case is that the rules have been agreed with the employers locally; the constitution of the National Joint Industrial Council does not give it authority to ratify, but the Council has the right to veto any particular rule. As the National Council has merely put forth amendments, which were rejected by the men's representatives, and had not vetoed the rules, the men claimed they should be in operation, and in some shops they came out on strike. The employers, on the other hand, through the Federated Electrical Association, state that the rules were agreed with the men, and were sent as a recommendation to the National Joint Industrial Council for ratification. They were referred back to the District Joint Industrial Council for further consideration. Electrical Trades Union members then stated that they were not prepared to accept any amendments, and resigned *en bloc* from the District Joint Industrial Council, and the Union demanded the adoption of the rules, failing which, all overtime would be stopped, and if this was not effective, other and more drastic measures would be taken. The District Council had requested that any action be deferred until after the meeting of the Council of the National Federated Electrical Association in London, on the 21st inst., but, through the E.T.U. not complying, the local employers in the N.F.E.A. were in the unenviable position of having to declare a lock-out, not only in support of the four firms which were being victimised, but as a means of hastening a decision. A deputation from Liverpool put the case before the N.F.E.A. in London on the 21st inst., with the result that the Council decided to approach the executive of the Electrical Trades Union, asking if it were willing to submit the case to an arbitrator appointed by the Ministry of Labour, the Council being of opinion that the question involves other districts, and is, therefore, a national question of the greatest importance to industry.

Staff Dinner.—The staffs of the Bury Electricity Works held their annual dinner and social last week at the Royal Hotel. Following the dinner and entertainment, Mr. S. J. Watson, borough electrical engineer, proposed the toast of the "Electricity Committee," which was responded to by the chairman, Councillor Holt.

Applications for British Trade-marks.—Appended is a summary of the recent applications for British trade-marks in respect of goods connected with the electrical industries:—

Magicoal. No. 395,318. Class 18. Electric fires. Herbert H. Berry, 86, Newman Street, London, W., September 18th, 1919.

Holdtite (lettering combined with a drawing of a vice). No. 392,951. Class 50. Friction tape, being an electrical insulation material composed of fabric treated with an insulating medium. United States Rubber Export Co., 1790, Broadway, New York, July 2nd, 1919.

Thor. No. 394,198. Class 6. Electric dish-washing machines and electric vacuum cleaners. Hurley Machine Co., 2115 South 54th Avenue, Cicero, Ill., U.S.A. August 12th, 1919.

Beeco (lettering combined with design). No. 395,700. Class 13. Electrical appliances. Charles Stevens Colton, 61, St. James' Street, London, S.W., October 2nd, 1919.

While I live I'll crow (lettering combined with design). No. 396,481. Class 50. Mica insulators. Attwater & Sons, Hopwood Street Mills, Preston, October 25th, 1919.

Dyneto. No. 394,804. Class 6. Electric generators, dynamos and electric motors. Dyneto Electric Corporation, 301, Wolf Street, Syracuse, New York, U.S.A., September 3rd, 1919.

Plasphalt. No. 397,205. Class 50. Electrical insulation materials made of bitumen combined with other substances. Albert E. H. Dussek, Empress Wharf, Sherman Street, Bromley-by-Bow, E., November 13th, 1919.

Design set representing streak of lightning in black circle. No. 397,241. Class 2. Electric batteries. Siemens Bros. & Co., Ltd., Palace Place Mansions, Kensington Court, London, W., November 14th, 1919.

Trade Announcements.—Owing to increased business, the firm of H. A. Easter has built a specially-designed factory. The firm will now be known as the BRITISH ELECTRIC CO., and the address will be Easter Works, 27-29, Lower Road, Rotherhithe, S.E. 16. Telephone: "Hop 5749."

MESSRS. HAMILTON, FOULDS & Co. have removed their head offices to the works at 23, Douglas Street, Glasgow. Telephone No.: "Central 1253." They now have representatives at Manchester, Sheffield, Newcastle, Liverpool, and Cardiff, from whom particulars of their "W.H." motor starters can be obtained.

MR. J. DAWSON, late with Charlesworth & Co., has commenced business as an electrical engineer at Elliott Street, Oldham.

MESSRS. MARSHALL, SONS & CO., LTD., have removed their London offices to 3, London Wall Buildings, E.C. 2.

The style of the business of Mr. P. W. H. Challenor, iron, steel, and hardware merchant, 18, Wallbrook, E.C., has been changed to MESSRS. P. CHALLENOR & CO., Mr. A. A. Challenor having been taken into partnership.

THE ENTERPRISE MANUFACTURING CO., LTD., have been appointed sole London agents for Messrs. H. Clarke & Co., of Manchester, who are manufacturers of all classes of insulating material, nuts, bolts, washers, &c., for London and South Wales territory.

We are informed that, in consequence of the initials "E.A.C." being already used by a business house, the accumulator charging panel bearing this name will in future be known as the "Enco."

Trade Union Membership.—The membership figures of trade unions for the year 1918 have been announced. At the end of that year the 1,220 British trade unions had a membership of 6,624,000, as compared with 5,547,000 at the end of 1917, being an increase of 19 per cent. The women membership stands at, roughly, 1¼ millions.—*Daily Telegraph.*

A B.T.H. Reunion.—A company of about 50 sat down to a reunion dinner organised by the ex-Service employés of the British Thomson-Houston Co., Ltd., Coventry Branch, and held at the Craven Arms Hotel, Coventry, on Friday last. Mr. F. Betts presided, and among those present were Mr. R. Dumas (works manager), Mr. W. G. Groocock (assistant works manager), and Mr. F. W. Naylor (chief of the accountants department). After the loyal toast, the silent toast, to "Our Glorious Dead," was observed, and the names of the 12 late employés (of the Coventry Works) who had made the supreme sacrifice were read out, following which, the company stood in silence for one minute. The toast, "The Company," was proposed by Mr. O. A. Pallett, who said how much the ex-Service men appreciated the kindness and consideration shown by the firm, and the way in which they had reinstated all who had returned. Mr. R. Dumas responded. In proposing the health of "The Visitors." Mr. T. Holder thanked the visitors for their presence, and the valuable work they had done at home during the war, especially mentioning Mr. Naylor, and thanking him for his zealous efforts on behalf of the soldiers. Mr. Groocock, in responding, expressed the hope that the function would be an annual occurrence. During the dinner, orchestral music was rendered, under the direction of Mr. W. G. Chapman. The remainder of the programme was contributed by Mr. D. Taylor (oboe soloist), Mr. W. Goalby (violinist), and Messrs. Breeze and Robinson sang several popular songs. The singing of "God Save the King," and a vote of thanks to the chairman and Mr. E. Thomas (who had been responsible for the evening's entertainment), brought the evening to a close.

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Catalogues and Lists.—MESSRS. FULLER'S UNITED ELECTRIC WORKS, LTD., of Chadwell Heath, E., have issued a "Sparta" battery show-sheet, which has been prepared for distribution to motor garages. Copies will be sent to any applicant. The sheet illustrates the Sparta batteries and tabulates particulars of different types for popular American cars. Prices, dimensions, weights, code-words, &c., are also stated.

MESSRS. L. D. HAND & Co., 63, High Holborn, W.C. 1.—Price schedules of electrical accessories, conduits, cables, &c.

WESTERN ELECTRIC CO., LTD., North Woolwich, S.E.—Pamphlet dealing with the Western-Electric "Omniphone."

GENERAL ELECTRIC CO., LTD., 67, Queen Victoria Street, E.C.—Showcard (30 in. × 20 in.) advertising the "Osram" (G.E.C.) automobile-type lamps. The card illustrates a car, with full headlights, in a dark country lane. At the bottom of the picture is a pocket designed for the reception of a very useful road-map, also supplied.

THE REMCO CARBON CO., LTD., Gravesend.—Illustrated and priced catalogue (11 pp.) of "Remco" non-metallic resistances.

THE MICANITE AND INSULATORS, LTD., Empire Works, Blackhorse Lane, Walthamstow, E. 17.—1920 List of standard insulating materials (27 pp.) and book of samples. A comprehensive list of mica, micanite, and other insulating materials for all purposes. The book of samples contains 15 selected pieces of insulation, including moulding micanite and paper, cloth and silk preparations.

MESSRS. WARD & GOLDSTONE, LTD., Sampson Works, Salford, Manchester.—Sectional List No. M 201. A complete catalogue of everything electrical for motor-cars, cycles, and garages. Fully priced and illustrated.

MR. H. C. SLINGSBY, 142-146, Old Street, E.C. 1.—List No. 155, describing and illustrating various types of mechanical trucks and labour-saving devices.

MESSRS. LESCO, LTD., Lloyd's Bank Buildings, King Street, Manchester.—Leaflets illustrating the "Lesco" lampholder and giving instructions for wiring.

THE BRITISH INSULATED AND HELSBY CABLES, LTD., Prescot, Lancs.—Pamphlet No. P.160, dealing with a "mistake proof" switch cut-out. Priced and illustrated.

Swedish Engineering Strike.—This strike is in full swing, steps intended to lead up to a settlement having proved unsuccessful.

Belgian Electricity Works During the War.—Some interesting references to the difficult position of Belgian electricity supply undertakings during the German occupation are contained in the report just issued of the Société d'Electricitè du Brabant, of Brussels. In June, 1915, the German military authorities started the manufacture of barbed wire in a factory they had seized at Ruysbroeck, for the operation of which they demanded the whole of the electrical output of the Brabant Co. The directors, considering that this was a breach of international agreement with regard to war, declined to supply, with the result that the Germans not only seized the station and connected the mains up to the factory, but also imprisoned the general manager and several members of the staff. The enemy remained in possession until the Armistice, when they departed without leaving any books, cash, or account of the financial operations during the occupation. Steps are, however, being taken to put in a formal claim to the German Government. At the present time the company holds the concessions for the supply of electrical energy to 21 small towns and communes.

Auction Sales.—MESSRS. P. HUDDLESTON & Co. will sell by auction at Hammersmith on February 5th a quantity of electrical apparatus, including motors, motor-generators, fans, cable and wire, &c. MESSRS. HALL, PAIN & GOLDSMITH are instructed by the Flying Boat Co., Ltd., to sell by auction at the Norman Thompson Flight Aerodrome, Middleton, Bognor, the freehold buildings, equipment, machinery (including the electric lighting and heating plant) and stock, &c., of the Norman Thompson Flight Co., Ltd. For further particulars see our "Advertisement Pages" to-day.

Patent Restoration.—An order has been made for the restoration of Patent No. 23,082, of 1912, for "improvements in electric heating and cooking apparatus," granted to R. F. Venner.

The Protest of the Bricklayers.—Complaint was made at a meeting of the Oldham Electricity Committee last week in a letter from the secretary of the Operative Bricklayers' Society, in regard to a man in the department's employ, who was engaged in bricklaying work in connection with electric cable laying. It was contended that the man was not a bricklayer. Mr. Ogden, engineer, explained that the department promised to employ a bricklayer, and they had done so. On the day in question, however, they were particularly busy, and one of the men simply laid a brick or two. They were allowed to do that under the Whitley agreement. The Mayor thought the Bricklayers' Society ought to be reasonable. They could not stop the job while they found a bricklayer.

Trade with the West Indies.—The Federation of British Industries has accepted the invitation of important members of the West Indian commercial community to send a representative to the Special Conference of the Associated Chambers of Commerce of the British West Indies, to be held at Barbadoes on February 23rd. Mr. Moir Mackenzie, the head of the Empire Section of the Federation, has left for the West Indies in company with Sir Edward Davson. At the Conference the whole trade policy and development of the islands will come under review, especially their relations to the United Kingdom.

Book Notices.—Technologic Paper of the Bureau of Standards, No. 146. "Cadmium Electrode for Storage Battery Testing." By H. D. Holler and J. M. Braham. Washington: Bureau of Standards (free on application).—The results obtained with the cadmium electrode are often contradictory. As the result of a research described in this paper, it is stated that the electrode should be corroded several days in acid before use, and is then accurate to about 0·02 volt. The best results are obtained when the cell is discharging. The greatest error is due to polarisation, caused by using a voltmeter of low resistance; if this is unavoidable, the best procedure is to measure the cadmium-negative potential, to which the cell voltage may be added to obtain the cadmium-positive potential.

"Conquest" (a magazine of modern endeavour). Vol. I. Nos. 3 and 4. London: The Wireless Press, Ltd. Price 1s. net.—The January and February numbers of this excellent magazine contain up-to-date articles dealing with science and invention. The January issue gives notes on the Einstein theory by Chas. Davidson, F.R.A.S., and information regarding the fixation of nitrogen by the three usual processes. The later number has interesting details of Germany's commercial airships and a few corrections of Mr. H. G. Wells's scientific inaccuracies, by Mr. R. I. Pocock, F.R.S. "Conquest" is well and profusely illustrated, and its employment of non-technical language will add to its popularity.

"*Proceedings* of the American Institute of Electrical Engineers." Vol. XXXIX. No. 1. January, 1920. 28 pp. New York: The Institute.—This, the first number of a new volume, marks a change in format. The size of the publication is now 12 in. × 9 in.; it was previously 9 in. × 6 in. The increase of size permits the presentation of much fuller information, and papers are given *in extenso*. The leading papers are "The Series System of Street Lighting Distribution," and "Multiple Systems of Street Lighting Distribution."

"The English Electric Journal." January, 1920. 32 pp. London: The English Electric Co., Ltd. Price 1s. net.—This is the first number of a journal which has as its objects the recording of electrical progress, to give an account of the company's activity, and thus keep up a connection between the company and those interested in electrical development. The chief features of the Journal's initial number are a description of the Coventry Ordnance Works, and a review of the electrification of the Lancashire and Yorkshire Railway. The publication is fully illustrated and well arranged.

"Training for the Electrical Railway Business." By C. B. Fairchild, Jun. 155 pp. Philadelphia and London: J. B. Lippincott Co. Price 6s. net. The "foreword" explains the scope of this work, which is "to explain, non-technically, the business side of electric railroading, and, by defining the electric railway organisation and its varied functions, to give an insight into the requirements, the opportunities, and the training involved in the several departments of this exacting business."

"Variation in Direction of Propagation of Long Electro-Magnetic Waves." Scientific Paper No. 353 of the U.S. Bureau of Standards. 15 pp. Washington: Government Printing Office. Price 5 cents. A report on observations made by various trans-Atlantic wireless stations and methods of compensating the minimum and increasing the accuracy of direction-finder settings for long waves.

"Practical Electric Welding." By H. B. Swift. Pp. 104; 66 figs. London: E. and F. N. Spon. Price 7s. 6d. net.

"Memoirs of the College of Engineering, Kyoto Imperial University." Vol. II, Nos. 1-4. Kyoto, Japan: The University.

A French Company's Finances.—The Electrométallurgie du Zinc (procédés Cote et Pierron) is confessedly in a bad financial position, the cause being that "the patents bought from M. Cote have resulted in grave deceptions." The company has instituted legal proceedings against M. Cote.—*L'Electricien.*

Joint Industrial Councils.—The decentralisation of the Whitley Scheme of Industrial Councils, as recommended in the first report of the Reconstruction Committee, is now making substantial progress. The industries in which District Councils have been authorised or formed and the areas constituting the various districts include the following:—

Electrical Cable-Making Industry.—Home Counties (including Sussex and Hants); Northern (including Scotland).

Electrical Contracting.—Belfast, Bradford, Brighton, Derby, Dundee, Edinburgh, Glasgow, Leicester, Manchester, Mersey District, Newcastle, Sheffield, South Wales.

Electricity Supply.—Northumberland, Durham and Cleveland; the rest of Yorkshire, and parts of Derby, Notts and Lincs; Westmoreland, Cumberland, Lancashire, Cheshire and North West Derbyshire, and North Wales, South Wales and Monmouth; Staffs, Worcester, Warwick and Shropshire; Hereford, Gloucester, Somerset, Wilts and part of North Devon; Leicester, Northants, Rutland and the remainder of Notts and Derbyshire; Hunts, Cambridge, Norfolk, Suffolk and South Lincs; Bedford, Essex, Bucks, Berks, Oxford, Surrey, Kent, Herts and Middlesex (excepting parts of those counties which fall in the London area); the London area: Sussex and Hampshire; Cornwall and part of Devon; Scotland.

Tramways.—Scotland; Northern: Lancashire, Cheshire and North Wales; Yorkshire, Lincolnshire and North Derbyshire; South Wales; Midland; Metropolitan; South-Western and part of South Coast Area; East, South-East and part of South Coast Area.—*Labour Gazette.*

New French Electrical Companies.—La Dauphinoise Electrique is a new company with a multifarious programme, including the making, purchase, sale, and repair, of all kinds of electrical material, and the installation, upkeep, and working of undertakings, generating, or utilising electrical energy. Its seat is at Grenoble, and its capital 300,000 fr. With similar objects the newly formed Société d'Enterprise d'Electricité (Anciens Etablissements Champion), which is located at Paris, has a capital of 25,000 fr.

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Canadian Cooking Combine.—The *Canadian Electrical News* reports that on January 1st the manufacturing departments of heating devices of the Canadian General Electric Co., Ltd., the Canadian Hotpoint Electric Heating Co., Ltd., and the Hughes Electric Heating Co., all of Toronto, were consolidated to form a new company known as the Canadian Edison Appliance Co., Ltd. This new enterprise will continue to manufacture the complete line of heating and cooking devices that have been manufactured in the past by the above-named companies.

The Ironmoulders' Strike.—The result of the ballot taken last week was as follows :—For resumption of work, 17,667 ; against, 11,263 ; majority for resumption, 6,404. The total vote was nearly 30,000, leaving 20,000 unrecorded votes. Men were returning on Monday last in most places ; at Barrow there was at first disinclination, for which certain new conditions were blamed, but this point was dealt with promptly, and the men have decided to resume. General resumption is stated to mean the return of 250,000 men to employment in other branches of the engineering industry.

LIGHTING AND POWER NOTES.

Accrington.—Supply Failure.—Owing to a failure in the supply of power on January 19th, three cotton mills had to suspend operations.

Bentley (Yorks.).—Price of Energy.—The Urban District Council has requested the Doncaster Corporation to consider a reduction in the proposed charges for electricity, as they are too high. The Doncaster Corporation stipulated that Bentley should erect a sub-station and pay for all installation work. The method of payment for energy proposed was a charge of 1s. per week per house and 2d. per unit consumed.

Bradford.—Appeal to Consumers.—The Electricity Department has issued a request to consumers to cut down their demands to a minimum, as the restarting of the engineering works after the moulders' strike will overload the plant considerably. A turbine undergoing repairs will be available in three weeks' time.

Cannock.—Mine Electrification.—In response to an urgent request from the owners of the Mid-Cannock Collieries, the Walsall Corporation is extending its mains from Bloxwich to the workings.

Chile.—Water Power.—In a recent issue of the *Electrical Review*, Chicago, details are given of a new hydro-electric plant being built by the Braden Copper Co. The scheme is for the utilisation of the Rio Pangal, a tributary of the Rio Cachapoal. A diversion dam is being constructed 10 miles up the river from the works, and the water will be conducted to a surge tank by a combination wood-stave and rivetted steel feeder pipe 7 miles long. The water-wheels are of the impulse type direct coupled to horizontal shaft A.C. generators. The maximum static head at present available is 1,595 ft., and the total capacity of the plant will be 20,000 K.V.A.

Continental.—Bavaria.—Work has just been begun on a large hydro-electric generating station to utilise the water power of Lake Walchen. The lake is to serve as a regulating reservoir, and will be supplied by a tunnel connecting with a branch of the River Isaar. The exit is to consist of a partly submerged canal leading to tanks from which descend six conduits, each of 1 metre diameter. The fall is 200 metres. Energy will be distributed at 100,000 volts to a dozen or so main sub-stations, which will reduce it to 25,000 or 50,000 volts. These sub-stations will be located in the principal towns in the region, and the area supplied will extend to a distance of 280 miles from the generating station. The high-tension feeders are of aluminium with a cross-section of 120 sq. mm., and will be carried on steel poles 25 metres high above ground. When the work is completed it is expected that 80 per cent. of the total energy consumed in this region of Bavaria will be derived from water power. The station at Walchen is being constructed by the State, and the cost of distribution will be shared between the State, the principal towns, and industrial enterprises interested.—*Tramway and Railway World.*

Belgium.—La Société de l'Electricité du Canton de Lens is the name of a new company which has lately been formed at Lens-sur-Dendre, with a capital of 1,500,000 fr., to establish a central generating station in the Lens industrial district for lighting and power purposes.

Conway.—Water Power.—The surveyor reports that the power obtainable from the river is too small to be of any commercial value, and the Council is advised to obtain a supply of electricity from the North Wales Power Co.

Croydon.—House Lighting.—The municipal houses being constructed are to have electric lighting installed.

Coventry.—New Power Station.—The Electricity Committee has recommended the erection of a new power station and generating plant. It is said that four years will be required for the completion of this station.

Dartmoor.—Hydro-electric Scheme.—According to *The Times*, in deference to the opposition from the Duchy of Cornwall and the Devon County Council, the promoters have decided to drop that part of the Hydro-Electric Bill by which they sought to utilise Dartmoor water for generating electricity. They will modify the Bill to restrict their powers to erecting overhead mains for supplying to consumers such surplus power beyond the requirements of their proposed copper-refining industry in mid-Devon, which they produce from lignite beds they intend to develop.

Dingwall.—Street Lighting.—A report is being prepared with a view to the lighting of the town by means of overhead lines.

Fleetwood.—Proposed Extensions.—The electrical engineer having reported upon the necessity of making extensions to the electricity works before next winter, details of the proposals are to be prepared.

Greenock.—Loan.—The Corporation is applying to the Secretary for Scotland for power to borrow £170,000 to meet the requirements of the electricity department.

Hove.—Minimum Charge.—The Town Council has reconsidered the question of a minimum charge of 13s. 4d. per quarter, and has decided instead to calculate a charge for a half-year in order to include a summer and a winter quarter.

Hull.—Inadequate Plant.—The City Council has received further demands for an inquiry and report upon the electricity undertaking by an independent expert. A motion to satisfy these demands was negatived, and instead the electrical engineer has been instructed to prepare a statement for the Council's consideration. All remaining restrictions will shortly be removed, but 500 prospective consumers cannot be supplied until the plant is augmented.

Jamaica.—Water Power.—A scheme to utilise the water-power of one of the largest rivers for the generation of electricity, by the construction of several large reservoirs, is being prepared. The calculated cost is £120,000.

Kingston-upon-Hull.—Time Extension.—The Board of Trade has extended for six months, until July 31st, 1920, the Electric Lighting (Extension) Order, 1914, for the extension of mains, &c.

Kirkintilloch.—Power Supply.—The Clyde Valley Electrical Power Co. has offered to supply power to the manufacturers of Kirkintilloch on a guaranteed minimum revenue of £5,000 per year.

Leeds.—Proposed Extensions.—In order to cope with increasing demands, the extension of the White Hall Road works is contemplated.

Liverpool.—Electricity in Docks.—The Mersey Docks and Harbour Board is introducing electrical cargo-loading machinery, and is substituting electric light for the present gas system. It is also intended to purchase a 200-ton floating crane, to be driven electrically.

London.—Hackney.—The Electricity Committee recommends the expenditure of £145,930 upon additions and extensions, including £23,600 for buildings, £24,950 for plant and switchgear, and £91,375 for mains and distributors.

Melrose.—Price Increase.—The Electricity Supply Corporation, Ltd., has increased the charge for energy for lighting to 9d. per unit, as from the December meter readings.

Mexborough.—New Station.—An obvious numerical slip occurred in the statement in our last issue that a new station of 10,000 KW. was to be erected. We understand that the scheme contemplates a station having an ultimate capacity of 90,000 to 120,000 KW., beginning with a 10,000-KW. set.

Milnrow (Lancs.).—Bulk Supply.—The District Council has been notified that Rochdale Corporation cannot undertake a bulk supply of electricity for at least 12 months. The Milnrow District Council is, therefore, communicating with Sir John Snell regarding the question.

Monaghan.—Electric Lighting.—A company has been formed for the purpose of supplying electricity for lighting to the town.

Richmond-on-Thames.—Price Increase.—The Electric Light and Power Co. has received permission to increase its charges to 6d. per unit for lighting, 2d. for heating, and 3½d. for power.

Rickmansworth and Chorley Wood.—Time Extension.—The Board of Trade has extended the Electric Lighting Order, 1914 (mains extension) until July 31st, 1920.

Sheffield.—Extensions.—The work to be carried out, or commenced, during 1920, includes the erection of an emergency sub-station at Blackburn Meadows and the extension of mains and installation of lighting for 1,500 new houses.

South Africa.—Port Elizabeth.—The Municipal Council has sanctioned an increase of 25 per cent. in light and power charges.

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Swansea.—WAGES.—The Borough Council is increasing the rates of pay of its employés in the electricity department. Firemen and trimmers are to receive an additional 7s. 6d. per week. Electricians, electrical fitters, and armature winders are to be paid 1s. 11d. an hour, inclusive of awards and bonuses, and improvers 1s. 9d. per hour.

The electrical engineer has been authorised to inspect the coal-handling plant of other electrical undertakings, and instructed to make a report thereon.

Teignmouth.—COST OF SUPPLY.—Dr. Purves, holder of an order for the lighting of the town, has explained that the cost of the necessary plant would be enormous, and a cheap supply, therefore, impossible. The only hope of low-priced electricity was the development of the Dartmoor scheme.

Tunis.—HYDRO-ELECTRIC UNDERTAKING.—A new company has recently been formed in Paris, with a capital of 500,000 fr., under the title of La Société Hydraulique Tunisienne, to establish plant to utilise water power in Tunis and North Africa to generate electricity.

Worsley.—ELECTRIC LIGHTING.—The District Council has requested the Lancashire Electrical Power Co., Ltd., to tender for the substitution of electric lighting for the present (gas) system.

TRAMWAY AND RAILWAY NOTES.

Barnsley.—INQUIRY.—The Light Railway Commissioners have held an inquiry into an application by the Dearne Light Railway Board for permission to abandon an authorised route and to obtain permission to construct a line previously disapproved, and also to increase its borrowing powers. The estimated cost of the proposed route is £300,000.

Bury.—BREAKDOWN.—The tramway services were suspended for four hours on January 21st, owing to a breakdown at the Whitehead Bridge station. A switchboard attendant and two employés were slightly burned.

Continental.—FRANCE.—The Minister of Public Works announces that in future no more concessions for steam railways will be granted. It has been decided to grant permission for the construction of electric systems only.

GERMANY.—Both the district railways and the tramways in Greater Berlin have recently increased their tariffs. These increases, says the *Konfektionär* (December 31st), press very hard upon the poorer classes, for on the district railway (Hochbahn) any person travelling for five or more stations has to pay Pf.40 third-class, while the shortest possible stage in a tramcar costs as much as a journey of 10 km.—*Economic Review.*

ITALY.—The working of the Civita Vecchia-Orte railway concession is in the hands of a newly-formed company—the Società Ferroviaria Italia. The line has a length of 85·315 km.

The construction of an electric railway is contemplated connecting the Ancona-Foggia line with Osimo and Castelfidardo, and from thence to Macerata and the sea. The cost is calculated at 6,000,000 lire.

Coventry.—INCREASED LOAN.—The Corporation has applied to the Ministry of Transport to increase the amount of the loan put forward for sanction from £93,135 to £126,081. This sum is to be spent on the reconstruction of the city's tramways.

Derbyshire.—ELECTRIC RAILWAY.—A Bill has been deposited at the House of Commons to incorporate the Derwent Valley, Calver, and Bakewell Railway Co. for the purpose of constructing a seven-mile electric railway from Grindleford to Longstone.

Doncaster.—YEAR'S WORKING.—The report on the working of the tramway undertaking for 1918-19, gives the year's revenue as £53,528, and the total expenditure as £37,566, leaving a gross profit of £15,962. The net profit, after payment of interest on loans and sinking fund charges, was £8,347.

Gateshead.—TRAMWAY EXTENSIONS.—The Town Council has been advised to protest against the Bill providing for extension of the tramways across the High Level Bridge, in the absence of working agreements between the Newcastle Corporation and the Gateshead and District Tramways Co. A local inquiry into the whole of the tramway company's working arrangements, with a view to satisfying the requirements of the travelling public, is also recommended.

Glasgow.—ANNUAL VALUATION.—The annual assessment of value of the tramways by the Assessor of Railways and Canals, was £263,258, as compared with £298,165 for the previous year. The Council is appealing against this valuation, and also against the income-tax assessment amounting to £77,920.

A Special Committee has been appointed to consider the question of increased travelling facilities, and the collection of fares on the cars.

London.—ACCIDENTS.—As a result of a collision between a tramcar and a taxicab at the junction of Copenhagen Street and Caledonian Road on Friday last week, four persons were injured.

Owing to signal failure at Sloane Square station, City-bound trains on the District underground railway were delayed for 15 minutes on Thursday morning last week.

Newcastle.—STRIKE AVERTED.—Following upon promises by the Lord Mayor and the manager to secure payment for overtime worked on December 27th last, the tramway employés rescinded their strike resolution.

Surrey.—OPPOSITION TO BILLS.—The County Council is opposing the tramway Bills being promoted by the L.C.C. and the London United Tramway Co.

Tasmania.—ELECTRIC RAILWAY.—The Tasmanian Parliament has approved a survey of the route of a proposed electric railway. This will be the first in the island, extending from Hobart to the River Huron, and the question of electrifying all existing lines depends on the success of this project.

Taunton.—PROPOSED PRICE INCREASE.—The Tramway Co. declines to pay a higher price for electricity. The present rate is 1·4d. per unit, as the minimum of 120,000 units a year at 1·2d. is not taken. The matter has been referred to a special committee.

Yorkshire.—FARE INCREASE.—The tramway companies serving the "heavy woollen" district recently applied for power to increase their charges of 1½d. a mile. As this met with strong protests from the local municipal authorities, the original proposals have been modified. Authority is to be given for an exra charge of ½d. on all fares above 1½d. and upon workmen's tickets.

TELEGRAPH AND TELEPHONE NOTES.

Telegraphic Delay.—Notice of telegraphic delay to Ireland, midland and south-west, is given.

France.—The Under-Secretary of State for Posts and Telegraphs announces that the additional tax of 55 centimes per franc, which has latterly been levied on the cost of all foreign telegrams, was provisionally removed on January 23rd. A plan is now under consideration to safeguard the interests of the Treasury where part of the telegraph charges have to be refunded to foreign companies in foreign currency with a consequent loss on the exchange. Some reimbursements will be necessary, as companies having accounts with the telegraph office were obliged to pay 200 fr. down to cover the extra expense when the tax was introduced only a short time ago.

Italy.—The postal, telegraph and telephone workers returned to work on January 21st, after being on strike for a week, thus preventing a Government lock-out. Their claims have not been granted, but as the Government promised before the strike, these will be put before Parliament.

Wireless Direction-Finding Stations.—The *London Gazette*, January 13th, 1920, contains an Admiralty Notice to Mariners, No. 49 of 1920, relating to wireless direction-finding (D.F.) stations. Regulations for, and particulars of, D.F. stations that have been established in Canada, Newfoundland, United States, United Kingdom, and France are given. In general the bearings taken by a station within the sector over which it is designed to work can be considered accurate to within two degrees. Bearings are often unreliable at night and in very bad weather, also when the direction runs roughly parallel with the coast line. The methods of asking for and giving bearings and the waves to be used will shortly be standardised by international agreement; and the particulars of the D.F. stations will eventually appear in the international list of wireless telegraph stations. Meanwhile, each country is publishing regulations governing the use of its own D.F. stations.

Wireless Telephony.—The Public Electricity Supply Co., of Northern Illinois, is installing wireless telephone equipment at its Blue Island and Joliet stations. The stations are 25 miles apart. The wireless telephones will have a range of about 100 miles, and will be used to safeguard communication in case the wire lines are put out of commission due to weather conditions or high-voltage induction disturbances.—*T. & T. Age.*

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the ELECTRICAL REVIEW *in which the "Official Notice" appeared.)*

OPEN.

Australia.—SYDNEY.—March 1st. Municipal Council. Supply of 2,000-K.V.A., 5,000 to 10,000-V. transformers. Electric Lighting Department, Town Hall.

MELBOURNE.—**March 10th.** City Council. Supply of 6,600-V. swichgear for sub-station switch houses, &c., and of six 250-K.V.A., three-phase transformers. Specifications from City Electrical Engineers' Office, Melbourne.—*Industrial Australian and Mining Standard*

April 12th. City Council. Two 2,000-KW. rotary converters; H.T. switchgear, 6,600 V.; D.C. switchgear, 600 V. (See this issue.)

ADELAIDE.—P.M.G.'s Department. Telephone material (schedules 539 and 540). (See this issue.)

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Aberdeen.—January 31st. Electricity Committee. Two water-tube boilers, with superheaters, economisers, steel chimney and accessories. (January 9th.)

Aldershot.—February 17th. Urban District Council. Electricity Department. Geared turbine and generator, condensing plant, pumps, water-tube boiler and superheater, cables, &c. (January 23rd.)

Belfast.—February 14th. Tramways Committee. Tramway stores, including electrical accessories, cable, lamps, carbon brushes, trolley wire, &c. (January 23rd.)

Belgium.—February 27th. Municipal authorities of Biehen, Province of Liege. Concession for the supply of electrical energy for lighting and power purposes in the district.

March 1st. Similar concession for the municipal authorities of Glons. Province of Liege.

Colne.—Electricity Department. New or second-hand 1,250-KW. to 2,000-KW., 6,600-v. turbo-alternator, with condensing plant. (January 16th.)

Edinburgh.—February 9th. Electricity Supply Department. One overhead travelling crane. (January 16th.)

Greenock.—February 3rd. Corporation. Electrical installation work at 114 houses. Particulars from Mr. A. Nimmo, Town Clerk.

Huddersfield.—February 2nd. Electricity Committee. Six Lancashire boilers and one Green's economiser, with all fittings. Mr. J. W. Turner, Borough Electrical Engineer, Electricity Supply Works, St. Andrew's Road.

Keighley.—February 10th. Electricity Department. One 900-KW. rotary converter, complete with transformer. (See this issue.)

Kings Lynn.—February 20th. Electricity Department. One Lancashire boiler, superheater, piping, &c. (See this issue.)

London.—Metropolitan Water Board. February 2nd. Three, six or twelve months' supply of electric lamps, electric wire and accessories. Chief Engineer, South Place, Finsbury, E.C.

Salford.—February 9th. Corporation Tramways Department. Stores for 12 months. General Manager, 32, Blackfriars Street.

St. Helens.—February 7th. Electricity Committee. One steam-driven turbine feed pump. (See this issue.)

Stockton-on-Tees.—February 5th. District Fund, Gas and Electricity Committees. Articles and stores for six months. (January 23rd.)

Warrington.—February 10th. Electricity and Tramways Committee. Two water-tube boilers; two mechanical stokers (underfeed type); water softener. (January 23rd.)

CLOSED.

Belgium.—The Belgian State Railway authorities in Brussels have placed a contract with the Société des Ateliers de Constructions Electriques, of Charleroi, for a large quantity of insulated cables. For one lot of telephone cable no tenders were received.

France.—The French State Railway authorities in Paris have placed a contract with the Société des Trefileries du Havre for 30,000 metres of insulated cable; and with Messrs. Geoffrey and Delore, of Cliohy, for 90,000 metres of insulated wire.

Glasgow.—Tramways Committee. Accepted :—

7/18 V.I.R. cable.—Liverpool Electric Cable Co.
½-in. vulcabeston.—Turners & Manville, Ltd.
Oil.—Vacuum Oil Co.

For Dalhousie Street sub-station :—

Rotary converter.—General Electric Co., Ltd.
Switchgear.—Metropolitan-Vickers Electrical Co., Ltd.

Electricity Committee. Recommended :—

Two 6,600-v. rotaries with spares, £37,825; four 20,000-v. ditto., £17,750.—Bruce Peebles & Co.

The Engineer reported regarding mercury-vapour rectifiers, manufactured by Brown, Boveri & Co., Ltd., and submitted an offer by that firm for the supply of rectifiers. The sub-Committee decided to recommend that the offer be submitted to the convenor, sub-convenor and the engineer, with power to accept one 500-KW. rectifier set with spares.

Government Contracts.—The following Government contracts were placed during December, 1919 :—

ADMIRALTY CONTRACT AND PURCHASE DEPARTMENT.

Electric lifts.—A. & P. Steven.
Electric platform cranes.—Stothert & Pitt, Ltd.
Low-resistance telephones.—S. G. Brown, Ltd.

MINISTRY OF MUNITIONS.

Batteries.—Tudor Accumulator Co., Ltd.
Air compressor.—Alley & McLellan.
Converters and spares.—Bruce Peebles & Co., Ltd.
Electrical plant.—English Electric Co., Ltd.

INDIA OFFICE STORES DEPARTMENT.

Cable.—Pirelli-General Cable Works, Ltd.; Siemens Bros. & Co., Ltd.; Callender's Cable & Construction Co., Ltd.
Insulator cups.—Bullers, Ltd.
Generating plant. Lancashire Dynamo Co., Ltd.
Transmitters.—Marconi's Wireless Telegraph Co., Ltd.
Electric wire.—B.I. & Helsby Cables, Ltd.
Wireless telegraph apparatus.—Marconi's Wireless Telegraph Co., Ltd.

POST OFFICE.

Protective apparatus.—Siemens Bros. & Co., Ltd.; Western Electric Co.
Telephone apparatus.—Automatic Telephone Manufacturing Co., Ltd.; British L.M. Ericsson Manufacturing Co., Ltd.; Karabon Co.; Siemens Bros. & Co., Ltd.; Western Electric Co., Ltd.
Telegraph and telephone cable.—B.I. & Helsby Cables, Ltd.; Fuller's United Electric Works, Ltd.; W. T. Glover & Co., Ltd.; Macintosh Cable Co., Ltd.; Siemens Bros. & Co., Ltd.
Distribution cases.—H. White & Co., Ltd.
Secondary cells.—Van Raden & Co., Ltd.
Joint box channels.—Ham, Baker & Co., Ltd.; McDowall, Steven & Co.
Earth clips.—E. Showell & Sons, Ltd.
Telephone cords.—Phœnix Telephone & Electric Works, Ltd.
Detectors.—Gambrell Bros., Ltd.
Ducts.—Albion Clay Co., Ltd.; Doulton & Co., Ltd.
Insulators.—Thos. de la Rue & Co., Ltd.; Doulton & Co., Ltd.
Tungsten lamps.—British Thomson-Houston Co., Ltd.; Edison & Swan Co., Ltd.; General Electric Co., Ltd.
Insulator spindles.—Bayliss, Jones & Bayliss, Ltd.
Electrophone tables.—British L.M. Ericsson Manufacturing Co., Ltd.
Bronze wire.—T. Bolton & Sons, Ltd.; B.I. & Helsby Cables, Ltd.; Shropshire Iron Co., Ltd.; F. Smith & Co. (incorporated with London Electric Wire Co. & Smiths, Ltd.).
Copper wire.—T. Bolton & Sons, Ltd.; B.I. & Helsby Cables, Ltd.; Johnson & Nephew, Ltd.; Shropshire Iron Co., Ltd.; F. Smith & Co. (incorporated with London Electric Wire Co. & Smiths, Ltd.); J. Wilkes, Son & Mapplebeck, Ltd.
Flame-proof wire.—H. W. Smith & Co., Ltd.
Switchboard wire.—Western Electric Co., Ltd.
Electrical equipment.—Mount Pleasant Sub-station: British Thomson-Houston Co., Ltd. Excavating and filling in trenches and constructing jointing chambers. Bridlington: Borough Engineer and Surveyor, Bridlington. Laying ducts, Queen's Park, Glasgow: R. & C. Murray. London-Manchester (Old Stratford-Loughborough, Section VI): Hardy & Co. London-Manchester (Loughborough-Derby, Section I): W. Hodge & Sons. Fraserburgh: W. Dobson. Bolton, South: W. Pollet & Co., Ltd. Gerrard-Cierkenwell Junction: D. R. Paterson, Ltd. Stratford-Walthamstow: G. J. Anderson.
Laying ducts and pipes.—Kingsland (High Street), Foote & Milne, Ltd.; Larne, Greig & Matthews; Rawtenstall (West), W. Dobson; Hawick, W. Dobson; Gerrard (N.W. of Dean Street), J. Mowlem & Co., Ltd.; Birmingham (Olton), Whittaker Ellis.
Laying ducts, troughing and pipes.—Blackheath Village, G. J. Anderson; Warwick, Whittaker Ellis; Upper Clapton-Dalston, H. Farrow.
Manufacture, supply, drawing-in and jointing cable.—Hornsey Telephone Exchange, Muswell Hill: Western Electric Co., Ltd.
Power and boiler plant.—Abu-Zabal, near Cairo, Wireless Station: English Electric Co., Ltd.
Telephone Exchange equipment.—Birmingham (North): Western Electric Co., Ltd.

CROWN AGENTS FOR THE COLONIES.

Electric light fittings for carriages.—J. Stone & Co., Ltd.
Insulators.—Taylor, Tunnicliff & Co.
Insulator spindles.—Bayliss, Jones & Bayliss, Ltd.
Telephone apparatus.—Western Electric Co., Ltd.
Copper Wire.—J. Wilkes, Son & Mapplebeck; T. Bolton & Sons, Ltd.
Insulated wire.—Hooper's Telegraph & I.R. Works Co., Ltd.

H.M. OFFICE OF WORKS.

Motor generator sets.—Electrical Construction Co., Ltd.

PUBLIC WORKS, DUBLIN.

Belfast district.—Electrical work and supplies: A. Stevenson.

Italy.—The Italian State Railway authorities have lately divided contracts for 76 electric locomotives between the following home concerns: Nicola, Romeo & Co., Saronne; the Società Italiana Westinghouse, Vada Ligue: Ernesto Breda & Co., Milan: the Tecnomasio Brown, Boveri, Milan; and the Società di Electro-Traction, Milan.

Kilmarnock.—Town Council :—

Electric lighting (dwellings).—A. G. & J. Smith & Co., £72.

FORTHCOMING EVENTS.

North of England Institute of Mining and Mechanical Engineers.—Saturday, January 31st. At the Wood Memorial Hall, Newcastle-on-Tyne. At 2 p.m. Special meeting.

Royal Institution of Great Britain.—Saturdays, January 31st and February 7th. At 3 p.m. At Albemarle Street, W. Lectures on "The Astronomical Evidence Bearing on Einstein's Theory of Gravitation," by Sir F. W. Dyson, F.R.S.

Thursday, February 5th. At 3 p.m. Lecture on "Recent Progress in Applied Optics," by Prof. A. E. Conrady.

Society of Chemical Industry.—Monday, February 2nd. At Burlington House, W. At 8 p.m. Paper on "The Theory and Practice of Lubrication: the Germ Process," by Messrs. H. M. Wells and J. E. Southcombe.

Institution of Electrical Engineers.—Informal meeting. Monday, February 2nd. At the Institute of Patent Agents, Staple Inn Buildings. At 7 p.m. Lecture on "Engineering Experiences during the War," by Major T. Rich.

Students' meeting. Friday, February 6th. At the City and Guilds Engineering College, South Kensington. At 7 p.m. Paper on "Electric Lifts and Cranes," by Mr. F. R. Housdon.

(**Western Centre**).—Monday, February 2nd. At the South Wales Institute of Engineers, Cardiff. At 7 p.m. Paper on "Large Power Transformers," by Messrs. A. G. Ellis and J. L. Thompson.

(**Scottish Centre**).—Wednesday, February 4th. Conversazione.

Association of Engineering and Shipbuilding Draughtsmen.—Wednesday, February 4th. At the Liverpool University. At 7.30 p.m. Lecture on "Electric Traction," by Mr. W. A. Barnes.

Lectures will also be given at Manchester on February 5th; and Sheffield, on February 6th.

Batti Wallahs' Society.—Wednesday, February 4th. At the Victoria Mansions Restaurant, Victoria Street, S.W. At 6.30 p.m. Informal meeting. "Amusing Lecture," by Mr. E. S. Barralet.

Industrial League and Council.—Wednesday, February 4th. At the Central Hall, Westminster, S.W. At 7.30 p.m. Lecture on "Conditions the Workers may Control," by Major E. A. Pells.

Paisley Association of Engineers.—Wednesday, February 4th. At 25, High Street, Paisley. At 7.30 p.m. Paper on "Oil," by Mr. W. Murray.

"Daily Mail" Ideal Home Exhibition at Olympia.—Wednesday, February 4th to 24th.

Institute of Cost and Works' Accountants, Ltd.—Wednesday, February 4th. At the Institute of Patent Agents, Staple Inn Buildings, W.C. At 7 p.m. Lecture on "The Principles and Practice of Correct Costing," by Mr. A. E. Goodwin.

Royal Photographic Society, Russell Square, W.—Exhibition of prints lent by the Röntgen Society. Open till February 7th.

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NOTES.

Electrical Power Engineers' Association.—At a meeting of the West Yorkshire Section, Mr. W. T. Atherton, of the National Alliance of Employers and Employed, delivered a lecture on "The Legitimate Sphere of Trade Unionism." The lecturer, who possesses great experience in the work of Trade Unions, gave it as his opinion that the bulk of the present-day Labour leaders were extremists, and, owing to the lethargy of the majority of members of Unions, were representative of only a small section. He accused the leaders of using their positions for political ends, losing sight of the real objects of Trade Unionism, which the speaker defined as securing better wages and conditions, proper treatment, constant work, and aid when work was scarce. He urged all Trade Unionists to take an active interest in the movement, and not permit themselves to be ruled by a few whose views were antagonistic to the majority. Mr. Atherton also deprecated the practice of promotion by mere favouritism, instead of by merit, and considered that this came within the scope of Trade Unions, which should insist upon the preferment of men whose ability entitled them to it. He characterised striking as the last resource of men who could not secure justice by peaceable means. If direct action was insisted upon to the detriment of public interests, the speaker thought that the public, including many Trade Unionists, would act as strike-breakers, and quite rightly so. As an instance of the way in which ill-informed workers obtained an exaggerated idea of the strength of the Union funds—an idea which worked incalculable harm—Mr. Atherton quoted the recent moulders' strike. Mr. Dyson (Hull) asked if the extremists might not defend their attitude by saying that they were simply departing from old-fashioned methods to adopt newer and quicker means of obtaining the same ends. Mr. Atherton did not consider that the extremists' methods were quicker, especially if they involved Parliamentary procedure, and they were certainly the least desirable. Mr. Jones (Dewsbury) said that under the existing methods of Trade Unionism the conscientious worker was bound to receive the same wage as an inferior man. Mr. Atherton attributed this condition of affairs to the lack of live interest in the mass of Trade Unionists, who should prevent their leaders from getting away from their real duties. The chairman (Mr. Chaytor) said that the E.P.E.A. was held in distrust by both employers and the Trade Unions, and urged that it should be represented on the National Electrical Industrial Council. He thought that the Association would have a moderating effect upon both sides.

An Electric Baling Press.—Where power is available, electric baling presses present many good points, amongst which are rapidity of operation and low cost of maintenance. A press of this class, which is illustrated in *Engineering*, was designed and built for the South Indian Export Co., Bombay, by Messrs. Hindle, Son & Co., of Haslingden, Lancs. The press exerts a total nominal pressure of 200 tons, and is worked by a series-wound motor, capable of a peak output of 30 B.H.P. at 230 R.P.M., and accelerating on light loads when lowering to 1,200 R.P.M. The frame does not take the stress exerted, as in the hydraulic press, but merely supports the table, machinery, &c. The whole of the machinery, motor, gearing, winding drums and brake are arranged on a casing on the top of the press framework. The table is raised by specially flexible steel cables, the load being distributed between 40 ropes. The rope from each corner is led up and wound on two grooved parallel winding drums, driven by the motor by worm and spur gearing. The motor runs in one direction for raising, and is reversed for lowering the press table; the pressure exerted can be maintained for an indefinite period by means of an electro-magnetic disk brake on the motor shaft. The control is by push-buttons which operate contactor switches; the press table operates an auxiliary switch at the top and bottom limits of its travel to prevent overwinding. A trip switch, incorporated in the controller, acts on a predetermined current being reached, and stops the motor when full pressure is obtained.

Dublin Electricity Official Imprisoned.—Mr. Fred. J. Allan, secretary of the Dublin Corporation Electricity Supply Committee, was convicted at the Dublin Northern Police Court, on Friday last, under D.O.R.A. Regulations, of having had in his possession, or under his control, at the Sinn Fein South Dublin municipal election committee rooms at Kingstown, leaflets relating to the recent election, which were suppressed as being likely to cause disaffection. Mr. Allan declined to enter into bail to provide sureties that he would keep the peace for two years, and was, in default, sent to jail for three months.

Electrolytic Potassium Permanganate.—Mr. M. deKay Thompson, in an article in *Chemical and Metallurgical Engineering* of November 26th to December 3rd, 1919, shows that experiments have proved it to be possible to manufacture potassium permanganate from commercial ferromanganese, containing about 75 per cent. manganese, by electrolysis in a potassium carbonate solution without the necessity of ever cleaning the anodes. The temperature must not be allowed to rise much above 40 deg. C., for if it does an insulating coating of oxides is formed, which prevents the production of permanganate. Carbonic acid is not lost in the electrolysis. The current efficiency was about 17 per cent., but it would be higher with better diaphragms. The current density was 65 amp. per sq. ft. The anodes are attacked more at the top than at the bottom. The anodic behaviour, as regards formation of insulating scale, is affected by a small change in the relative amounts of iron and manganese in the anode.

Wages in Electricity Supply Undertakings.—The Board of Trade *Labour Gazette* states that the District Council established, under the Whitley Scheme, for the electricity supply industry in the North-Western area of England and Wales (Cumberland, Westmorland, Lancashire, Cheshire, Anglesey, Carnarvon, Denbigh, Flint, Merioneth, Montgomery, and part of Derbyshire) has now fixed rates for Lancashire and Cheshire. In these counties the Council has determined that there shall be three separate "Zones," in which differential rates shall be paid. "Zone A," for which the highest rates are fixed, comprises Liverpool (Corporation undertaking), Bootle, Birkenhead, Manchester, Oldham, Salford and Stockport; "Zone B," for which lower rates are fixed, includes Blackburn, Blackpool, Bolton, Bury, Chester. Preston, Warrington, Wigan, and a number of other places; and "Zone C," in which the rates are lowest, includes the undertakings in such districts as Alderley and Wilmslow, Altringham, Cark, Crewe, Hoylake and West Kirby, Macclesfield, Morecambe, Northwich, Ormskirk and Prescot. Comprehensive schedules have been drawn up for each of these "Zones," specifying the rates of wages fixed for the various grades of workpeople, and have been approved by the National Joint Industrial Council for the Electricity Supply Industry. In the following table a few examples are given of the basic rates fixed for Lancashire and Cheshire. The new rates are payable as from September 4th last. The hourly rates shown are calculated on the basis of the weekly hours in operation before the reduction in hours which took place in 1919. Accordingly, to obtain the weekly "basic" rates these hourly rates must be multiplied by the hours formerly worked (usually 53 for day-workers) and not by 47, the present working hours. In addition to these basic rates, war wage advances are payable, amounting to 33s. 6d. per week in the case of men of 18 years or over. A bonus of 12½ per cent. on earnings is also paid to men 21 years of age or over.

Grade.	Basic rates of wages fixed per hour for undertakings in Zone A.	Zone B.	Zone C.
Electrical fitters	Standard district engineering rate.		
Electricians or elec. wiremen			
Armature winders			
Jointers	9·5d.	9d.	8·5d.
Plumber jointers	10·5d.	10d.	9·5d.
Meter fixers	7·65d.	7·25d.	7d.
Cable hands	6·75d.	6·25d.	6d.
Fitters' mates	6·75d.	5·75d.	5·5d.
Electricians' mates	6·75d.	5·75d.	5·5d.
Labourers, general, indoor ...	6·3d.	5·75d.	5·5d.
" " outdoor ...	6·75d.	6·25d.	6d.
Switchboard attendants:—	Per week.	Per week.	Per week.
Plant up to 5,000 KW. ...	45s.	37s. 6d.	32s. 6d.
" above 5,000 KW. ...	54s.	42s. 6d.	37s. 6d.

The Council was elected in August, 1919, by representatives of all electricity supply undertakings in the North-Western Area, and by the Trade Unions concerned. It consists of 12 employers' representatives and 12 Trade Union representatives. Alderman T. E. Higham, J.P., C.C. (Accrington), is chairman of the Council, and Mr. P. A. Irvine, of the Electrical Trades Union, vice-chairman.

An Ex-Service Men's Association.—The "Ex-Service Professional and Commercial Association" has been formed to protect and promote the interests of the many men who, engaged in a profession or trading on their own account, sacrificed all in order to answer their country's call, and have consequently suffered serious losses—in some cases total destruction of their businesses. The Association will issue to its members a badge ("the sign of the Tin Hat"), which will enable the public to identify a shop or office the owner of which "did his bit"; no further inducement should be necessary to persuade the public to give preference to such cases. A buyers' guide and directory will be prepared, giving the names and addresses of members, and an inquiry bureau will be opened. Women with suitable qualifications will be entitled to full membership. The annual subscription is 5s.; honorary members (not in business on their own account) may join with a minimum subscription of 2s. 6d. per annum. Service in the Navy, Army, or Air Force between August, 1914, and November 11th, 1918, is the necessary qualification. The head offices are at 38-39, Piccadilly, London, W.

London County Council and Electricity Supply Loans.—The Finance Committee of the London County Council reports as follows:—

"By Section 19 of the Electricity (Supply) Act, 1919, the Council ceases to be the sanctioning authority for borrowing by Metropolitan Borough Councils under the Electric Lighting Acts and Orders, and the duty of sanctioning them is transferred to the Electricity Commissioners, who, however, are required to act in consultation with the Council in regard to the powers thus transferred. Pending the appointment of the Electricity Commissioners, there is no appointed authority for the sanctioning of these loans, unless it be held that the Council should continue to santion the loans until the Commissioners are appointed. This is the view taken by the Board of Trade, and we propose to act upon it. We are taking steps to ascertain as soon as practicable what advice the Electricity Commissioners will desire to have from the Council, and to what extent they wish the Council to examine applications for the loans in question."

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State Control of London Transport.—The Ministry of Transport has been requested to take over the control of the whole of the undertakings of the London Traffic Combine. The latter states that at the present rate its deficit for the year would be £2,600,000. It was stated that the Ministry was considering the question of control of the Underground railways under the Transport Act, but would not take over the motor-omnibuses. As the latter are the principal source of loss, and have been considered part of the Combine's scheme, the loss being considered in relation with the revenue from the railways, the Combine considers that the omnibuses should also be placed under State control. If they were run as a separate concern fares would necessarily have to be increased, and this would divert traffic to the underground railways, making the position worse than ever. The question of guaranteeing shareholders their pre-war income, as has been done in previous instances, requires carefully looking into, as many of the separate undertakings of the Combine were working at a loss prior to the war.

Canadian Power Company's Law Case Settled.—A Reuter dispatch from Ottawa states that the claim for a million dollars made by the Toronto Power Co. against the Dominion Government has been settled out of Court for $800,000, of which the Ontario Power Co. is to pay $510,000 and the Dominion Government the balance. The question at issue arose out of the distribution of power in the Niagara district by the Power Controller during the war.

Post Office Robberies.—In a letter to *The Times*, Mr. R. Gladstone suggests that a very simple and effective way of preventing robberies at post offices and banks would be to fix a large electric alarm gong high up on the wall outside each post office, controlled by switches just under the counter.

Educational.—Engineering scholarships for local apprentices, tenable at the Manchester Municipal College of Technology, or some other suitable institution, are to be founded in Manchester as a result of the generosity of the contractors to the Manchester and District Armaments Output Committee. Further information can be obtained from Mr. H. J. Brocklehurst, M. Eng., The College of Technology, Manchester.

The Coal Rebate.—Consumers of electricity will receive their rebates on account of the reduction in the price of coal at the end of the March quarter; there will be no separate rebate for December.

Electric Furnaces.—Referring to the notice in our issue of January 9th, as to the supply of electric furnaces to Norway, our Bradford correspondent writes that Messrs. Jessop & Boydell, electrical contractors, of Bradford, are supplying and shipping to Tyssedal, Norway, five 800-K.V.A. single-phase furnaces, to be used for the manufacture of pig-iron from Norwegian ore concentrates without briquetting.

Automatic Lighting Sets.—In the course of his speech at the special meeting of the Austin Motor Co., Ltd., at Northfield, at which resolutions were passed increasing the capital by 3,350,000 shares of £1 each, to £5,000,000, Sir Herbert Austin said that the company's schedule of production, necessitated by the orders already in hand, called for a weekly output of 200 20-H.P. cars, 100 agricultural tractors, 60 30-cwt. lorries, 500 electric lighting sets, and a large amount of switchboards and other electric equipment. He said that they had recently completed the tests, and passed into mass production, of a complete automatic lighting outfit, which would give current sufficient for a small country residence, and which they were selling at an inclusive price of about £120. The possibilities of the sale of this type of outfit he described as enormous. Although they were preparing a large production, they would not be able, unless they made very large increases to their schedule, to do more than touch the fringe of the possibilities of this part of their programme. They had three or four other sizes of automatic lighting sets of larger dimensions scheduled for production, which would enable them to accept orders for outfits up to those required for village and small township lighting.

Fatalities.—The White Lund Munition Works explosion caused the death of two electricians and seven others, on January 14th. The former, Jos. Augustine Thompson (23), and Stanley Bridson (18), were busy repairing lights when they met their death, but Mr. Harry B. Kershaw, charge electrician, made it clear to the Coroner on Monday last that there was no fault in the installation that would have caused a spark. The distribution board was outside the room. The fuses were drawn out of the circuit they were working on. The single-pole switch was knocked off, which precluded the idea of a wire fusing. A verdict of "Accidental death" was returned.

At the inquest on George Corser (55), a Heywood gardener, who succumbed to injuries received as the result of an explosion in Bury, a verdict of "Accidental death" was returned. It was stated that a number of men were disconnecting the electric cables in consequence of a leakage, when the explosion occurred, and Mr. S. J. Watson, the borough electrical engineer, attributed the explosion to the presence of gas.

Signals from Mars?—A journalistic sensation this week was based on a statement of Senator Marconi that signals frequently received on a long wave-length from an unknown but very distant source might possibly emanate from Mars or some other planet. In the *Daily News* of Wednesday, Mr. Marconi protested, with some indignation, against the interpretation that had been placed upon his "purely fanciful speculations."

R.E. Dinner.—A dinner for ex-members of the 351st E. and M. Co. R.E. is being held in London on February 14th. Those members who have not yet been communicated with should write at once to the hon. secretary, Lieut. H. F. A. Kinder, 9, Maze Hill, St. Leonard's-on-Sea.

The Tunnelling of Mont Blanc.—A Reuter message to *The Times* states that French and Italian engineers have arrived in Chamonix in order to study the ground and make all necessary investigations for the boring of a tunnel under Mont Blanc, through which a line would be run linking up France and Italy. The project has been under examination for many years, but at last appears to be near execution, as both the French and Italian Governments have voted the necessary credits for the construction of the tunnel, France allotting 45,000,000 fr. to the work, and Italy 40,000,000 lire.

The "Lay" Press.—In *Electrical Industries* there appears a letter (signed "Supply") defending *The Times Trade Supplement* against our recent criticism, but endorsing our advice to supply authorities to hurry up with their co-operative schemes. From the references to "our contemporary" in the letter, it would appear that it was submitted for use as a leaderette, but the editor preferred to put it under the head of "Correspondence." We should not be surprised to learn that "Supply" wrote the article in the *Supplement*. A leading article in the same issue of *Electrical Industries* attacks *The Times* with virulence, referring to it as "our amazing contemporary," and characterising its views on the moulders' strike as "the nonsense of ignorance."

Promotion in the Navy.—At the instance of the Admiralty, says the *Morning Post*, it is provided by an Order in Council that commissioned electricians are to be eligible for promotion to the relative rank of lieutenant with the title of electrical lieutenant, and, on attaining eight years' seniority as such, are to have the relative rank of lieutenant-commander.

Inquiries.—Makers of the F. T. Reed patent time switch; of a lamp suitable for installation inside a baker's oven; of McDougall's patent commutator grinding blocks; and of electric floor polishers, are asked for.

Appointments Vacant.—Cable jointer (84/4) for the Tynemouth Corporation Electricity Works; plumber jointer for the Wolverhampton Electrical Engineers Department; shift engineer (82/7) for the Eccles Corporation Electricity Works; correspondence clerk (£200) for the Walthamstow Urban District Council Electricity Department; sub-station attendant (82/8) for the Stoke Newington Borough Council Electricity Works; shift engineer (£220) for the Torquay Corporation Electricity Department. See "Official Notices" to-day.

Synthetic Ammonia.—A new French process for the production of synthetic ammonia, invented by M. Georges Claude, and superior to the Haber process, is to be put in operation at Maryport by the Cumberland Coal, Power and Chemicals, Ltd. It is claimed that the scheme will provide the whole of the nitric acid, nitrate of ammonia, cyanides, &c., required by this country at a lower price than from Chile nitrate.

Protection for X-ray Workers.—The December *Archives d'Electricité Médicale et de Physiothérapie*, in an article commenting upon the death of Dr. Jaugeas, the Parisian X-ray surgeon, puts forward several suggestions for the protection of those engaged in X-ray work. Isolated platforms are recommended, as well as rubber gloves and shoes. All parts of the apparatus should be electrically continuous and efficiently earthed. When the right hand is touching a wire the left should be placed behind the back. Many other precautions and safeguards are given by various authorities on the subject.

INSTITUTION NOTES.

Institution of Electrical Engineers.—A debate between representative members of the Midland Junior Gas Association and the SOUTH MIDLAND CENTRE of the I.E.E. will take place at the Birmingham Council House, on February 5th, on the subject of "The Uses of Gas and Electricity." The debate will be opened by Dr. E. W. Smith, chief chemist at the Birmingham gas department, on the Utilisation of Fuel for the Generation of Power; and the case for electricity will be submitted by Mr. F. Forest, M.I.E.E. Dr. C. W. Walter, of the Industrial Research Laboratory of the Birmingham gas department, will speak on "The Industrial Application of Gas and Electricity" (furnaces in particular), and Mr. E. J. Moffatt, B.A., will present the claims of electricity. Other subjects to be discussed in the debate will include Domestic Appliances, Transmission or Distribution of Power, and the discussion will be wound up by Dr. Smith and Dr. C. C. Garrard, M.I.E.E. Councillor Marks (Electricity Supply Committee, Birmingham) will preside.

SCOTTISH CENTRE.—A paper, entitled "The Electrical Power Supply in the War Zone," was read by Major Thos. Rich, O.B.E., at Edinburgh, on January 13th. The chairman, in thanking the author, characterised the paper as full of first-hand information and absorbing details.

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Institution of Civil Engineers.—The Council proposes to take steps for the introduction of the measure for the registration of civil engineers in the next Session of Parliament as a Public Bill. The proposal is that any person who complies with the qualifications to be laid down by the Institution shall have a right to be registered, whether a member of the Institution or not, and eligibility to register does not involve any obligation to become a member of the Institution of Civil Engineers or of any other society. The Council claims that the body which is best fitted to determine the proper qualifications and to regulate the conduct of those registered is the Institution of Civil Engineers.

Paisley Association of Electrical Engineers.—On January 16th, a lecture on "Electricity and Matter" was delivered by Principal Angus M'Lean, B.Sc., and on the 17th the members visited the works of The Howden Boiler and Armaments Co., Ltd., at Govan. The chief items of interest were turbines and high-speed engines in various stages of construction.

Greenock Philosophical Society.—Under the auspices of this Society, Prof. C. G. Barkla, F.R.S., of Edinburgh University, delivered the Watt anniversary lecture in the Watt Institution, on January 16th, the subject being "Radiation and Matter"; the lecture was illustrated by experiments and lantern slides. His own investigations had been concerned with the electrons, not at the surface, but deep within the atom. The outer electrons were those which determined the optical and chemical properties of a substance; the inner ones were those which vibrated so rapidly as to emit, not light, but X-rays and gamma rays. He had found that each element under suitable stimulus emitted its own characteristic X-rays; that was, it had its own characteristic "colour" in X-rays, which chemical and physical processes could not affect. There were, in fact, series of X-ray spectral lines. Recent investigations had afforded strong evidence of a high-frequency X-radiation, which was possibly due to vibrations in the nucleus itself. This was at present being studied in the Edinburgh University physics laboratory.

Society of Dyers and Colourists.—A lecture was delivered before the members of the West Riding Section of the Society on January 22nd, by Dr. F. M. Perkin, in which he surveyed the increasing application of electricity in the dyeing industry. After stating the advantages to be derived from the use of electricity, he showed how, generally, caustic soda, chlorine, and other dyework materials were now being produced electrically, and the degree of purity of the bleaching agents, solvents, and scouring materials so produced. Dr. Perkin, asked by one of the members, if he thought the results obtained by electrochemical methods would justify further expenditure in this direction, replied that he did not think Government schemes would prove of much advantage, but the work of installing power plant at the pitheads would be done by private enterprise. Cheap electrical power would be accomplished by private enterprise, and then that power would be available for electrochemical processes as well as for power.

Association of Mining Electrical Engineers.—At a meeting of the Midland Branch of the Association, at Nottingham University College, on January 17th, Mr. A. W. Williams, of Mansfield, condemned the vagueness which characterised certain regulations in connection with the use of electricity in mines. Indefiniteness as to the safeguards to be adopted had, he thought, led to the creation of a complicated position in certain cases. He urged that all apparatus should not only be made to conform to certain specifications, but should also before being used in mines, be certified, and a certificate should be secured by the manufacturers from a Government department. This reasonable request would cover the manufacturers and relieve the electrical engineer of the responsibility as to whether the apparatus was suitable or not. At the same time it would obviously not necessarily relieve the electrician of the responsibility as to the type of system or apparatus to be adopted. The granting of a certificate by the Home Office indicating, after official inspection, that the apparatus had been approved, would have a tendency in the direction of giving confidence to all concerned. It might be urged that these tests would involve a number of inspectors, but the result would be increased safety in operation, and if the inspectors were competent and had a knowledge of electricity as applied to underground workings, the additional expenditure would be well justified. A resolution was passed with the object of calling the attention of the Home Office to the vagueness of certain of the existing regulations, and suggesting the need of revision.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Shareholders of the Metropolitan Wagon & Finance Co. last week presented Mr. F. DUDLEY DOCKER, C.B., with an illuminated address in appreciation of his administration of the affairs of the company during 17 years. The address was accompanied by a sum of money for the creation of Docker scholarships at Birmingham University. A presentation was also made to Mrs. Docker.

Mr. E. H. W. COOKE, chief accountant to the Birmingham Gas Department, has been appointed chief accountant to the Metropolitan-Vickers Electrical Co., Trafford Park. He has been in the employ of the Birmingham Corporation 30 years. He was engaged in London on the compilation of the register of volunteers, under National Service, and later became chief registration officer to the Birmingham Food Control Committee.

The Newcastle-under-Lyme Corporation has increased the salary of the borough electrical engineer, Mr. A. J. C. DE RENZI, to £450 per annum.

The *Times* states that Mr. L. H. KIEK, general manager of the Anglo-South American Bank, has been elected a member of the board of the Vera Cruz Electric Light, Power, and Traction, Ltd.

Mr. E. MERCER has resigned his position as resident engineer under the Yorkshire West-Riding Tramway Co., Castleford, and has started in business as the Electrical Contracting and Motor Co., Castleford. He wishes to receive lists and catalogues of electrical goods.

The Electrical Contractors' Association of Scotland (Glasgow Branch) held a successful "At Home" in the Burlington House, when a presentation of silver salver and purse and cheque was made to Mr. J. M. DAVIES on retiring from the secretaryship of the Association, and a pendant to Mrs. Davies.

The Burton-on-Trent Town Council has increased the salary of the electrical engineer (Mr. HALL) by £150 a year.

The Military Cross awarded to Capt. F. L. LAWRENCE, R.F.A., works manager of Chamberlain & Hookham, Ltd., for distinguished service on November 6th and 7th, 1918, while in action near Mons, was presented to him at the recent local investiture held by H.R.H. Prince Henry at the Birmingham Town Hall.

At Cape Town in December the employés of Messrs. E. A. Shaw & Co., were entertained to a smoking concert by Mr. F. E. TRILL, who was severing his partnership connection with the firm. Mr. Hylands, the works manager, on behalf of the employés, presented Mr. Trill with an illuminated address and a silver rose bowl.

The employés of the Musselburgh & District Electric Light and Traction Co., Ltd., held their annual dinner, the first since the war, on the 15th inst. The local director, Mr. J. ANDERSON, took the chair. Several of the employés contributed to the musical programme. During the evening the manager, Mr. H. C. Babb, presented the oldest employé, Mr. W. Elliot, who has been with the company since its inauguration, with an envelope of Treasury notes.

Obituary.—DR. CECIL R. C. LYSTER.—We regret to learn that Dr. Cecil R. C. Lyster, who was for 17 years in charge of the electro-therapeutic department of the Middlesex Hospital, passed away on Monday at the age of 60 years. He is described as a "martyr to science." The *Times* states that he was a pioneer in X-ray investigation, particularly in relation to the treatment of cancer. "Through exposure to the rays in the early days of research, he himself contracted the disease, but in spite of much suffering he insisted upon pursuing his invaluable work until a few weeks ago, when he was compelled to lay it aside." It appears that recently he had been concerned in an attempt to standardise the application of radium as a remedial agent in the treatment of cancer, and though a victim to the disease he had sought to conquer he declined to be set aside from his purpose.

MR. K. L. AITKEN.—The *Electrical News* (Canada) reports the death of Mr. Kenneth L. Aitken in California. Mr. Aitken was manager of the Toronto hydro-electric system in its early days.

MR. J. H. P. BROWN.—The death has occurred, at the age of 57 years, of Mr. J. H. P. Brown, who until a few months ago was P.O. telegraph superintendent at Hull. He had been in the service 44 years.

NEW COMPANIES REGISTERED.

General Welding Co., Ltd. (10,881).—Private company. Registered in Edinburgh January 9th. Capital, £10,000 in £1 shares. To carry on in Glasgow the business of welders by oxy-acetylene and other autogenous processes, &c. The subscribers (each with one share) are: R. Baillie, 11, Woodhall Drive, Cardonald, Glasgow, engineer; A. Paton, 145, Old Shettleston Road, Glasgow, boilermaker; P. Linn, 318, Scotland Street, Glasgow, secretary. The first directors are: R. Baillie, A. Paton and P. Linn. Qualification, £100. Registered office: 19, Muirhouse Street, Glasgow.

Icenj Engineering Co., Ltd. (163,037).—Private company. Registered January 20th. Capital, £3,000 in £1 shares. To carry on in Letchworth and elsewhere the business of mechanical and electrical engineers, &c., and to adopt an agreement with T. F. Wild. The subscribers (each with one share) are: J. W. E. Powell, 204, Broadway Chambers, Letchworth; G. W. Swanson, 7, Norton Way North, Letchworth; C. F. Ball, 336, Norton Way, Letchworth. The first directors are: C. F. Ball, J. W. E. Powell, G. C. Swanson, E. J. Simmons and C. H. Jolley. Solicitor: F. W. G. Bolton, Letchworth.

Portadown Electric Co., Ltd. (4,871).—Private company. Registered in Dublin January 8th. Capital, £20,000 in £1 shares (5,000 preference). To produce, store, supply and sell electrical energy, &c. The subscribers (each with one ordinary share) are: M. Curran, 2, Kent Street, Belfast, electrical engineer; D. Chapman, Edenderry, Portadown, jam merchant and druggist. The first directors are: M. Curran and D. Chapman. Registered office: 7-8, Market Street, Portadown, Co. Armagh.

Tuam Electricity Co., Ltd. (4,808).—Registered in Dublin on September 14th. Capital, £8,000 in £1 shares. To carry on in Tuam and elsewhere the business of an electric light company. The first directors are: A. Eaton, St. Jarlath's College, Tuam; O. Harman, Tuam; G. Murray, Tuam; A. O'Malley, Tuam; T. J. Mellin, Tuam; and P. McTigue, Tuam. Secretary: J. Daly. Registered office: Dutlin Road, Tuam.

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Technical Intelligence Service, Ltd. (162,972).—Private company. Registered January 17th. Capital, £1,000 in £1 shares. To carry on the business of a news and intelligence agency, &c. The first directors are: E. Hudson, 15, Queen Anne's Gate, S.W., newspaper proprietor; Major W. E. Simnett, Temple Fortune House, Hampstead Way, N.W.4; H. Pratt, 62, Lyford Road, S.W.18, newspaper director. Registered office: 20, Tavistock Street, Covent Garden, W.C.

Technical Review, Ltd. (162,973).—Private company. Registered January 17th. Capital, £2,500 in £1 shares. To carry on the business of proprietors and publishers of newspapers, reviews and periodicals, &c. First directors: E. Hudson, 15, Queen Anne's Gate, S.W., newspaper proprietor; Major W. E. Simnett, Temple Fortune House, Hampstead Way, N.W.4; H. Pratt, 62, Lyford Road, S.W.18, newspaper director. Registered office: 20, Tavistock Street, Covent Garden, W.C.

I. Calvete, Ltd. (163,036).—Private company. Registered January 20th. Capital, £10,000 in £1 shares. To take over the interest and goodwill of I. Calvete and L. N. Viola in the business of contractors, electrical and mechanical engineers, manufacturers of electrical apparatus, &c., carried on by them at 11, Little Street, Andrew Street, St. Martin's Lane, W.C. The first directors are: L. N Viola, 6, Russell Court Mansions, Great Russell Street, W.C.; I. Calvete, 17, Upper Addison Gardens, West Kensington, W Solicitor: L. E. Townroe, 26, Budge Row, E.C. Registered office: 11, Little St. Andrew Street, St. Martin's Lane, E.C.

Southwark Lighting Co., Ltd. (163,008).—Private company. Registered January 19th. Capital, £1,000 in £1 shares. To carry on the business of manufacturers, importers and exporters of and dealers in electrical, gas and lighting goods and accessories, &c. The subscribers (each with one share) are: W. Lennard, 3, Love Lane, Eastcheap, E.C., produce merchant; R. C. Radeglia, 3, Love Lane, Eastcheap, E.C., merchant. The first directors are: W. Lennard (chairman) and R. C. Radeglia. Solicitor: H. Crafter, 7, Southampton Street, W.C. Registered office: 3, Love Lane, Eastcheap, E.C.

Power Research Co., Ltd. (163,004).—Private company. Registered January 19th. Capital, £100,000 in £1 shares. To acquire and turn to account any mines, rights and property in the U.K. or elsewhere, and to carry on the business indicated by the title. The subscribers (each with one share) are: P. G. Smart, 38, Salisbury Road, Forest Gate, E.7, clerk; B. R. Bayliss, 21a, Parkholme Road, Dalston, E.8, clerk. The subscribers are to appoint the first directors. Solicitor: G. C. Pullman, 24, Coleman Street, E.C.

Portumna Electric Light and Power Co., Ltd. (4,874).—Registered in Dublin on January 12th. Capital, £5,000 in £1 shares. To carry on in Portumna and elsewhere the business of an electric light company. The directors are: Viscount Lascelles, A. E. Moeran, Mrs. M. M. Nolan, J. Hynes, N. J. Kelly, J. Corcoran, G. J. Coates, J. Taylor, and J. Murphy, all of Portumna, County Galway. Secretary: M. C. Woulfe. Solicitor: J. J. Kearns, Portumna, Co. Galway. Registered office: New Street, Portumna, Co. Galway.

Car Lighting Set Co., Ltd. (162,890).—Private company. Registered January 16th. Capital, £5,000 in £1 shares. To carry on the business of manufacturers, suppliers, installers and repairers of lighting, heating, starting and driving apparatus and appliances for all kinds of cars, vehicles and boats by electricity, fuel, gas, spirit, oil, &c. The subscribers (each with 500 shares) are: C. W. Akers, 224, Brixton Hill, S.W.2, scientific instrument maker; A. J. Austin, 308, Brixton Hill, S.W.2, engineer; W. Blenkarn, 30, Glencagle Road, Streatham, S.W.16, electrical engineer. The first directors are: C. W. Akers, A. J. Austin and W. Blenkarn (all permanent). Registered office: 36, Maiden Lane, Strand, W.C.2.

British Electrical Development Association (162,942).—Registered January 17th as a company limited by guarantee, not formed for profit. The word "limited" being omitted from title by licence of the Board of Trade. Objects: To promote and protect electrical industry and enterprise in the British Empire, to develop the use of and demand for electrical energy for industrial, commercial, public, domestic, agricultural and other purposes, &c. There are to be founders, ordinary members and associates. The first members of the Council are: S. T. Allen, Homelea, Wrottesley Road, Tettenhall, Staffs; L. B. Atkinson, Alste, Little Hampden, Great Missenden; C. O. Bastian, 32, The Avenue, N.W.6; C. R. Belling, 10, Glebe Avenue, Enfield; A. F. Berry, Hayes, Middlesex; T. H. Bowden, 101, Eltham Road, Lee, S.E.12; W. A. Chamen, The Gables, Llantwit Fardre, Pontypridd; J. Christie, A. C. Cramb, R. S. Downe, D. Watson, D. N. Dunlop, L. E. Edgecombe, I. W. Elliot, S. E. Fedden, W. A. Gillot, E. E. Hoadley, E. T. R. Murray, H. C. Palmer, A. R. Phipps, F. I. Walker, F. H. Williams, W. B. Woodhouse and C. H. Wordingham. Each founder (including the Institution of Electrical Engineers, the British Electrical and Allied Manufacturers' Association, the Incorporated Municipal Electrical Association, the Incorporated Association of Electric Power Companies, the Electrical Contractors' Association, Incorporated, and the Electric Lamp Manufacturers' Association of Great Britain, Ltd.) is to be entitled to one representative on the Council. Solicitor: T. Trimmell, 71, Lincoln's Inn Fields, W.C.

Simplex Power Generator Co., Ltd. (163,053).—Private company. Registered January 20th. Capital, £2,000 in £1 shares. To acquire and turn to account any invention relating to power, gas and gas engines, &c. The first directors are: Capt. E. F. Hill, Southmead, Newbury, Berks; R. G. Harley, 20, Market Street, Mayfair, W., accountant. Solicitor: R. Burrow, Rolls Chambers, 88-9, Chancery Lane, W.C. Registered office: 20, Market Street, Curzon Street, Mayfair, W.

London Electricity Joint Committee, 1920, Ltd. (163,101).—Private. Registered January 21st. Capital, £50,000 in £1 shares. To prepare schemes with a view to the improvements of the organisation of the supply of electricity within the counties of London and Middlesex and adjoining counties or districts. The subscribers (each with one share) are: W. F. Fladgate, 18-19, Pall Mall, S.W., chairman, Charing Cross, West End and City Electricity Supply Co., Ltd.; Lord Downham, Eccleston Place, Belgravia, S.W., chairman, Westminster Electric Supply Corporation, Ltd. The board shall consist of one authorised representative of each of the companies and local authorities who are for the time being members of this company. Until such directors are appointed, the subscribers are deemed to be the directors of the company. Solicitor: F. G. C. Morris, 40, King Street, Cheapside, E.C.

British Non-Ferrous Metals Research Association (163,067).—Registered January 21st as a company limited by guarantee, not formed for profit. The word "limited" is omitted from the title by licence of the Board of Trade. Objects: To promote research and scientific work in connection with the study, production, treatment and utilisation of non-ferrous metals and alloys, &c. The number of members is unlimited, and each member is liable for not more than £5 in the event of winding up. The first members of the Council are: A. J. Bailey (Sir W. H. Bailey & Co., Ltd., Salford); T. Bolton (T. Bolton & Sons, Ltd., London); C. Cookson (Cookson & Co., Ltd., Newcastle-on-Tyne); J. S. Cornwell, Newton Chambers, Cannon Street, Birmingham (chairman of Bedstead Manufacturers' Federation); J. N. Earle (Earle, Bourne & Co., Ltd., Birmingham); S. Evered (Evered & Co., Ltd., Smethwick); A. P. M. Fleming (Metropolitan-Vickers Electrical Co., Ltd., Trafford Park, Manchester); W. W. Gibbins (Birmingham Battery and Metal Co., Ltd.); H. L. Heathcote (Rudge-Whitworth, Ltd., Sparkhill, Birmingham); H. E. Howard (Stewarts & Lloyds, Ltd., Halesowen); R. S. Hutton (Sheffield Flatware Co., Ltd.); J. W. Maddey, Ho, Edmund Street, Birmingham; G. H. Muntz (Muntz's Metal Co., Smethwick); W. M. Morrison (British Aluminium Co., Ltd., London); Z. Payne (Phosphor Bronze Co., Ltd., London); H. L. Reason (J. Russell & Co., Ltd., Birmingham); F. Tomlinson (Broughton Copper Co., Ltd., Manchester); A. H. Wiggin (H. Wiggin & Co., Ltd., Birmingham); A. H. Wolseley (C. Clifford & Sons, Ltd., Birmingham). Solicitors: Pinsent & Co., Birmingham.

Castle Engineering Co., Ltd.—Registered January 23rd. Capital, £5,000 in £1 shares (2,500 preference). To carry on the business of mechanical and electrical engineers, manufacturers of and dealers in electric, magnetic, telegraphic, telephonic and other appliances, &c. The subscribers (each with one share) are: E. L. Castle, Holly Mount, Station Road, Pendlebury, electrical engineer; F. C. Lomax, Ennerdale, Campbell Road, Swinton, cotton manufacturer. The first directors are: E. L. Castle, E. W. Castle, F. C. Lomax, and H. Easson (all permanent). Solicitor: J. Knight, 2, Ridgefield, Manchester.

Accumulators of Woking, Ltd. (163,120).—Private company. Registered January 22nd. Capital, £35,000 in £1 shares. To take over the business of Accumulators, Ltd., and to carry on the business of mechanical engineers, machinists, fitters, millwrights, manufacturers of and dealers in electrical batteries and accumulators, &c. The first directors are: H. P. Martin, Lingwood, Gower Road, Weybridge, engineer; H. Fulton, Byways, Berkhampstead, general manager; G. H. Handasyde, The Vines, West Byfleet; L. C. Rawlence, 40, Sackville Street, W., motor engineer Registered office: Maybury Hill, Woking.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Drake & Gorham, Ltd. (70,275).—Return dated December 3rd, 1919. Capital, £125,000 in £1 shares. All shares taken up. £85,000 paid. £40,000 considered as paid. Mortgages and charges, nil.

Lancashire Power Construction Co., Ltd.—Charge on the company's undertaking and property present and future, including uncalled capital, and certain debentures and shares, registered December 6th, 1919, to secure all moneys due or to become due from the company to Lloyd's Bank, not exceeding £50,000.

United Kingdom Lighting Trust, Ltd.—Debenture to secure all moneys due or to become due from company to Barclay's Bank, Ltd., registered December 2nd, 1919, charged on the company's undertaking and property, present and future, including uncalled capital.

CITY NOTES.

British Columbia Electric Railway Co., Ltd.

The report for the year ended June, 1919, shows that after deducting £154,727 for depreciation, sinking fund, and renewals, and £1,818 for addition to capital amortisation fund, the ordinary net revenue from all sources was £224,601, plus £138,419 profit on exchange in remittances from Vancouver to London and moneys formerly set aside for contingencies and now no longer required for such, and £6,085 brought forward, making £369,105. Debenture interest absorbs £132,447; dividend on the 5 per cent. cumulative perpetual preference stock for the year £72,000; dividends, interim and final on the preferred ordinary stock, making 5 per cent. for the year, £72,000; 3 per cent. on the deferred ordinary stock, £43,200; bonus of 3 per cent. on the deferred ordinary stock, £43,200; to be carried forward £6,258. The bonus of 3 per cent. upon the deferred ordinary stock is an exceptional distribution rendered possible this year, as shown by profit on exchange in remitting moneys from Vancouver to London, and by the appropriation of certain moneys held for contingencies which, under the altered conditions, the directors consider may now be safely distributed. In regard to the dividend of 3 per cent. on the deferred ordinary stock, the directors consider that the improvement in local conditions, as reflected in the current earnings, is such as to justify reasonable hope that a distribution on the deferred stock may be maintained. The net earnings of the company for the current year, as compared with the year under review, are as follows:—

	1918. $	1919. $	Increase. $
July	*19,165	149,109	129,944
August	88,436	166,808	78,372
September ...	130,548	181,811	51,263
October	124,326	183,415	59,089
	$362,475	$681,143	$318,668

*NOTE.—Strike in progress for 11 days during July, 1918.

The Bill to establish a Public Utilities Commission became law in March, 1919. Both the terms of the Act and the decisions of the Commissioner have shown every indication of a desire to treat the company with justice. The Act gives a right of appeal from the decision of the Commissioner. There is a special clause relating to the 6 cent fare now being charged on the Vancouver City lines. The Vancouver City Council in July, 1918, granted the company the right to charge a 6 cent fare for a period of nine months. The Public Utilities Act was passed before this period expired and provided for the continuance of the 6 cent fare, subject to the company being able to satisfy the Commissioner that such rate was just and reasonable.

The Act also provides that until such proof is furnished to the satisfaction of the Commission the amount received by the company in excess of the five cent fare previously charged is to be deposited in a special account in a chartered bank in Vancouver, and that if the rate should be fixed at less than six cents the excess amount is to be handed over to the Vancouver General Hospital. Owing to an amendment of the general Railway Act of the Dominion of Canada the railways of the company passed from the jurisdiction of the Province of British Columbia and of the Public Utilities Com-

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mission to that of the Dominion of Canada and of the Dominion Railway Board, but it is anticipated that amending legislation will be passed early in 1920 which will place the company's railways again under the jurisdiction of the Public Utilities Commission, and the company has joined with the local authorities in petitioning for this to be done. When this has been done it is expected that an investigation, which was commenced by the Commissioner some time ago to ascertain the correct fare to be charged in Vancouver City, but which, owing to the circumstances reported above, has been temporarily adjourned, will be resumed, and that an appraisal of all the property of the company on the mainland will be made.

In June, 1919, the employés of the company and of most other industries in Vancouver went on strike, not for any increased wages or any improved conditions, but in sympathy with the general unrest which was then prevalent in labour circles throughout Canada, particularly in Winnipeg. The strike lasted from June 5th to 29th, when the men returned to work on the old terms. The revenues of the company on the mainland from its railway system were reduced to almost nothing during the 24 days that this strike lasted. In August, 1919, a request was received for a further increase in wages. This request was submitted to arbitration, and under the arbitration award increases were granted which will cost the company a large sum.

The directors consider that the improved conditions warrant a return to the practice of paying the dividend on the 5 per cent. cumulative perpetual preference stock half-yearly, as before the war, and a half-year's dividend of 2½ per cent. has been declared.

The end of the war and the gradual return to normal conditions is having a good effect upon the company's revenues. In addition to the return of the men who left the Province of British Columbia for overseas service, it is stated that a large number of men who enlisted in other parts of Canada went to British Columbia on being demobilised.

East London Railway Co.—During 1919: passengers carried 12,721,929, against 10,569,541, exclusive of season-ticket holders. State control of railways has operated and continues to operate particularly inequitably—inasmuch as while the Government absorbs the greatly increased receipts due to the electrification of the railway, the company derives no benefit therefrom, but on the contrary is responsible for interest on the amount expended upon the electrification. An appeal was made to the Railway Executive Committee asking for special consideration, and the secretary replied that the Board of Trade were informed that the claim of the company was one which should receive the sympathetic consideration of the Board of Trade and of the Treasury.

British Trade Corporation.—The net profit for 1919, after payment of all expenses and making provision for depreciation of investments and contingencies, amounts to £88,340, plus £14,252 brought forward. The directors recommend a dividend of 8s. per share (subject to tax), leaving £22,592 to be carried forward.

Mather & Platt, Ltd.—A scheme has been prepared for capitalising and distributing £450,000 of the undivided profits, in the shape of new ordinary shares of £1 each. The capital is to be increased by £1,500,000 new shares to £2,500,000 if resolutions to be submitted at a meeting on February 3rd are agreed to.

Marconi's Wireless Telegraph Co., Ltd.—Dividend on the 7 per cent. cum. part. preference shares of 7 per cent., being 1s. 4.80d. per share, less income tax; on the ordinary shares an interim dividend of 10 per cent., being 2s. per share, less income tax.

Metropolitan Railway Co.—£40,000 is placed to general renewals; a dividend at the rate of 1½ per cent. per annum for the half-year, making 1½ per cent. for the year, is to be paid; and £20,000 is to be carried forward.

Prospectuses.—Industrial Glass Works, Ltd.—The 'ist closes on February 3rd in an issue of 20,000 10 per cent. cum-pref. shares of £1 each at par and 20,000 ordinary shares of 1s. each at par.—Messrs. Erinoid, Ltd., have been offering to shareholders 100,000 shares of 5s. each at a premium of 5s. each.

Stock Exchange Notice.—The Committee has ordered the undermentioned to be officially quoted:—

Edison Swan Electric Co., Ltd.—360,000 ordinary shares of £1 each, fully paid, Nos. 598,308 to 958,307.

Yorkshire (West Riding) Electric Tramway Co., Ltd.—Dividend 6 per cent., less tax, on the cum. pref. shares. There is put to renewals, depreciation and reserve £21,259. Purchase of funded preferential dividend certificates, £12,837. Carried forward, £1,386.

Stothert & Pitt, Ltd.—Interim dividend for the past half-year at the rate of 10 per cent. per annum, free of tax.

Blackpool, St. Annes & Lytham Tramways Co.—Profit for 1919 (to October) £10,093; after meeting debenture charges, the debit balance carried forward amounts to £37,991.

Crossley Bros., Ltd.—An issue of 255,000 of the new ordinary shares is being offered to the existing holders at par.

STOCKS AND SHARES.

TUESDAY EVENING.

THERE is noticeable slackening in Stock Exchange activity, although no check to the outpouring of new issues. Probably the latter has something to do with the former. The Government's appeal that fresh applicants for money should exercise a certain amount of restraint while the subscription lists are open for the new 5¾ per cent. bonds has not had much effect, the newcomers sheltering themselves behind the reasonable excuse that they had made their arrangements for issue some time before the Government appeal appeared, and that they were unable to stop their prospectuses. It may be mentioned, in this connection, that when underwriting is being arranged, there is almost invariably a clause to the effect that underwriters are only bound to their obligation provided the prospectus is issued within a certain period, and the time, as a rule, is comparatively close to that on which the underwriting is completed, so that it is likely enough that the excuse is a valid one in most instances.

The first Home Railway dividend announcements exercised a chilling effect upon the market for the stocks. The Metropolitan repeats its performance of last year, which has, incidentally, the effect of throwing into relief the extremely meagre yield afforded by the ordinary stock. The East London Railway figures are not bad, showing traffic increases in passenger and freight traffic, but shareholders get nothing out of the improvement, thanks to the arrangement with the Government. The Railway Executive has promised that the claim of the company to special consideration shall receive sympathy, whatever that may mean.

What is the position of London Tubes may be a little clearer at the end of the week than it is now. Manifestly there is something afoot between the Combine and the Ministry of Transport: and curiosity stirs itself laxily to ask what is likely to happen. The two main questions are: Will the Government take over the Tubes? and, Are the fares going to be doubled? to which the daily strap-hanger adds a third, When shall I get a seat for my money? Market sentiment is reflected in ¼ fall in Underground £10 shares, and 3½ points in the Income Bonds, although such movements might have occurred in the general dulness of Home Railways, irrespective of the questions surrounding control of the four Tubes, three tramway and three omnibus companies concerned in the Combine.

London United Tramways 5 per cent. preference shares of £1 each stand at two and ninepence, and the 4 per cent. debenture stock at 40. South Metropolitan Tramways 4 per cent. debenture is quoted 58. Metropolitan Electric Tramways 4½ per cent. debenture stock is, according to the Stock Exchange official price, 60 to 63, although business was marked at 72 only a week ago, and the company's 5 per cent. debenture stock stands at 73½. London and Suburban Traction ordinary are a florin apiece, the preference 4s. 6d., and the debentures 52 and 71 for 4½ per cent. and five's respectively. Potteries Electric Traction ordinary and preference have come on to the same line at 14s. British Electric Tractions are 40½ and 68½ for ordinary and preference; the two debentures have changed hands this year at 82⅛ and 64½ for firsts and seconds.

Holders of such stocks and shares may well regard with feelings of envy the proprietors of Bombay Electric ordinary. We mentioned some time ago that the price rose pounds in one day to the neighbourhood of 60. To-day it is £100—indeed, a bargain was marked at 101 on Friday last. Intrinsically it is difficult to see that the shares are worth 20, being of the nominal value of £10. Last year a dividend of 7 per cent. was paid; in the previous twelve months the dividend was 9 per cent. The Stock Exchange market refers the rise to buying for control. A rise of 5s. lifted the preference to 14; they carry 6 per cent. dividend and no participating rights. Other Indian tramway shares are quiet, Calcuttas 8⅛, Madras preference 4.

Mexicans mostly retreated further, where they moved at all. Mexican Light and Power firsts at 52½ are down 3½. Pachuca Fives are dull at 43, Mentereys at 31½. Mexican Electric Light 5 per cent. bonds changed hands at 43¾ on Monday; the deposit receipts at 43. The optimist may be pardoned for thinking he sees a breath of improvement in the market. A little encouragement, and prices would be rapidly up again. South American Light and Power 5 per cent. registered debentures were sold a few days back at 80. Brazilian Tractions continue to give way, and are down to 56. The strength of Anglo-Argentine Tramways yielded to what was termed profit-taking. British Columbia Electric stock spurted on the dividend declaration; a bonus on the deferred was quite unexpected.

The cable market has turned better, and Western Telegraphs at 17¼, Eastern ordinary 165½, Anglo-American pre-

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ferred 90, "Chinas" and Globes 16½ show, with slight improvements, the tendency of the market. United River Plate Telephones are higher at 8, but Orientals at 2⅛ parted with some of their recent advance. Automatic Telephones reacted to 3 5-16. Anglo-Portuguese Telephone ordinary hold their price at 19s. Marconis continue to be neglected, but Canadians spurted to 14s., while Americans lagged behind at 30s. 6d.

Electricity supply shares show scarcely any movements. Although the recent Bill had its fangs drawn, a new Bill is to be presented next session, in which the features objectionable to shareholders in the companies are likely to be repeated, and already a movement is on foot to protest against infringement of the companies' rates. An interesting registration is that of the London Electricity Joint Committee (1920), Ltd., with a nominal capital of £50,000 in £1 shares. The company is a private one, and the two signatories are Mr. W. F. Fladgate and Lord Downham. The objects of the company are to prepare schemes with a view to improvement of organisation of electricity supply within London, Middlesex and adjoining counties or districts.

Edisons were a little lower at 27s., and General Electrics eased off to 41s. Siemens at 29s. 6d. have reacted a trifle. Electric Construction debentures fell 6 to 60. On the other hand, Castner-Kellners have risen to 4 owing to an improvement in Brunner Monds. Henleys are ½ up at 2⅜. Callenders 7s. 6d. higher at ⅝ and Telegraph Constructions 10s. to the good at 27. A fair amount of business is being done in the shares of all the manufacturing companies. The rubber market continues quiet, with no object of special interest, and in the metal markets, rises in gold and tin have drawn renewed attention to the companies concerned with the production of both.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1917.	Dividend 1918.	Price Jan. 27, 1920.	Rise or fall.	Yield p.c.
HOME ELECTRICITY COMPANIES.					
Brompton Ordinary	10	8	5⅞	—	£6 16 2
Charing Cross Ordinary	4	4	8	—	6 18 4
do. do. do 4½ Pref.	4½	4½	2⅞	—	8 8 8
Chelsea	5	5	3	—	5 0 0
City of London	8	8	18	—	6 8 1
do. do. 6 per cent. Pref.	6	6	4½	—	6 6 4
County of London	7	7	9¼	— ⅛	7 11 4
do do. 6 per cent. Pref.	6	6	8⅞	—	6 15 2
Kensington Ordinary	7	6	4⅜	—	6 6 4
London Electric	Nil	Nil	1⅜	—	
do. do. 6 per cent. Pref.	5	6	8⅜	—	8 17 10
Metropolitan	4	5	8 1/16	—	7 16 10
do. 4½ per cent. Pref.	4½	4½	2⅜	—	7 16 6
St. James' and Pall Mall	9	10	6	—	8 6 8
South London	5	5	2⅝	—	7 12 8
South Metropolitan Pref.	7	7	1	—	7 0 0
Westminster Ordinary	9	8	5½	—	7 12 5
TELEGRAPHS AND TELEPHONES.					
Anglo-Am. Tel. Pref.	6	6	90	+ ½	6 13 4
do. Def.	1½	88/6	21½		7 1 2
Chile Telephone	8	8	6⅜	+ ⅛	6 5 6
Cuba Sub. Ord.	7	7	10½	—	*6 13 4
Eastern Extension	8	8	16¼	+ ⅜	*4 18 6
Eastern Tel. Ord.	8	8	165½	+1	*4 16 8
Globe Tel. and T. Ord.	7	8	16¼	+ ¼	*4 18 6
do. do. Pref.	6	6	9⅛	+ ⅛	6 6 4
Great Northern Tel.	22	22	23½	—	9 7 2
Indo-European	18	18	48⅛	—	6 18 4
Marconi	20	25	4⅛	— 1/16	6 1 6
Oriental Telephone Ord.	15	10	2⅛	— 1/16	4 11 6
United R. Plate Tel.	8	8	8	+ 1/16	*5 0 0
West India and Panama	1/8	1/8	1 1/16	— 1/16	5 9 6
Western Telegraph	8	8	17½	+ ½	*4 12 9
HOME RAILS.					
Central London Ord. Assented	4	4	58½	—	6 16 9
Metropolitan	1	1½	24½	— 1	5 1 6
do. District	Nil	Nil	21	—	Nil
Underground Electric Ordinary	Nil	Nil	2⅜	— ¼	Nil
do. do. "A"	Nil	Nil	7/6	—	Nil
do. do. Income	4	5	83½	—3½	*5 19 9
FOREIGN TRAMS, &c.					
Adelaide Sup. 6 per cent. Pref.	6	6	8⅞	—	7 14 10
Anglo-Arg. Trams. First Pref.	5½	Nil	4	⅛	—
do. do. 2nd Pref.	—	—	3⅞	—	—
do. do. 5 Deb.	5	5	65½	—	7 12 8
Brazil Tractions	—	—	56	—3	—
Bombay Electric Pref.	6	6	14	+ ¼	4 5 9
British Columbia Elec. Rly. Pfce.	5	5	64	+3½	7 15 0
do. do. Preferrred	Nil	2½	59½	+3	8 8 0
do. do. Deferred	Nil	Nil	55½	+3	—
do. do. Deb.	4½	4½	64	—	6 15 0
Mexico Trams 5 per cent. Bonds	Nil	Nil	46	—	Nil
do. 6 per cent. Bonds	Nil	Nil	85⅛	—	Nil
Mexican Light Common	Nil	Nil	22½	—	Nil
do. Pref.	Nil	Nil	35	—	Nil
do. 1st Bonds	Nil	Nil	52½	—3½	—
MANUFACTURING COMPANIES.					
Babcock & Wilcox	15	15	3⅜	—	*4 9 0
British Aluminium Ord.	10	10	1⅞	—	5 14 3
British Insulated Ord.	25	12½	2 1/16	—	5 14 2
Callenders	25	25	9⅜	+ ⅜	6 9 10
,, 6½ Pref.	5	6½	4⅜	—	7 2 1
Castner-Kellner	25	20	4	+ ⅛	—
Crompton Ord.	7	10	21/6	—	9 6 0
Edison-Swan, "A"	—	10	1⅜	+	7 5 0
do. do. 5 per cent. Deb.	4	5	79½	—	6 5 9
Electric Construction	10	10	1 1/16	—	8 8 8
Gen. Elec. Pref.	6	6½	19/-	—6d.	6 16 10
do. Ord.	10	10	41/-	- 1/-	*4 15 3
Henley	25	25	2⅜	+ ⅛	5 5 3
do. 4½ Pref.	4½	4½	3⅜	—	6 4 2
India-Rubber	10	10	16	—	*6 5 0
Met.-Vickers Pref.	—	—	2½	—	5 14 0
Siemens Ord.	—	10	29/6	—6d.	*6 18 0
Telegraph Con.	20	20	27	+ ½	*4 9 0

* Dividends paid free of Income Tax.

MARKET QUOTATIONS.

IT should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Tuesday, January 27th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Oxalic	per lb.	1/5	...
a Ammoniac Sal	per ton	£95	...
a Ammonia, Muriate (large crystal)	,,	£75	...
a Bisulphide of Carbon	,,	...	...
a Borax	,,	£42	£3 inc.
a Copper Sulphate	,,	£48	£4 inc.
a Potash, Chlorate	per lb.	11d.	2d. dec.
a ,, Perchlorate	,,	1/8	...
a Shellac	per cwt.	£44	10/- inc.
a Sulphate of Magnesia	per ton	£15	...
a Sulphur, Sublimed Flowers	,,	£28	...
a ,, Lump	,,	£25	...
a Soda, Chlorate	per lb.	6d.	...
a ,, Crystals	per ton	170/-	...
a Sodium Bichromate, casks	per lb.	...	...
METALS, &c.			
g Babbitt's Metal Ingots	per ton	£118 to £345	...
c Brass (rolled metal 2" to 12" basis)	per lb.	1/3½	½d. dec.
c ,, Tubes (solid drawn)	,,	1/6½ to 1/7	½d. dec.
c ,, Wire, basis	,,	1/3½	½d. dec.
c Copper Tubes (solid drawn)	,,	1/9½	½d. dec.
g ,, Bars (best selected)	per ton	£167	...
g ,, Sheet	,,	£167	...
g ,, Rod	,,	£167	...
d ,, (Electrolytic) Bars	,,	£125	...
d ,, ,, Sheets	,,	£156	...
d ,, ,, Wire Rods	,,	£140	...
d ,, ,, H.C. Wire	per lb.	1/5½	...
f Ebonite Rod	,,	3/-	...
f ,, Sheet	,,	2/6	...
n German Silver Wire	,,	2/9	...
h Gutta-percha, fine	,,	13/-	...
h India-rubber, Para fine	,,	2/7½	...
i Iron Pig (Cleveland Warrants)	per ton	Nom.	...
l ,, Wire, galv. No. 8, P.O. qual.	,,	£48 10/-	
g Lead, English Pig	,,	£47 15/-	15/- dec.
g Mercury	per bot.	£23	10/- dec.
e Mica (in original cases) small	per lb.	6d. to 4/6	...
e ,, ,, ,, medium	,,	5/- to 10/-	...
e ,, ,, ,, large	,,	12/6 to 25/- & up	...
g Phosphor Bronze, plain castings	,,	1/8 to 2/-	...
g ,, ,, rolled bars and rods	,,	2/2 to 2/6	...
g ,, ,, rolled strip & sheet	,,	2/3 to 2/9	...
d Silicium Bronze Wire	per lb.	1/11	...
r Steel, Magnet, in bars	per ton	...	...
g Tin, Block (English)	,,	£387 to £388	£9 to £10 inc.
n ,, Wire, Nos. 1 to 16	per lb.	5/-	...
White Anti-friction Metals	per ton	£90 to £845	...

Quotations supplied by—

a G. Boor & Co.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormston & Sons.
r W. F. Dennis & Co.

Zinc Smelting.—In a review of the spelter situation in *The Journal of the Society of Chemical Industry* Mr. H. M. Ridge says that until conditions improve we are dependent on American supplies. Owing to the necessity of preference being given to the shipment of foodstuffs, wool and other essential commodities, zinc ore is being shut out, and there seems no prospect of the British or Belgian works being able to run their furnaces at full capacity during the coming months.

During the war zinc smelting was classified as one of the important key industries, but no steps have yet been taken to make the country self-supporting, although ample supplies of ore are available within the Empire.

In the treatment of zinc concentrates no radically new methods have yet proved suitable. Electrolytic precipitation has been tried in a number of works in the country, but all of these have been shut down, including the Hoepfner process plant at Winnington, from which such a good product was obtained for several years. It is interesting to note that at the same time electrolysis has been adopted for the new plants in Tasmania, Canada, and at one works in the United States, but in each of these cheap power is available. The demand for high-grade zinc will be large in future, but it can now be obtained cheaply by new means which were worked out during the war. Much progress has been made with the electric furnace reduction in Norway, Sweden, and France, and the troubles experienced in the condensation of the zinc vapour have been largely overcome, but here also cheap power is essential.

Charging the pots in the furnace probably used to be the most laborious work of the zinc smelter, and this has been overcome with the aid of charging machines. These are driven electrically, and are much more efficient than hand charging, the pots being more uniformly charged and the charge denser. The duration of the manœuvre is shortened by about two hours.

The more extensive use of machinery reduces the number of men, and at the same time makes the management more independent of the skilled workmen.

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TRANSFORMERS FOR ELECTRIC FURNACES.

By J. LINDLEY THOMPSON. M.Sc., A.M.I.E.E.

(*Abstract of paper read before the* INSTITUTION OF ELECTRICAL ENGINEERS.)

ELECTRIC furnaces in commercial use at the present time may be classified under four heads: (1) Radiation arc type for steel; (2) conduction arc type for steel; (3) induction type for steel; (4) resistance type for carbide, carborundum and ferro-silicon. With furnaces under types (1), (2), and (4), transformers are nearly always required, while type (3) is in itself a static transformer.

The induction furnace has not made much progress, and this country is almost entirely unfamiliar with its service conditions.

With both arc and resistance furnaces transformers are in general use. The electrical characteristics of the transformers for the two types of furnace differ somewhat, but their construction is on similar lines. Various troubles were experienced with transformers built to early designs when put into operation, and they were briefly as follows: (1) Loss of L.P. voltage across the arc due to bad lay-out of leads, or to reactance values of the transformers being too high. (2) Failure of insulation of switchgear and transformer terminals on the H.P. side due to the heavy auto-transformer effect in consequence of the large range of voltage. (3) Mechanical damage to coils in the transformers due to frequent current-rushes. (4) Unbalanced voltages on the L.P. side of Scott-connected transformers due to unscientific design. (5) Failure of transformers due to bad housing, unskilled operation, and heavy overloads. With the experience of the past few years and a careful study of the conditions of service on site, the above causes of trouble have been practically eliminated. Since the steel furnace is that which is most common and causes most criticism, it is with transformers for this condition of service that the author mainly deals.

Furnaces in general require a minimum of three L.T. pressures for use at different stages of production. The transformers must be provided with a certain amount of reactance for steadying the arc and reducing the rush of current to safe values in the transformer windings and supply mains. This reactance may be internal or external. It is necessary to reinforce heavily the end turns of the high-pressure windings, also extra insulation between the remaining turns is advisable, especially where tappings are brought out. The tappings for voltage variation should be on the H.P. side, for due to the few turns on the L.P. side, correct voltages cannot readily be obtained. The switchgear problem is also simplified by the use of H.P. tappings, which should be in the middle of the winding. The ratio of iron to copper loss is not important.

Coils connected in parallel should be so placed that they are equally loaded under all conditions of service. The transformer must be of sound mechanical construction with its coils rigidly supported in all directions in which movement is possible under a heavy rush of current. All leads, high and low pressure, should be securely clamped to prevent movement due to heavy current rushes. The insulating material should be strong and firmly held in position, being assembled with the coils and secured while under pressure. Numerous ventilating ducts should be provided by means of suitably arranged spacing blocks between the several coils to prevent local heating. Only the H.P. leads required should be brought out of the case, the remainder being retained under oil level. The high-pressure line leads should be brought through individual insulators. The L.P. leads should be increased in section, from two or three inches under oil level, to prevent heating.

Self-cooled transformers should be placed in well-ventilated chambers with a minimum distance between them of 18 in. for sizes up to 1,000 K.V.A. and 24 in. for larger sizes. They should be kept clean, easy of access, and be placed as near to the furnace as possible and symmetrical, with a fireproof barrier between them and the furnace. Unskilled attention has been the cause of serious trouble. The L.P. leads should be as near together as possible, and interleaved for currents higher than 5,000 amperes.

Transformers for furnace work are manufactured of both the core and shell-type construction, and both are giving good service.

Up to the present time, electric steel furnaces have been designed and built for dealing with quantities up to about 15 tons, but the future will demand larger sizes up to 30 or 40 tons' capacity. Taking the kilovolt-amperes required per ton at 200, then transformer groups of 6,000 to 8,000 K.V.A. will be required. The problem of transforming this amount of power is not unreasonable, since power transformers for dealing with much larger capacities have been manufactured.

There are several alternatives whereby this increased power can be supplied to the furnace: (1) Power can be increased by increasing the currents at the present voltage values, and subdividing this current into two or more parallel paths through the furnace. With an 8,000-K.V.A. furnace at 85 volts to the bath, over 47,000 amperes per phase for a two-phase, and over 31,000 amperes for a three-phase furnace will be required. Transformers for dealing with such currents can be designed and manufactured, but only the furnace designers can give expert opinion on the possibility of providing for the numerous electrodes in the roof structure of the furnace. (2) Power can be increased by raising the voltage between the electrode and the bath. The possibility of this suggestion is dependent on the roof lining of the furnace. Here again is a problem for the furnace designer, as the transformers present no difficulties. (3) The third alternative, that of increasing the

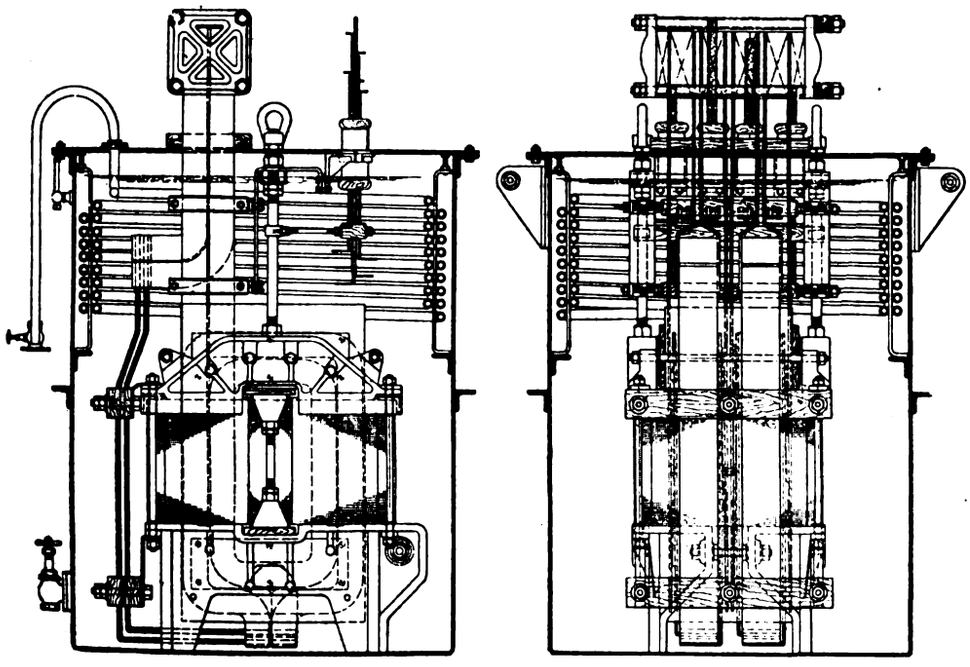

FIG. 1.—SINGLE-PHASE, 1,250-K.V.A., SHELL-TYPE FURNACE TRANSFORMER; 1½ TURNS ON L.T. WINDING.

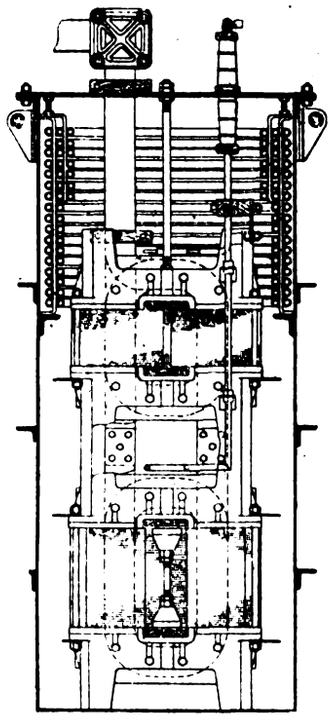

FIG. 2.—SINGLE-PHASE, 1,250-K.V.A., SHELL-TYPE FURNACE TRANSFORMER, WITH L.T. BOOSTER.

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number of phases, seems to be the one favoured by furnace designers. Up to the present time, the author is under the impression that in this country the maximum number of phases used in a steel furnace has been three. Furnaces for four, six, and eight phases have been designed and various transformer connections suggested and patented to obtain these requirements. None of these, however, has had, as far as the author is aware, any practical commercial trial up to the present.

The practical limit of size for an electric furnace will, in the author's opinion, be a compromise between all three alternatives and will depend on: (1) The maximum current that can possibly be carried per electrode. (2) The maximum voltage that can be sustained across the arc without destroying the roof. (3) The maximum number of electrodes that can be installed without danger to the roof.

The fundamental principles underlying the design of large furnace transformers are the same as those in power transformers, but due to the large currents, special reactance and possible intricate connections, special attention must be given to their design. In a straight transformer the designer's chief problem is the arrangement of the parallel low-pressure conductors.

This is more difficult of solution the larger the size of the unit and the higher value of current to be catered for. As the size of unit becomes larger, the core section becomes greater, and consequently the L.P. turns become few in number, which is more pronounced with shell-type than with core-type transformers, for considering the same size of unit the section of the shell is generally much larger than that of the core type for economical proportions of active material. In large shell-type transformers, the choice of the number of L.P. turns often lies between one and two. If one turn is used, then a large iron section is necessary; or if two be used, a large

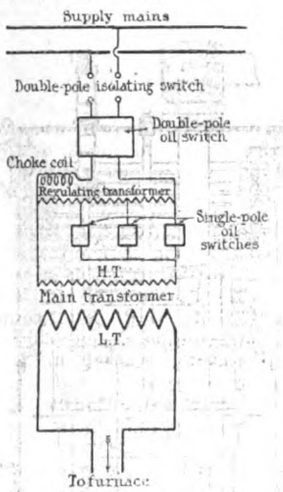

FIG. 3.—FURNACE TRANSFORMER WITH H.T. AUTO-REGULATING TRANSFORMER AND EXTERNAL REACTANCE.

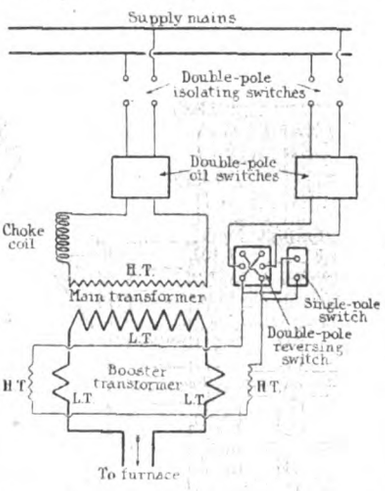

FIG. 4.—FURNACE TRANSFORMER WITH L.T. BOOSTER AND EXTERNAL REACTANCE.

weight of copper is required, while neither will give economic proportions of active material and minimum losses. If one and a half turns be used, as described in the author's patent No. 131,026, a proportion of active material nearer to the economical value can be obtained (fig. 1).

In order to simplify the design and manufacture of furnace transformers, and especially those for heavy currents, it is desirable to increase the number of L.P. coils in parallel, thus reducing the reactance value of the transformer. A transformer of low reactance, while satisfactory for resistance furnaces, is unsafe for arc furnaces, hence the transformer reactance would have to be supplemented by an external reactance in either the L.P. and H.P. side. An ideal transformer would also be one as simple as possible having no tappings. If voltage variation on the L.P. side is required, this would be obtained by means of a regulating transformer (fig. 3), a booster (figs. 2 and 4)), or an induction regulator.

Furnace transformers and the alternative auxiliaries above mentioned are suitable for all types of furnace, since the reactance being external can be varied at will or cut out.

The ideal furnace transformer is, in the author's opinion, a simple transformer of one voltage ratio with a moderate reactance. The necessary auxiliaries for voltage requirements and safe working are, an external reactance on the line side of the high-pressure winding, a regulating transformer, a booster transformer, or an induction regulator for voltage variation.

A great deal has been said on various occasions concerning the heavy stresses to which furnace transformers are subjected. While this in a measure is true, it should not be interpreted to mean that the mechanical forces exerted on the transformers are of extremely high value, but that during operation frequent and repeated stresses of a moderate value are exerted. These stresses take place frequently during the melting period, and are brought to bear on the coils and leads.

A 2,000-K.V.A., 25-period, single-phase, shell-type transformer, having a reactance of 7 per cent., will, if short-circuited directly across its secondary leads, allow a current of approximately 14.3 times its full-load current to flow provided the supply voltage is maintained. This current brings a mechanical stress to bear on the coils in an axial direction of approximately 60 tons. If the transformer is supplying a furnace and during the melting period (power factor 0.8) is short-circuited by the electrode coming into direct contact with the bath, the short-circuit current that will flow will be 1.6 times full load since the reactance in circuit is 60 per cent., *i.e.*, 7 per cent. in the transformer+53 per cent. in the furnace lay-out. The mechanical stress due to this current is approximately 0.3 ton on the coils in an axial direction. If the short-circuit occurs during the molten period, *i.e.*, power factor=0.9, the short-circuit current is 2.3 times full load, for the reactance in circuit is now approximately 43.5 per cent., *i.e.*, 7 per cent. in the transformer and 36.5 per cent. in the furnace and lay-out. This current brings a mechanical stress of approximately 0.8 ton on to the coils in an axial direction. The figures of stress are those on the coil surface.

The satisfactory operation of electric furnaces is not dependent solely on the transformers being of correct design and sound construction, but also on the relative positions of transformers and furnace and the heavy current connections between them. The effects of a bad lay-out are chiefly: Low operating power factors, hence inefficient working and a possible loss of useful working voltage. Heating up of leads, clamps, and cables. Unbalancing of voltages on the furnace

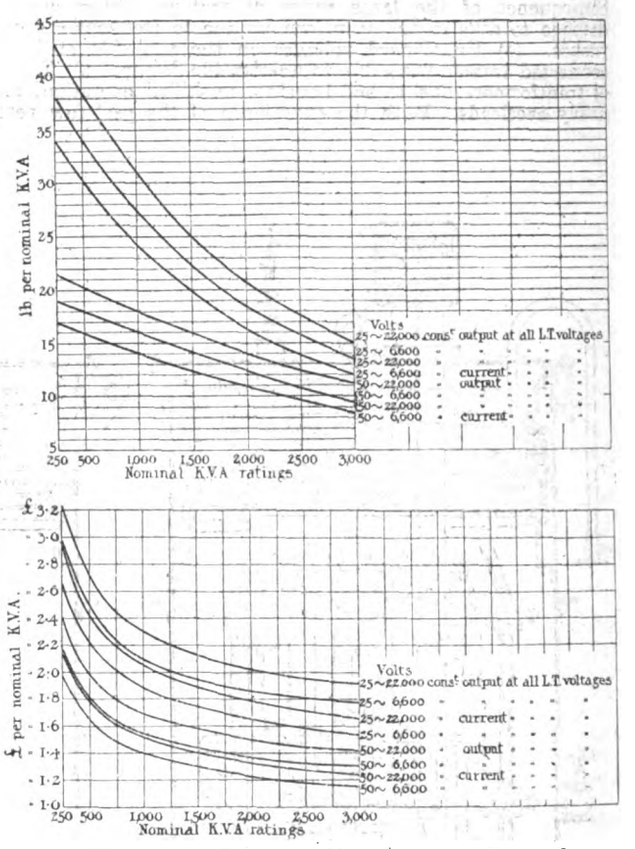

FIG. 5.—WEIGHT AND PRICE PER NOMINAL K.V.A. RATED OUTPUT FOR SINGLE-PHASE, OIL-INSULATED, SELF-COOLED FURNACE TRANSFORMERS WITH L.P. RANGE OF 1 TO 1.31.

and unbalanced load currents and phase relation on the supply side of the transformers. The chief cause of lay-out trouble is that the inductance of the leads on the low-pressure side between the transformers and the furnace is either too high or unequal in the different phases.

In order to reduce the possibility of a heavy choking effect and unbalanced voltages, the following suggestions will be helpful: (1) The transformer or transformers should be placed as near to the furnace as possible, so that the heavy L.P. leads may be of minimum length. (2) The L.P. leads of the various phases should be symmetrically placed with respect to the transformers and furnace. This is essential so that the leads of each phase may be of approximately the same length, and also that the area enveloped in each phase should be equal and hence the inductance of each phase equal. (3) The area between the positive and negative L.P. leads should be as small as possible, and also that between phases, in order that the inductance may be a minimum or of a practicable value. (4) The L.P. leads for heavy currents (above 5,000 amperes) should be in multiple and interleaved from the transformer to a point as near the furnace as possible. This will keep the inductance down to a low value and make that of each lead approximately the same, thus ensuring that each parallel lead takes its proper share of the load. (5) The heavy current leads should not be run near any heavy magnetic structure such as girders or

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supporting columns, unless both the positive and negative leads are run together and interleaved. (6) No magnetic material should form a closed circuit around any positive or negative conductor, or heavy currents will be induced in that circuit. The positive and negative conductors interleaved may be run through a magnetic circuit. Clamps for heavy current leads should be of non-magnetic material.

From the point of view of lay-out, it is possible that a maximum current limit will be reached for satisfactory operation. This limit is suggested by the fact that with heavier currents more latitude is required as regards loop area for the accommodation of the leads, and especially is this the case where they become flexible so as to allow movement of the electrode and the flexibles attached to them.

The 2,000-K.V.A. furnace transformer already referred to under the best working conditions has an operating power factor of 0.92. The lay-out then has an inductive drop of approximately 39 per cent. for a current of 23,500 amperes at a terminal voltage of 85. This inductive drop can be split up into transformer inductive drop of 7 per cent. and lay-out inductive drop of 32 per cent. The above figures are those for an average case and represent a fairly good lay-out that cannot be much improved. Now suppose the transformer, leads, and furnace be replaced by one of 5,000 K.V.A. the transformer having the same reactance value of 7 per cent. Taking the lay-out to be similar to the 2,000 K.V.A. unit, but of heavier copper section, the loop area the same, though in practice it would have to be larger, then the following would result. The load current is now 58,800 amperes with a terminal voltage of 85. This will cause an inductive drop of $32 \times 58,800/23,500$ 80 per cent. or a total of 87 per cent. approximately, including the transformer. This results in the voltage across the furnace being only 49 per cent. of the terminal voltage, *i.e.*, 41.6 volts and an operating power factor of 0.49. Thus although, for the same type of lay-out, the K.V.A. output has been increased from 2,000 to 5,000, *i.e.*, 150 per cent., the power factor has dropped from 0.92 to 0.49, and the energy has only been increased from 1,840 to 2,450 KW., or 33 per cent. Actual experiences similar to the above example are not uncommon, and point to a limitation of furnace size on account of limitations in lay-out. In other words, a lay-out suitable for a 2,000 K.V.A. unit is not suitable for a 5,000 K.V.A. unit.

The inefficient results given in the example above may be partially overcome by increasing the voltage on the L.P. terminals, so that the resultant voltage across the furnace may be equal to that for the smaller unit. For the 2,000 K.V.A. unit the terminal voltage is 85 and the furnace voltage 0.92 of 85, *i.e.*, 78.2 (neglecting resistance drop), while for the 5,000 K.V.A. unit the furnace voltage is only 0.49 of 85, or 41.6 volts. Now suppose the terminal voltage of the 5,000 K.V.A. unit be 101 instead of 85, the load current would be then reduced to 49,500 amperes. The inductive drop in the lay-out would be $32 \times 49,500/23,500 \times 85/100 = 56.6$ per cent.

The total inductive drop would be $7 + 56.6 = 63.6$ per cent., and so the operating power factor would be 0.77 and the voltage across the furnace $0.77 \times 101 = 77.8$ volts. As a result of increasing the terminal voltage, the increasing of the K.V.A. rating from 2,000 to 5,000 has increased the power from 1,840 to 3,850 KW., *i.e.*, 109 per cent., which is an improvement as against increased current only. It will be noticed, however, that the power factor has fallen from 0.92 to 0.77, which is a low figure, and points to the limitation of current capacity and lay-out already suggested.

The cost and weight of furnace transformers are dependent on the maximum L.P. current and the voltage variation required, apart from the variables of voltage and frequency. In general, the furnace transformer K.V.A. rating is a figure much below that for a power transformer of the same weight.

Approximate prices and weights are given in the curves (fig. 5) for transformers whose voltage variation is obtained by means of tappings. For furnace transformers complete with boosters or regulating transformers, the prices would have to be increased 10 to 15 per cent.

In conclusion the author wishes to express his thanks to Messrs. The Metropolitan-Vickers Electrical Co. for their assistance in the preparation of this paper.

DISCUSSION IN LONDON.

MR. H. M. SAYERS described furnace transformers as caricatures of power transformers; the conditions to be fulfilled were abnormal, and the design, therefore, differed a good deal from that of ordinary transformers. In the early days the specifications to which designers had to work were unnatural as the necessary conditions were not known. Furnace transformers were very similar to those used for resistance welding, only in the latter the ratio of turns to current was still more exaggerated. It was now the practice in many cases for the whole of the welding apparatus, including the transformer, to be designed by one person, and in the speaker's opinion it was very desirable for this method to be adopted also in the case of furnace transformers. With regard to voltage regulation on the low-pressure side, the rational method was undoubtedly by means of a booster as described by the author; this would help also to keep up the power factor. The author apparently preferred to keep to one flux path, but the speaker thought it would be advantageous to split it up. This would possibly increase the iron and copper, but it would make possible a better disposition of the leads. Amongst other advantages would be that of better cooling; a larger tank would have to be provided, but that would improve the circulation of the oil. The preference for the shell type of transformer from the designer's point of view, as well as from that of price, could be readily understood, but the operating engineer would favour the core type on account of the greater facilities for inspection and repair of coils. With regard to the future, they would require capacities of not 6,000, but more like 60,000 K.V.A. in a lump, not, of course, supplied by one transformer.

MAJOR A. M. TAYLOR thought the paper most useful in that it explained in such detail the exact location of the reactance in the secondary circuit. It appeared, from the figures given, that a serious short-circuit on the secondary side comparable with those which might obtain in power transformers, could not take place, at any rate in the furnace itself. This seemed to be at variance with other statements. If the primary of the booster (or better, of an additional booster) were connected across the phase in advance of that to which the main transformer was connected, an E.M.F. would be injected into the main transformer circuit which could be arranged to bring the power factor of that circuit up to unity at the expense of the power factor of the primary circuit of the said booster. There would be no advantage in such an arrangement unless a separate feeder were available to carry back the lagging current to the generating station. In such a case a special motor-driven generator could be provided to supply this wattless current for the whole system. The advantage of this would be that the regulation on the principal system, to which lights and motors were connected, would be greatly improved, as the principal system could be worked at unity power factor. He, the speaker, had experimentally proved the complete practicability of passing 50-period currents over the conductors of a 25-period system, with complete non-interference of the two systems; hence, by installing 25-period generators, an existing 50-period system could link up with a neighbouring 25-period system, and at the same time take on a 25-period load, or *vice-versa*.

MR. S. E. FEDDEN contragulated the author on his paper, which contained much useful information, as did also his other paper on power transformers, recently read at Leeds.* His experience at Sheffield had been that all H.T. tappings had proved a failure, especially with Scott-connected transformers; they had broken down and resulted in flash-overs. With regard to the author's statement that they would in the future require transformers of 8,000 K.V.A. capacity, the speaker thought it would be preferable to employ four units of 2,000 K.V.A. each instead of one, as experience at Sheffield had taught them that it was advisable to divide up the transformers. The lay-out was a matter of very much importance; the first furnace installed at Sheffield when started up, although all instruments showed full load, received very little power at the electrodes, and the cause was only discovered by someone leaning up against an iron girder, near which the leads passed, and nearly burning himself. The intricate Scott and double-Scott connections referred to in the paper were entirely unnatural, and surely anything that went against nature would never prove satisfactory. The author's method of regulation by means of a booster was certainly much more desirable than the employment of tappings. With modern means of regulation no trouble should be experienced through furnace disturbances. At Sheffield they had had fluctuations of as much as 6,000 KW, several times a minute, and although when one machine only was run difficulty was experienced, it was found that when four or more machines were on load it was possible to entirely dispense with the regulators; the machines regulated themselves quite satisfactorily.

MR. R. G. MERCER explained that in the early days trouble was caused by the transformer makers and furnace users not appreciating the conditions to be fulfilled, and the stresses liable to occur in transformers. In the past, transformers of a much too small K.V.A. capacity had been installed by the users, they being encouraged to do so by the transformer makers guaranteeing the transformers to work satisfactorily under considerable overloads for long periods. This was a great mistake, and bad policy, as the conditions to be fulfilled were entirely different to those of ordinary power supply. To-day, however, new conditions obtained, and with automatic voltage control the old troubles could be entirely avoided. The firm with which he was at present connected had installed the largest electric furnace in the country, of 15 tons capacity, and it worked perfectly. Freedom from surges was entirely due to the automatic regulator which took care of the melting stages. When users installed too small transformers they got what was known as "heat draining" back on to the transformers, which resulted in a rise in temperature and sludging of the oil. He had known cases where transformers had been nearly destroyed by this "pumping," and they had only just been saved in time.

DR. S. P. SMITH inquired why it was desired to have the reactance in the transformer itself, was it a question of safeguarding it? There were many reasons why the core type of transformer was preferable; in the case where 1½ coils

* ELEC. REV., May 9th and 16th, 1919.

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were employed, would it not be possible to make them concentric? It was rather a surprise to him to hear the use of sandwich coils advocated, as they would thereby have higher reactance, also would not the proposed booster result in a higher reactance?

Mr. J. R. Cowie thanked the author for his very fine paper. The core type of transformer had, in his opinion, only one advantage, and that was the facility for carrying out repairs. It would have added much to the value of the paper if the author had included more figures concerning efficiency, &c., of shell-type transformers. The problem of large transformers would, he thought, have to be faced; in the future large furnace installations the difficulties and cost of transmitting power to the site would be considerable. He had recently worked out figures in this connection, and had found that the cost of 11,000-volt cable and switch gear would be very high.

Mr. J. Lindley Thompson, in reply, agreed that designers laboured under a great disability in the early days. The question of lay-out was of the most importance, but although he made attempts to be allowed to design the original lay-out as well as the transformers, it had never been agreed to. Faults entirely due to the lay-out were often placed on the shoulders of the transformer designers. In one case the transformers were stated to be the cause of the plant having a power factor of only 0.6, but when certain alterations had been made to the lay-out the P.F. at once rose to 0.8. With regard to the suggestion that the tappings should be made at the neutral point, a large percentage of furnaces worked on 2-phase, and there was, therefore, no neutral point, also they had to balance on the L.T. side. The use of 1½ turns in the transformer was in reality the equivalent of splitting up the flux path. The failure of shell-type transformers was very much less than that of the core type. During the war he had seen a shell-type transformer that had taken so long to deliver that on arrival it was green with mould. No difficulty was experienced in thoroughly drying it out, and it had since worked for 12 months satisfactorily. There was no difficulty in working electric furnaces at supply frequencies of from 25 to 60 cycles per sec., but the users maintained that the best results were obtained at 50 cycles. Personally he did not like Scott connections; they were not scientific, and with them were so many things to think of, that a small slip might easily be made that would result in disaster. Transformers had been known to burn out due to bad handling of the furnace and to unequal loading of the two halves of the transformer. There was always much to be learned from failures, and the present-day transformer was the result of failures in the past. With regard to the statement that transformers with 1½ turns had been in use for some years, all he could say was that the Patent Office did not seem to have any knowledge of the fact.

FAILURES OF TURBO-GENERATORS, AND SUGGESTIONS FOR IMPROVEMENTS.

On January 13th Mr. J. Shepherd's paper was discussed by the North-Western Centre of the Institution of Electrical Engineers at Manchester. An abstract of the paper was concluded in our last issue.

Mr. J. S. Peck said that there were more troubles in the early days of turbo-alternators than there were to-day. The method of bracing in general use was such that an alternator might be short-circuited across its terminals with a very small distortion of the windings. His firm had found it better to use sweated joints for the end connectors than machine-welded joints; it was extremely difficult to tell whether a weld was perfect or not. Their general practice had been not to laminate the stator bars so finely as some makers had done, but to transpose the bars inside the slot, so that each bar occupied a symmetrical position in the slot. In that case the ends of these conductors in parallel could be sweated together. Thus far no thoroughly satisfactory fireproof insulation had been found for the end winding; the use of automatic devices which, in the event of trouble occurring in the alternator, would instantly disconnect the machine from the busbars and at the same time break the field was becoming general, and where this was done the damage was generally something which could be repaired in a very short time. With regard to Mr. Shepherd's proposed water-cooling system, he foresaw many difficulties. It was extremely difficult to insulate the windings so that they could be clamped against the supports. Welded joints were very treacherous things. Once the joint started leaking in a machine of this kind disaster was almost certain to result. He would have a great hesitancy in attempting to build a machine with hundreds of joints which must be watertight.

Dr. Miles Walker said that in applying water cooling to stators the fundamental difficulty was that one had a perfectly closed metal pipe. The only way was to break up the water-cooling system with insulated sections, and when one did that one immediately got a troublesome joint. Water cooling of stators would probably come in the future, but its application to the end connectors was a very difficult problem. With regard to the saving effected, it would surprise him if they could get £17,000.

Mr. Shepherd gave the exact figures: 5 per cent. loss on a 10,000-kw. machine represented 303 tons of coal per annum, worth at to-day's prices £757. At 6 per cent. compound interest for 15 years that represented £17,500.

Mr. Sills, referring to the side slip of rotor coils, said that the coils must be most accurately formed, so that they actually occupied the radial position in running, otherwise stresses were set up. All manufacturers now made sure that there was going to be no movement after the set was put into operation. With regard to the lamination of the stator, the troubles in the past were in some respects due not only to the failure of the jig room, but also to faulty erection, owing to the assembling of a machine on site when really it ought to be done under skilled supervision. With a really first-class tool room they could turn out first-class jigs and dies to get over the trouble. The stator might be heated while being built, three or four times if necessary. This took time, but it got over the loose cores. The latest idea in one machine was to use cast steel instead of the usual cast iron at the end of the core. It seemed advisable not only to have a wet-air filter, but also a dry-air filter between the machine and the wet-air filter. The dry one need not be of the large size that it was at present.

Mr. G. A. Juhlin said he had never met a case where side slip had occurred in a properly designed rotor. With regard to the question of air dampers, they were gradually moving in the direction of using a closed air circuit. In such a case, if a breakdown occurred in a stator winding and fire took place, the oxygen in the air would soon be used up, and the air would not support the fire. Recent tests made on large generators indicated an extraordinarily uniform temperature all along the core. Attempts were being made by means of thermo-couples to show what the internal temperatures of the machines actually were. Loose cores were a thing of the past. Recent information showed that mica insulation on the bars would withstand very much higher temperatures than those indicated in the paper. He thought that full appreciation had not been given to the fact that the greatest drop of temperature took place in the insulation and in the air spaces. A small air space would give an enormous temperature drop. It was an exceedingly difficult thing to get close contact between the supports of the coils and the coils themselves. A great thickness of insulation would be required on the end connections in the author's design, and in all probability the temperature would be higher than in an air-cooled machine. Another very serious difficulty introduced by the coil supports was the question of expansion.

Mr. H. C. Lamb said that in a modern station equipped with the best bethods of heating feed water the saving on the coal consumption due to the recovery of heat from the generator would amount to something less than half of one per cent. Cloth filters gave a great deal of trouble in cleaning and renewing the cloth, which very soon rotted, and wet filters had high maintenance costs, so that the water-cooled machine was certainly the ideal; but he thought Mr. Shepherd had given an exaggerated importance to the dangers and troubles which existed with air-cooled machines. He had looked up the records of certain turbo-generator plant with which he had been connected for a number of years, which had grown during the last eight years from 20,000 kw. to 100,000 kw. During that period there had only been two cases of faults on stator windings, and in no case could the fault be attributed really to the alternator itself. In one instance the turbine thrust block gave way; the set was automatically cut off from the bars, the field current was cut off, and the damage done was trifling. In the second instance through an accident some steam was turned into the air intake, and naturally the alternator broke down. Again the damage was repaired in a very short time. In that period of eight years there had been two rotor faults. In one case the rotor went to earth. It was during the war, and the machine could not be spared; it ran on for two years with an earth on the winding. When it was eventually sent away for repair, it was found that the fault was due to the winding moving in a slot, and of course it had to be rewound. The other rotor fault was also quite a small matter of insulation breakdown on the end turns. These generators, ten in number, had many times been on short circuit, in some cases on short-circuit direct on to the busbars, but so far as they had been able to discover, never in any case had any winding suffered on account of short-circuit. They could never trace any movement of the coils or the end connections. They simply found it necessary to clean the winding, clean out all the ventilation slots, and revarnish the machine. If he carried the period back to ten years he would have to admit four more cases of stator fault. One of those was due to a defective joint. The other three faults were all due to the burning out of the cotton insulation between the turns of the winding. In a low-speed plant of 1,700 kw. over a period of 15 years the number of faults which occurred was really very great, there must have been during that time 40 or 50 stator faults. That was entirely due to the cotton insulation on the turns of the winding in the slots. During eight years the maintenance costs for plant which was now 100,000 kw. worked out at 0.3d. per 1,000 kw.-hours. In comparison with that the maintenance cost of a low-speed generator for 15

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years worked out at 1¾d. per 1,000 KW.-hours—five times as much.

MR. H. RATCLIFFE, referring to reactance, thought the correct thing was to have a moderate amount of reactance in the machine, from 10 to 15 per cent., and in addition, suitably to divide the system either by reactances between the bus-bar sections or between the bus-bar section and the tie bar. Heavy short-circuit currents resulted in the creation of strong magnetic fields in the reactance portion of the circuit, accompanied by an enormous mechanical force on the conductors forming that portion of the circuit. Therefore there should be some advantage in removing that reactance field and the resulting strains from the machine, and transferring them to a device which had been designed especially to deal with these matters. Machines should be designed so that internal faults invariably developed or started as faults to earth instead of faults between phases. If they could ensure that, the protection of machines would immediately be very much simplified, and consequently the protection of the system as well.

MR. J. A. KUYSER said that there was no difficulty in cooling large stators. In the case of a rotor, the temperature rise might be, say, 100 deg. Of these 100 deg., quite 70 deg. or 80 deg. were taken up in the insulation. By water cooling the temperature rise might be, say, 5 deg., and the total temperature would be reduced from 100 deg. to 75 deg. or 85 deg. To get the full benefit from water cooling it would be advisable also to reduce the heat of the insulation. This could be done perhaps by increasing the number of slots in the rotor. Another possibility was to use oil cooling instead of water cooling, and to bring the oil in direct contact with the copper. Cooling water was, of course, subject to centrifugal forces, and hydrostatic pressure would be created in the cooling water, amounting to as much as 1,000 lb. per sq. in. As regarded the stator conductors, he agreed that the laminations should not be carried any further than was absolutely necessary to reduce the heating to a reasonable value. He had got good results with a system of radial ventilation. The temperature of the stator was taken the whole length of the core; the maximum temperature was 38 deg., or far more than 50 per cent. in excess of the average temperature.

MR. C. BAUMANN said the author claimed a saving of heat worth £17,000; it was not £17,000 but £1,700. The heat in the alternator was heat at a very low temperature, of very little use.

MR. SHEPHERD, in reply, pointed out that all the drawings which showed water cooling must be taken as diagrams and not working drawings. It was wonderful to think that new type of machinery, which 20 years ago no one would buy, had in 15 years put on one side the high-class low-speed engines for which Lancashire was so famous. The high-speed alternator had developed faster in 15 years than the low-speed engine developed in 50 years. With regard to welded against sweated joints, if they could get a construction so that they could join the conductors turn by turn, he thought a fusion-welded joint was better than any sweated joint. The idea of the paper was to suggest other ways of looking at alternator design in the near future than the present methods, and fusion-welding was used every day for methods of construction as difficult as any proposed in the paper. The heat which they would save from a machine was a secondary matter; nobody would introduce water cooling in turbo-generators from the point of view of recovering the heat. The problem was to build a stronger machine, a better machine, a machine which should be fireproof, and one which would allow the user to have some idea of what was going on within it.

TRADE STATISTICS OF AUSTRALIA.

THE following figures, showing the imports of electrical and allied goods into Australia during the twelve months ending June 30th, 1918, are taken from the recently-issued official trade statistics. The figures for 1913, being the last normal year of trade, have been given for purposes of comparison, and notes of increases or decreases have been added. The 1916-17 figures were published on p. 430 of our issue of November 1st, 1918.

	1913. £	1917-8. £	Inc. or Dec. £
Gas and oil engines.—			
From United Kingdom ...	148,000	12,000	– 136,000
,, United States ...	38,000	77,000	+ 39,000
,, Sweden ...	2,000	2,000	—
,, Other countries ...	4,000	9,000*	+ 5,000
Total	192,000	100,000	– 92,000
* Canada £9,000.			
Portable and traction engines.—			
From United Kingdom ...	87,000	5,000	– 82,000
,, United States ...	56,000	9,000	– 47,000
Total	143,000	14,000	– 129,000
Dynamo-electric machines up to 200 h.p., static transformers, coils, &c.—			
From United Kingdom ...	168,000	66,000	– 102,000
,, Italy	5,000	5,000	—
,, Sweden	9,000	6,000	– 3,000
,, United States ...	154,000	176,000	+ 22,000
,, Other countries ...	57,000*	2,000	– 55,000
Total	393,000	255,000	– 138,000
* Germany £48,000.			
Dynamo-electric machines over 200 h.p. and parts.—			
From United Kingdom ...	56,000	9,000	– 47,000
,, United States	10,000	13,000	+ 3,000
Total	66,000	22,000	– 44,000
Regulating, starting, and controlling apparatus.—			
From United Kingdom ...	26,000	23,000	– 3,000
,, United States	39,000	35,000	– 4,000
,, Other countries ...	9,000*	—	– 9,000
Total	74,000	58,000	– 16,000
* Germany £7,000.			
Electroliers, gasoliers, &c.—			
From United Kingdom ...	36,000	2,000	– 34,000
,, United States	2,000	6,000	+ 4,000
Total	38,000	8,000	– 30,000
Lamps and lampware.—			
From United Kingdom ...	57,000	27,000	– 30,000
,, Japan	—	19,000	+ 19,000
,, United States	47,000	61,000	+ 14,000
,, Other countries ...	50,000*	7,000‡	– 43,000
Total	154,000	114,000	– 40,000
* Germany £41,000. ‡ Canada £5,000.			
Electric fittings, switches, fuses and lightning arresters.—			
From United Kingdom ...	51,000	15,000	– 36,000
,, Japan	—	12,000	+ 12,000
,, United States	16,000	22,000	+ 6,000
,, Other countries ...	14,000*	1,000	– 13,000
Total	81,000	50,000	– 31,000
* Germany £11,000.			
Telephones, telephone switchboards and appliances.—			
From United Kingdom ...	47,000	14,000	– 33,000
,, Belgium	25,000	—	– 25,000
,, Sweden	46,000	1,000	– 45,000
,, United States	47,000	42,000	– 5,000
Total	165,000	57,000	– 108,000
Wire (copper).—			
From United Kingdom ...	175,000	4,000	– 171,000
,, Japan	—	15,000	+ 15,000
,, United States	11,000	27,000	+ 16,000
,, Other countries ...	27,000*	7,000‡	– 20,000
Total	213,000	53,000	– 160,000
* Germany £19,000. ‡ Canada £7,000.			
Cable and wire (covered).—			
From United Kingdom ...	554,000	24,000	– 530,000
,, Japan	—	124,000	+ 124,000
,, Italy	2,000	1,000	– 1,000
,, United States	20,000	32,000	+ 12,000
,, Other countries ...	61,000*	—	– 61,000
Total	637,000	181,000	– 456,000
* Germany £56,000.			
Arc lamp carbons.—			
From United Kingdom ...	—	3,000	+ 3,000
,, Spain	—	4,000	+ 4,000
,, United States	—	3,000	+ 3,000
,, Germany	17,000	—	– 17,000
,, Other countries ...	1,000	—	– 1,000
Total	18,000	10,000	– 8,000
Electrical appliances not included elsewhere.—			
From United Kingdom ...	90,000	47,000	– 43,000
,, Denmark	10,000	—	– 10,000
,, Japan	—	34,000	+ 34,000
,, Holland	10,000	68,000	+ 58,000
,, United States	36,000	82,000	+ 46,000
,, Other countries ...	65,000*	2,000	– 63,000
Total	211,000	233,000	+ 22,000
* Germany £55,000.			

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	1913. £	1917-8. £	Inc. or Dec. £
Electric heating and cooking appliances.—			
From United Kingdom ...	7,000	6,000	– 1,000
,, United States	3,000	7,000	+ 4,000
Total	10,000	13,000	+ 3,000
Accumulators or storage batteries, arc lamps, vacuum tubes, instruments and insulating tape.—			
From United Kingdom ...	109,000	28,000	– 81,000
,, Sweden	1,000	1,000	—
,, United States	11,000	62,000	+ 51,000
,, Other countries ...	46,000*	6,000‡	– 40,000
Total	167,000	97,000	– 70,000
* Germany £43,000. ‡ Switzerland £4,000.			
Coal-cutting machines.—			
From United States	19,000	10,000	– 9,000
Earth and rock cutting, excavating, &c., machines.—			
From United Kingdom ...	31,000	18,000	– 13,000
,, United States	18,000	14,000	– 4,000
,, Other countries ...	9,000	—	– 9,000
Total	58,000	32,000	– 26,000
Rotary and percussive rock drills.—			
From United Kingdom ...	3,000	5,000	+ 2,000
,, United States	28,000	27,000	– 1,000
,, Other countries ...	1,000	—	– 1,000
Total	32,000	32,000	—
Machine tools.—			
From United Kingdom ...	78,000	42,000	– 36,000
,, United States	55,000	56,000	+ 1,000
,, Other countries ...	15,000*	1,000	– 14,000
Total	148,000	99,000	– 49,000
* Germany, £11,000.			
Steam turbines, economisers, superheaters, &c.—			
From United Kingdom ...	92,000	69,000	– 23,000
,, United States	5,000	4,000	– 1,000
,, Other countries ...	11,000*	—	– 11,000
Total	108,000	73,000	– 35,000
* Germany £11,000.			
High-speed reciprocating steam engines.—			
From United Kingdom ...	26,000	3,000	– 23,000
Motive power machinery, N.E.I.—			
From United Kingdom ...	263,000	33,000	– 230,000
,, Sweden	—	2,000	+ 2,000
,, United States	80,000	60,000	– 20,000
,, Other countries ...	34,000*	5,000‡	– 29,000
Total	377,000	100,000	– 277,000
* Germany £20,000. ‡ Canada £5,000.			
Wire, iron, and steel.—			
From United Kingdom ...	89,000	5,000	– 84,000
,, Canada	2,000	40,000	+ 38,000
,, United States	219,000	420,000	+ 201,000
,, Other countries ...	330,000*	5,000‡	– 325,000
Total	640,000	470,000	– 170,000
* Germany £327,000. ‡ Japan £3,000.			

COMMERCIAL ENGINEERING.

AT the opening meeting of the LIVERPOOL SUB-CENTRE of the INSTITUTION OF ELECTRICAL ENGINEERS, on January 19th, Prof. E. W. MARCHANT, D.Sc., the chairman, delivered an address, of which the following is a brief résumé. The speaker's opening remarks were mainly directed to the position occupied by Liverpool in the shipping world, and also in the manufacture of cables and telegraph and telephone equipment. Prof. Marchant thought that the telegraph industry was very poorly represented, and the discussion of telegraphic problems occupied too small a proportion of the Institution's proceedings. He therefore expressed the hope that the new sub-centre would help to remedy this. Other subjects which the chairman commended to his audience were wireless telegraphy and electrical engineering in chemical works.

The future of the engineering graduate then received attention. It was often questioned whether the great number of men now undergoing training at universities, &c., could be absorbed at the end of their instruction. Having regard to the progress of electricity, and the certainty of huge future developments, the speaker thought that the need for such men would probably be greater than the supply. Prof. Marchant mentioned many industrial undertakings which offered a vast field for the electrical engineer, railways, mines, and all descriptions of factories. It had been said that university-trained engineers did not give the commercial side due consideration—aiming at efficiency rather than cheapness of production. He did not wholly agree, but allowed that the economic side of engineering should receive greater attention.

He said: "We have got to realise that under modern conditions, a vast number of trained engineers are wanted, who shall be equipped not only with technical knowledge, but with such knowledge also as will enable them to deal readily with commercial problems. If we are to satisfy this need, we shall look to close co-operation with those undertakings and industries which are associated with the works and factories in our district. The subject of cost of production is of fundamental importance.

I do not wish to suggest that all engineers in the future are not to be scientifically trained men, men whose business it is to harness the great sources of power in nature for the use and convenience of many kind, but I am inclined to think that the university graduate would be more efficient in carrying out his beneficent function, if he were a better business man. One of our members recently put forward a criticism of the university-trained graduate, which I have taken to heart, namely, that he was too apt to look at a project from the point of view of its theoretical or scientific efficiency, and not enough from the point of view of pounds, shillings, and pence; that he would decide in favour of a project because it gave an efficiency of 90 per cent., rather than in favour of another that gave an efficiency of 80 per cent., and cost half as much to develop. I do not think this criticism, as I have stated it, is a fair one, but I want to put the matter broadly, and there is I believe a great deal to be said for dealing more in detail with the economic side of engineering than has been customary in the past. One of the great deficiencies of the man in the street to-day is, I believe, his inability to understand economic problems. The last years of the war have taught us all a very great deal, and if the man of to-day has not realised the importance of increase of production for the well-being of the community it is not the fault of the newspapers. This, however, is only one side of the question. There is, I believe, a great and increasing field for scientifically trained engineers in the business side of great undertakings. Mr. Swinburne once said "Any fool can invent a thing; it takes a clever man to make an invention a practical success; but it takes a genius to sell it."

Now I do not want to suggest that it is part of the function of the engineering faculty of a university or technical college to produce geniuses as Mr. Swinburne has defined them, but I am quite sure, as time goes on, that a larger number of trained engineers will be attracted to the commercial side of engineering works, and I think this tendency is wholly good.

It is good, I venture to think, from the point of view of industry; with the expanding activities of large electrical engineering firms, it is becoming more and more necessary that their representatives—especially those in foreign countries—should be well-trained engineers, able to discuss any problem that may arise in connection with the supply of electrical machinery and equipment with their clients. One of the most interesting developments of British industry has been the formation of the Federation of British Industries. This association has projected a great scheme of what they call trade ambassadors, who shall act in the 22 different sections into which they have divided the world, as connecting links between the manufacturer at home and the consumer in a foreign country. It is estimated that this plan will involve an expenditure of a million a year. In connection with such an organisation it seems evident that a number of highly trained technical engineers will be wanted, men who are able to familiarise themselves with local conditions, and shall have had a wide commercial experience. Such men, either in connection with such federation or in connection with private firms will, it is to be hoped, have had a university or technical college training. They will have to deal with technical engineering problems. It is as necessary that they shall be fully qualified engineers as the man who has to put the actual machinery in place, or to put it into operation. The universities in this country are now establishing schools of commerce, which are meeting with considerable support; it is to be hoped that technically trained engineers will also come into the organisation of such a system."

In his concluding remarks, Dr. Marchant spoke of the tremendous possibilities in wireless telegraphy and telephony following upon the invention of the three-electrode valve. He regarded this as of the first importance to Liverpool, as he considered the sub-centre the natural home of telegraphy.

Slough Motor Depôt.—Referring to the paragraph on page 84 of the ELECTRICAL REVIEW for January 16th, dealing with "The Slough Motor Depôt," the Western Electric Co., Ltd., inform us that they secured the order for the manufacture, laying, and jointing of *all* the main feeder and distribution cables. These are paper-insulated, lead-covered, and steel-tape armoured, laid direct in the ground.

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NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

G.E. Co. Auto-Steriliser.

During the past few years the application of electricity to important work in connection with medicine, surgery, and dentistry has increased enormously on account of its cleanliness, adaptability, and safety.

One of the latest pieces of medical apparatus is an ingenious "auto-steriliser" patented by the GENERAL ELECTRIC CO., LTD., of 67, Queen Victoria Street, E.C.4. Made on the "Magnet" principle, *i.e.*, with easily replaceable heating element (immersion type), it embodies several valuable features, including a heat insulated handle for raising the lid, and a perforated self-draining instrument tray which is automatically lifted out of the liquid by lever hinges when the lid is raised (see fig. 1). In addition, there is a gutter or ledge which receives water condensing on the lid, and tips it back into the container when the lid is closed. The loading is such that the liquid is rapidly brought to boiling point, and the heating elements can be obtained for standard voltages of 100/110, 200/220, and 230/250.

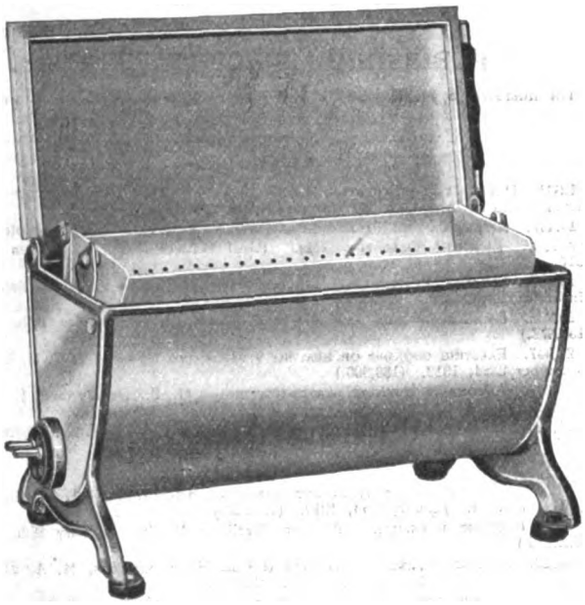

FIG. 1.—"MAGNET" AUTO-STERILISER.

The method of use is to fill the containing vessel with water so that the heater is well covered and the instrument tray properly immersed, then to switch on the current, and as soon as the sterilisation is complete to raise the lid by means of the insulated handle. The instrument tray is thereby raised out of the water and the instruments dry rapidly by residual heat.

An Electrical Vaporiser.

We have described in our columns on previous occasions devices designed for the evaporation of paraffin and the heavier oils to permit their use for the propulsion of petrol engines, or to enable engines to be started up without difficulty in cold weather. The GENERAL ELECTRIC CO., LTD., of 67, Queen Victoria Street, E.C. 4, has drawn our attention to another electrical vaporiser recently put on the market. This is known as the "Kramer-Vaporiser" (fig. 2), which consists of an asbestos cushion containing an electrical heating element. This cushion is mounted on the packing material between the induction and carburettor pipe flanges, and projects upwards into the entry pipe (figs. 3 and 4). On the suction stroke of the piston the cushion takes in the spray from the carburettor, and by means of its heating element converts the oil into the hot vapour necessary for starting the engine. The device can be made applicable to any make of engine, the heating element being wound to suit the accumulator or car-lighting voltages. The total weight is about 3 oz., and power consumption 30 watts. Flange packing is rendered unnecessary in most cases by the use of this vaporiser. The device is very easily fitted, it only being necessary to disconnect the flange of the induction and carburettor pipes, insert the cushion, and bolt up again. The terminals of the heating element are then connected by means of a flexible cord to a combined switch and pilot lamp and an accumulator, in parallel.

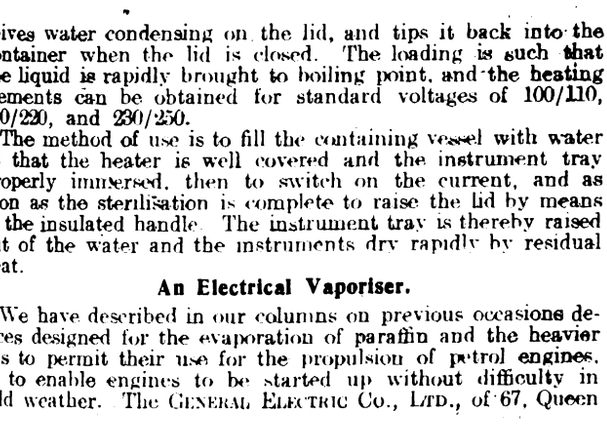

FIG. 2.—KRAMER-VAPORISER.

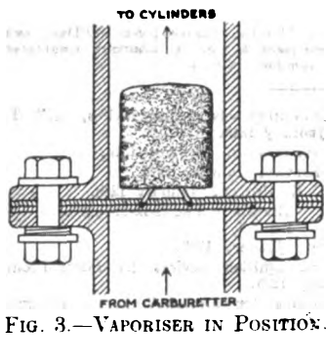

FIG. 3.—VAPORISER IN POSITION.

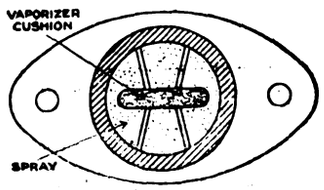

FIG. 4.—SECTIONAL PLAN OF INDUCTION AND CARBURETTOR PIPE, SHOWING POSITION OF VAPORISER.

Magnetic and Split-blade Screwdrivers.

In doing small repair work on electrical apparatus cases arise where the workman cannot hold a screw with his hand. Two screwdrivers, for large and small screws respectively, have been developed for use where this difficulty arises. The former (A) has a short shank and is magnetised, and the latter consists of a split-spring blade attached to a ¼-in. (6-mm.) rod. To use the screwdriver the two springs are sprung together and inserted in the screw slot. Their tendency to spring outward grips the screw.—*Electrical World.*

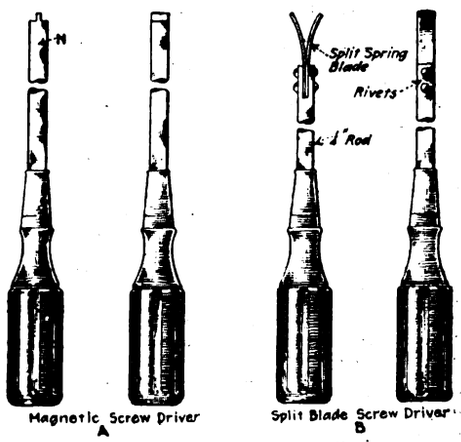

FIG. 5.—MAGNETIC AND SPLIT-BLADE SCREWDRIVERS.

Thermostatic Metal.

A special thermostatic metal has been developed for use on thermostatically operated devices of all kinds by the BRITISH THOMSON-HOUSTON CO., LTD., of 77, Upper Thames Street, London, E.C. 4.

The metal is in the form of a duplex strip, prepared by the permanent union, throughout their entire length, of two metals with widely differing co-efficients of expansion. When the strip is subjected to a change of temperature the difference in the rates of expansion or contraction of the two halves causes the whole strip to bend one way or another. This reaction is always the same for a given length and thickness of strip and a given temperature change, and consequently is claimed to provide a reliable basis for the operation of any thermostatic device.

The union between the component metals is complete and durable; no matter how much the strip is bent, twisted or hammered, the metals will not separate at any point, and even with heating the bond will not be broken down at a

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temperature below the melting point of the softer of the two metals. Owing to this permanency of union the metal can be formed into any desired shape and annealed after formation. It can be safely employed at any temperature below 500 deg. F. The component metals will not corrode under ordinary conditions, and may be used in any reasonable situation without fear of deterioration or change in operating characteristics.

Thermostatic metal is made in standard thicknesses ranging from 0.015 to 0.25 in., in widths up to 6 in., and lengths to suit the purchaser, and in special cases thermostatic metal parts may be completely formed to specification.

NEW PATENTS APPLIED FOR 1920.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by MESSRS. SEFTON-JONES, O'DELL AND STEPHENS (successors to W. P. Thompson & Co., of London), Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

932. "Electric generators for electric-lighting sets of automobiles, &c." T. A. D. LAWTON and W. H. MARSTON. January 12th.

941. "Morse-signalling lamps." J. H. HANSEN. January 12th.

948. "Electric heaters." A. M. E. BEAVAN. January 12th.

968. "Electric plug connection." R. K. BUTLER. January 12th.

974. "Electron-discharge devices." BRITISH THOMSON-HOUSTON CO. (General Electric Co.) January 12th.

993. "Sparking plugs." T. C. SMITH. January 12th.

1,003. "Trip mechanism for electric ignition devices for internal-combustion engines." A. J. ADAMS. January 12th.

1,007. "Wireless direction-finding means for aircraft." J. M. FIRNIVAL and H. R. C. VAN DE VELDE. January 12th.

1,017. "Charging electrical accumulators." T. DICKINSON. January 12th.

1,025. "Galvanic batteries." G. OLDHAM, J. OLDHAM, O. OLDHAM, OLDHAM & SON. January 12th.

1,045. "Sparking plugs." H. S. COOKE. January 13th.

1,067. "Sparking plugs." W. C. BAYLISS and A. L. WOOD. January 13th.

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1,384. "Armatures for dynamo-electric machines." METROPOLITAN-VICKERS ELECTRICAL CO. January 15th. (United States, January 16th, 1919.)

1,385. "Ignition apparatus for internal-combustion engines." BOSCH AKT. GES. R. (Germany, October 19th, 1918.) January 15th.

1,386. "Electrical condensers." BOSCH AKT. GES. R. January 15th. (Germany, March 15th, 1915.)

1,387. "Rotating interrupting devices for high-speed sparking apparatus." O. IMRAY (R. Bosch Akt. Ges.) January 15th.

1,388. "Ignition apparatus for internal-combustion engines." R. BOSCH AKT. GES. January 15th. (Germany, January 21st, 1918.)

1,390. "Portable electric generating sets." R. BOSCH AKT. GES. January 15th. (Germany, January 26th, 1918.)

1,391. "Device for preventing sparking in electric ignition circuit when lead becomes broken, for use in aeroplanes, &c." R. BOSCH AKT. GES. January 15th. (Germany, January 5th, 1918.)

1,396. "Medical electrodes." J. S. D. DUTHOIT. January 15th.

1,402. "Indicating arrangement for underground railways, tramways, &c." AUTOMATIC TELEPHONE MANUFACTURING CO. and S. R. SMITH. January 16th.

1,415. "Means for timing of electric ignition apparatus of internal-combustion engines." F. C. EWART. January 16th.

1,468. "Sparking plugs and methods of making same." BRITISH THOMSON-HOUSTON CO. (General Electric Co.). January 16th.

1,474. "Magnetos." N. C. F. JENSEN and M. J. E. THESEN. January 16th.

1,475. "Electrolysers." G. G. HEPBURN. January 16th.

1,489. "Starting devices for internal-combustion motors." H. FOENTE. January 16th.

1,498. "Electric starting devices for internal-combustion engines." O. IMRAY (R. Bosch Akt. Ges.) January 16th.

1,499. "Magneto generators." O. IMRAY (R. Bosch Akt. Ges.) January 16th.

1,500. "Devices for preventing starting of electrically-ignited internal-combustion engines." R. BOSCH AKT. GES. January 16th. (Germany, March 27th, 1916.)

1,504. "Magnetos." J. H. TOUNAYRE. January 16th. (France, February 21st, 1919.)

1,507. "Housings for mechanical interrupters of electric ignition apparatus." AMERICAN BOSCH MAGNETO CORPORATION. January 18th.

1,529. "Commutators." L. E. HODGES. January 17th.

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1,591. "Electric condensers." BRITISH THOMSON-HOUSTON CO., H. L. DURRANT and A. P. YOUNG. January 17th.

1,610. "Electrical brush-gear." W. F. GRAETON. January 17th.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1918.

1,634. DEVICE FOR REGULATING THE VOLTAGE OF CURRENT GENERATED BY A DYNAMO. Bosch Akt Ges. R. January 26th, 1917. (113,096.)

10,457. APPARATUS FOR ELECTRO-OSMOTICALLY REMOVING LIQUIDS FROM MATERIALS. Elektro-Osmose Akt. Ges. (Graf Schwerin Ges.) October 20th, 1917. (135,818.)

19,053. ELECTRIC HEATERS FOR LIQUIDS AND THE LIKE. P. J. H. Bernard. November 20th, 1918. (136,865.)

20,832. DYNAMO-ELECTRIC MACHINES. E. Harrison. December 13th, 1918. (136,872.)

21,547. ELECTRIC COOKING OR HEATING VESSELS AND APPARATUS. C. H. Lauth. December 23rd, 1918. (136,900.)

21,776. AUTOMATIC ELECTRIC WATER-HEATERS. G. P. Dennis and J. Law. December 30th, 1918. (136,913.)

21,913. ELECTRIC SWITCHES. E. Abegg. December 31st, 1918. (136,918.)

1919.

84. ELECTRIFICATION OF SEEDS AND APPARATUS THEREFOR. J. J. H. Sturmey and J. Hewett. January 2nd, 1919. (136,920.)

364. ELECTRIC FURNACES. Armour Fertiliser Works. January 28th, 1918. (122,828.)

4,320. ELECTRIC FURNACES. Watson & Co., H. A. Greaves, H. A. Etchells and W. Travis. February 21st, 1919. (136,961.)

5,216. CONNECTORS FOR USE WITH ELECTRICALLY-OPERATED OR HEATED DEVICES. G. H. Collins, H. F. Collins and C. G. Pitcher. March 3rd, 1919. (136,967.)

11,540. ELECTRICAL RESISTANCES. M. Perree. May 8th, 1919. (136,998.)

13,665. ELECTRICAL GENERATORS. B. Ames. May 29th, 1919. (137,002.)

13,667. ELECTRICAL CONDENSERS. B. Ames and P. J. Gilinson. May 29th, 1919. (137,003.)

14,919. AIR-COOLED SPARKING PLUGS. L. Pineschi. June 13th, 1919. (137,008.)

15,760. ELECTRIC COOKING OR HEATING APPARATUS. C. H. Lauth. December 23rd, 1918. (Divided application on 21,547/18.) (137,012.)

17,641. SELECTING DEVICES FOR AUTOMATIC TELEPHONE SYSTEMS. Siemens Bros. & Co. and D. A. Christian and G. P. Sumner. July 14th, 1919. (137,018.)

Petitions for Extensions of the Terms of Patents.—In connection with proceedings that are pending or contemplated under Section 18 of the Act of 1907, attention is directed to Section 6 of the Act of 1919. The general extension granted by the latter section renders premature the presentation or consideration at the present time of petitions in respect of patents the original term of which had not expired on December 23rd, 1919 (the date of the coming into force of the Act of 1919), as the Court would be unable at this date to determine satisfactorily the question whether or not the petitioner had been adequately remunerated.—*Illustrated Official Journal* (*Patents*).

Alpine Water Power.—A *Times* correspondent states that one of the most important schemes for the exploitation of the water power of Switzerland is that of the Forces Motrices Bernoises, which proposes to generate 210,000 H.P. in the Oberbasli Valley (Bernese Oberland). To this end a large dam has been erected at the foot of the Bächli Glacier, near the Juchlistock. The valley here is now a splendid lake surrounded by vast rocks, and washing up to the edge of the glacier. By the Grimsel the change is to be much greater still. From the formidable slopes of the Nägelis Grätli (above the Rhône Glacier) to the Unteraar Glacier there will be a lake just over three miles in length, taking in the two present lakes. The dam which will form this lake is to be over 320 ft. in height. The Gelmersee, too, is to have its dam, which will quadruple its area. There will be two power stations, one at Guttannen and one at Innertkirchen, but all tubes and pipes will be underground, so that the natural beauties of the district will not be disfigured. The total costs of the scheme are estimated at 100,000,000 fr. (about £4,000,000 sterling at the rate of 25 fr. to the sovereign), and it is hoped that the work will be completed within six years.

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THE

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VOL. LXXXVI. FEBRUARY 6, 1920. No. 2,202.

ELECTRICAL REVIEW.

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THE PRICE OF THE "ELECTRICAL REVIEW."

During the War, almost exceptionally among technical publications and periodicals of the character of the ELECTRICAL REVIEW, we have refrained from increasing the price. Owing, however, to the constant increases in cost of paper, printing, engraving and production charges generally, we have reluctantly decided that the price from the beginning of this year must be raised to 6d. per copy. The change will not apply to unexpired subscriptions.

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THE NEED FOR THE SPIRIT OF CONFIDENCE.

THE promotion of good feeling and mutual confidence and esteem between employers and employed, is a question which has been one of the most prominent in the minds of those—and they include almost everyone—who have been brought into contact with it, for some considerable time. From many of the daily papers it might be gathered that it has only arisen during the war, and there are those who curse the ex-Kaiser—wretched being—for the moulders' strike, the railway situation, the coal shortage, and all the disadvantages of the present industrial situation.

Those whose knowledge and industrial experience go back beyond August, 1914, will probably agree that the war did little more than precipitate various aspects of this among other problems, and that the problems themselves—or this problem of industrial relations at any rate—are of such venerable antiquity as almost to seem eternal. Like the poor, they are always with us, and there are, and always have been, extremists on either side. The famous Statute of Labourers, enacted after the Black Death, sought to force all able-bodied persons, of either sex, to serve any employer who required them to do so, and to take only the wages which prevailed in the district before the plague began. Later, the labourer was tied to the district, and if he or she left it, was liable to be hunted, brought back, and subjected to various pains and penalties: in Scotland miners were bought and sold with the mines in which they had to work. The Peasant Revolt under Wat Tyler arose largely out of this attempt at coercion, and the Complaint of the Commons of Kent, under Jack Cade, 70 years later, was to a great extent due to circumstances to which many parallels can be found at the present time. Any attempt at an historical survey of the subject, though of considerable interest, would take up a great deal of space, and would lead us beyond those limits within which we prefer to remain. Let it suffice to say that there are still employers and others who, although not employers, think with them, who would seem to wish that all workers should be compelled to work whenever required, for fixed wages, and should be content to be turned off and left to exist as best they can when not needed for the production of goods. On the other side there are those who would make an equal division of the wealth of the world, and who would give the most corrupt and incompetent an equal voice in the Government with the real hard worker.

In both classes of extremist the underlying idea is a desire to be the top dog, and a feeling that all merit resides on one side only of the case. There is a lack of any spirit of confidence: and it is this spirit which alone can influence the situation for good. It is useless and wicked to talk about "the inevitable conflict between Capital and Labour," and "the need for a little blood-letting," or for a class war. The advocates of these policies always fail to ask themselves the question: What will be the situation *after* the inevitable conflict, or the class war, has been fought and won and lost, or the blood has been let? The answer is that the problems, which just now we ventured to call eternal, will still be there, and will still need tackling, while feeling will have been exacerbated and settlement rendered more than ever difficult.

The industrial question, then, although much discussed, seems as chaotic as ever. This seeming chaos, however, is only due to the many-sidedness of the question and to the necessity of continual adjustment. There never can be any finality where growth is concerned. The tree which

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ceases to grow, dies. The business which fails to make progress, falls sooner or later into liquidation, and comes to an end. There is no comparison possible even between one generation and another, for in the whole community generations overlap, and so the adjustment required is, as we have said, continual.

The aspects from which the question may be regarded are many. There is that of the relationship between federations of employers and Trade Unions, or federations of them. This aspect has been developed more in Great Britain than in any other country in the world, and it is of very great importance, inasmuch as it prevents local settlements as well as local strikes, though it is more effective in the first case than in the second. The fastest pace of a squadron of ships is the fastest pace of the slowest ship in the squadron. Where federations are concerned, the fastest pace at which the federation can move is the fastest pace at which the most obstinate constituent member of the federation can be persuaded to move. Then there is that of the relationship between individual employers and trade unions, which has been developed in the United States and the constituent nations of the British Empire, as well as in Great Britain and elsewhere. Again, there are those of the relationship between individual employers and individual workers, between employers and other employers, between workers and other workers; and last, but not least, there is the question of the relationship of the public at large to any or all of the other parties.

Thus outlined, the question of industrial relations is seen to be one of the most vast with which statesmen and thinkers can occupy their minds. When we consider one small corner of it, viz.: the relationship between an individual firm and its employés, we cannot fail to be struck by the negligent way in which it is dealt with. Lip-service is rendered to the need for the spirit of confidence, and a great deal is said about team-work. In some cases attempts are made to bring the various classes of workers together at clubs, where concerts, games, dinners, dances, lectures, and the like can be arranged. It is seldom, however, that employers, or even the higher officials, participate actively in such things; and a lengthy experience has convinced us that measures of this sort scarcely touch the fringe of the question. They contribute little or nothing to effectiveness during work. Conditions of remuneration, heating and cooling and ventilation of the works or offices, and attention to the personal comfort of the workers as regards the cleanliness of the place in which they have to work, decent sanitary accommodation, the provision of lockers in the works, and of comfortable desks and chairs in the offices—all these are more productive of improved efficiency than billiard tables or cardrooms, football matches or dinners.

Yet, in a large concern, it is frequently found that every departmental manager engages his own staff, and fixes their remuneration according to his own notions. There is a great deal of secrecy between various sections as to the salaries paid—why, we have never been able to discover. In the public service, whether Imperial or municipal, salaries are known from the various year books, and although public employment has some unpleasant features, it at least ensures that positions of equivalent responsibility in various sections or departments receive equivalent remuneration. In manufacturing concerns expediency is the governing factor, and the tendency is to pay as little as the worker will take.

An article by Mr. Dudley R. Kennedy, in *Industrial Management* for November, 1919, entitled "Employment Management and Industrial Relations," brings out the need for accomplishing the improvement of those relations in the proper spirit. The good intentions of a board of directors can easily be frustrated by the incompetency or lack of goodwill of those whose duty it is to carry the board's policy into effect; and, be it noted, the failure of an attempt of this sort is a most disastrous thing, for distrust of the genuineness of the intentions behind it is inevitably engendered.

The Labour policy must, says Mr. Kennedy, be directed by some one individual, of high executive rank. His duties are numerous and important, and his standing must be equal to that of the heads of the financial, manufacturing, designing, or selling departments. Such an individual would be able to study the conditions obtaining, and to evolve a system of grading various positions, assigning remuneration between certain limits in accordance with merit and length of service. This accomplished, a great step would have been taken towards the inculcation of a spirit of confidence and trust between employé and employer.

Mr. Kennedy observes: "While it may seem to be a broad statement, nevertheless it is becoming more and more a conviction with many, that where an employer's employés secede *en masse* to the ranks of a Union, that they have gone to those whom they feel can help them, and that the employer has lost their confidence in his integrity, his honesty, and his fairness." While the grammar is deplorable, the truth of the statement is manifest, and many, if not most, of our readers will realise its personal application. While on the subject of grammar, we should like to express the hope that in future articles Mr. Kennedy will do his best to avoid such sentences as this: "The fact that even that many people are somewhat familiar with the subject is attributable largely, I think, to the fact that because of requirements imposed by the necessities of war production, coupled with the sudden atrophy of immigration, a very drastic shortage of labour has occurred." These lapses overlooked, Mr. Kennedy seems to have the root of the matter in him. We believe that there is a tendency in Great Britain in the direction indicated. Some few individual firms have real employment managers who prepare and administer the policy throughout all the ranks of the employed persons, from the directors to the cleaners and errand boys. Others have a labour department which deals with the operatives, and has no concern with the staff. Many more have employment departments which deal with applications and file statistics, but have no more interest in the policy of the firm than the employment exchange. Of these, the first is the right policy, and it would soon prove itself to pay best from all points of view, because it would bring about and maintain the spirit of confidence, which to-day is conspicuous by its absence.

Employes' Inventions.

At a meeting of the City Council of Christchurch, N.Z., according to the *Auckland Weekly News*, it was reported that the city electrical engineer, Mr. E. E. Stark, had patented an instantaneous hot-water heater and an electric kettle capable of boiling water in seven minutes, and had offered to the Council the right of manufacturing and selling these articles; as they were manufactured and sold by the Council's electricity department with considerable success, the Electricity Committee had agreed to pay the royalties on them to Mr. Stark. Opposition was raised to this, on the ground that when an employer paid a man for his services he had a right to the product of that man's brains while they affected the occupation in which he was employed; but the chairman of the Committee considered that if a man invented anything, that invention was his own property, and on a division the report was adopted by 12 votes to 2.

That was a right decision—not only morally just, but right in the eyes of the law. Unless an employé is engaged for the specific purpose of inventing and of developing inventions on behalf of the employer, he retains an unquestionable right to the products of his brain; he is entitled to patent his inventions in his own name, and to demand the payment of royalties by his employer, should the latter desire to manufacture or use such inventions.

Employers whose ethics are in need of correction are apt to claim the inventions of their workers as theirs by right; they are, however, entitled only to the labour that they pay for, not to the fruits of a worker's inspiration. Hence clever ideas on the part of workmen ought to be handsomely rewarded if they effect a saving in the cost of manufacture, or if they lead to the production of new devices. To give a man 5s. for an improvement in a workshop process which will save the firm hundreds of pounds, is

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sweating in its most aggravated form—nay, worse, it is robbery, and could only be justified in a state of slavery under which the worker was body and soul the property of his master.

As stated by Frost in "Patent Law and Practice," "in the absence of special contract, the invention of a servant, even though made in the employer's time, and with the use of the employer's materials, and at the expense of the employer, does not become the property of the employer so as to justify him in opposing the grant of a patent for the invention to the servant, who is the proper patentee, and the patent when obtained is the exclusive property of the servant." The servant may, however, under certain circumstances, be declared by a Court of Law to hold the patent as trustee for his employer. A patent taken out by an employer alone for an invention discovered and worked out by an employé is void.

Automatic Sub-stations.

The rapid progress which is being made in the adoption of automatic sub-stations in the United States is indicated in the interesting abstract which we reproduce elsewhere in this issue. The principle is, of course, an old one; those who are familiar with the early days of electricity supply will call to mind several examples in this country, such as the direct-current system installed at Oxford, Chelsea, &c., in which the rotary transformers were placed in unattended sub-stations, and, with the batteries, were controlled from the generating station. It must be admitted, however, that these were only semi-automatic, and that, so far as we know, none of them has survived to the present day. The American installations, on the other hand, are often entirely automatic, going on load when the demand calls for it, and switching themselves out when the load falls off; although the first of them was started up as recently as Christmas, 1914, there are now no fewer than 37 installations in operation and 35 on order, and rotary converters as large as 1,000 KW. are handled automatically, while a 2,000-KW. motor-generator is about to be put into service, and a 3,000-KW. synchronous condenser is running. It is clear that the system has proved successful, and that great economies have resulted from its adoption, not only in wages, but also in capital outlay on feeders, and in the saving of light-load losses.

On various occasions we have drawn attention to these sub-stations, and in our issue of June 21st, 1918, we gave an illustrated description of a hydro-electric generating station which was automatically controlled on similar lines; the latter is of considerable importance in view of the possibility of utilising the numerous small waterfalls in the mountainous districts of this country. By using asynchronous generators the difficulties of speed regulation and synchronising can be overcome, and the control reduced to its simplest terms. In these days it is very necessary to stop the leakage of energy derived from natural sources, and turn it to practical use, as Mr. Steinmetz pointed out in an article which we recently quoted. We may again draw attention in this connection to the competition for the best solution of the problem of conserving the Welsh water-powers, which will take place at the National Eisteddfod in August; particulars were given in our issue of November 14th, 1919, and entries must be completed by May 24th.

Manufacturers and the Act.

Directly the broad purpose of the Electricity Supply Act is achieved, so soon will a corresponding benefit accrue to the manufacturers of electrical apparatus used by consumers. This purpose is, first, an ample supply of electric power for industries; secondly, cheap electricity for domestic purposes. Cheapness in either direction means an extended use of the supply by consumers, and, as this can only be done by using apparatus, it means a big opening, in the first case, for electric motors, and, in the second, for electric cooking and heating apparatus (chiefly). But outside the prospect of the Act thus increasing the market for direct sales to consumers, there is for manufacturers a more special point of interest—namely, the encouragement which the Act gives to electric supply undertakings (both company and municipal) to hire out apparatus. Now, the wholesale use by people of, say, electric cooking and heating apparatus, must depend, in a great measure, upon whether the various undertakings will consent to hire. In the case of electric motors this hiring question has a similar bearing, although not to anything like the same extent. But in the case of cooking stoves and heating apparatus the hiring question seems paramount, certainly if we are to judge by the analogous case of gas companies, whose hiring of gas stoves has been the foundation on which their huge cooking and heating business has been almost entirely built up. Now the present Act gives a much-needed legal recognition to the practice of hiring. Up to the present, through no fault of the undertakers, however, the hiring of electric apparatus has been of a languishing and intermittent character. Municipal undertakings especially have been handicapped. But by Section 23 of the Electricity Supply Act the question of hiring is placed on an unequivocal footing. It provides that "a joint electricity authority and any local authority authorised by special Act or by order to supply electricity may provide, let for hire, and in respect thereof may connect, repair, maintain and remove . . . electric lines, fittings, apparatus and appliances for lighting, heating and motive power." . . . Further, the section contains the important proviso that any of the apparatus and appliances thus provided on consumers' premises "shall be deemed to form part of the undertaking." . . . The whole business of hiring apparatus is made legally part and parcel of the operations of both municipal and company electric supply undertakings, and there is no obstacle, therefore, to business going ahead in this direction immediately circumstances allow of it.

Further, as a subsidiary favourable factor acting in the same direction, the erection of capital stations will gradually relieve individual undertakings of the necessity for further capital outlay on generating plant, and so set them free to use all available capital to develop the distributing side of the business, in which hiring schemes should play a useful part. As to the manufacturers' part in this, there is every urgency for them to effect standardisation of apparatus as far as possible, since in hiring schemes *standardised* apparatus is almost a *sine qua non*.

A New Federation.

To-morrow, at the instance of the Labour Research Department, a meeting of representatives of associations of administrative, clerical, and professional workers is to be held in London, with a view to the formation of a "National Federation of Professional, Technical, and Supervisory Workers." According to a circular issued by the Labour Party, the purpose of the new organisation will be "to work out common economic programmes" for its constituents.

We are assured that "the question of political action is, of course, completely outside the scope of this conference," a statement which may be taken for what it is worth; that one object of the movement is to promote friendly relations between the "black-coated" class, as the Press has it, and the industrial workers' organisations is not disguised, and the political views of the chairman of the conference, Mr. G. D. H. Cole, of the Labour Research Department, are well known to be of an advanced nature. Associations which are subsidised by employers are expressly declared to be ineligible for affiliation.

The draft constitution of the proposed federation is harmless enough on the surface, and we should be the last to demur to the promotion of friendly relations between staff associations and labour unions, and between them both and the employers; we heartily desire to see them all working together for the common good on the most harmonious terms. But everything depends on the motives which do not appear on the surface, and which have to be gauged and tested by other means than external appearances. We await further particulars with interest, and in the meantime suspend our judgment on this latest turn of the association kaleidoscope.

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CLEANING BLAST-FURNACE GASES.

For several years past the advantages of the use of cleaned blast-furnace gas have been freely discussed, and it has been proved that a very marked increase in efficiency can be obtained by the use of gas which has been highly purified.

The advantages to be secured by properly cleaning the gas are many, and may be summed up as follows :—(1) The operation of stoves and boilers becomes more uniform ; (2) interrupted operations due to the clogging of gas connections are avoided ; (3) the cost of cleaning pipe connections, stoves and boilers is reduced to a minimum ; (4) the loss of heat due to repeated cleaning of stoves is avoided ; (5) the useful effect of the hot-blast stove is increased because the heating surfaces remain clean ; (6) the operation of gas

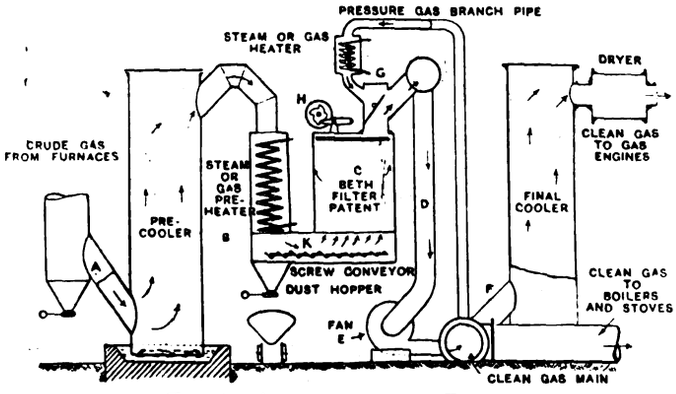


Fig. 1.—Arrangement of Plant.

engines becomes regular and positive ; the clogging of passages and the rapid wear on the moving parts of the engines is avoided. The advantages gained by the use of clean gas in gas engines are already too well known to need any further comment, but the excellent results obtained by the use of clean gas in stoves, boilers, steel furnaces, &c., have not up to the present been fully appreciated.

Although in the past the installation of large gas engines has not made such rapid strides in this country as on the Continent and in America, there is evidence, under the new conditions, where economy is of such vital importance, that their installation is being seriously considered by iron and steel-works engineers. Various authoritative tests have been published during recent years, both on gas engines and boilers, worked under these new conditions, but up to the present no information is available as to the benefits to be derived from the use of highly-cleaned gas in soaking pits, mixers, melting furnaces, push furnaces, coke ovens, foundries, briquetting plant, &c. By thoroughly cleaning the gas and preventing all waste, there appears to be no reason why the whole works should not be run without the use of solid coal, or even producer gas.

Apart from the dry separation of the heavy particles in dust-catchers, which are usually placed close up to the furnaces, blast-furnace gases have, until quite recently, been cleaned by the wet system—that is, by bringing the gas into close contact with water. Within recent years, endeavours have been made to eliminate the inherent objections to the wet method of gas cleaning, some of which are :—(1) The difficulty of recleaning the water, rendering large settling tanks a necessity. (2) The difficulty of dealing with the wet mud. (3) The inconvenience and expense of keeping the tanks clean and in good order. (4) The large consumption of water, which is often not over-plentiful, and expensive to obtain near blast furnaces. (5) The large consumption of power.

The Halberg-Beth dry-cleaning plant cleans the blast-furnace gas by separating the dust without requiring water. The sole manufacturers of this plant in Great Britain are Messrs. Fraser & Chalmers, of Erith, Kent. In March, 1910, a small plant on this system, having a capacity of 175,000 cb. ft. of gas per hour, was installed. The experience gained with this plant led to two others being started in June and July, 1911, having respective capacities of 700,000 and 900,000 cb. ft. of gas per hour. The excellent results obtained were followed by a great demand for this type of cleaner, and in 1914 50 installations of plant of large capacity were in various stages of construction, the total capacity amounting to 140,000,000 cb. ft. of gas per hour.

The following is a brief description of the Halberg-Beth dry gas-cleaning system :—The gas given off by the blast furnaces at greatly varying temperatures, dependent upon the working and condition of the furnaces, is collected and conveyed by a main pipe A (fig. 1) into a suitable cooler of the surface type. The temperature of the gas is thereby reduced to 150-170 deg. F. After cooling, the gas passes into a superheater B, and is superheated from 15 to 25 deg. F. to safeguard against the risk of moisture being deposited on the filter bags, and then passes on into the Beth filter chamber C.

The standard Halberg-Beth filter is a mild steel rectangular

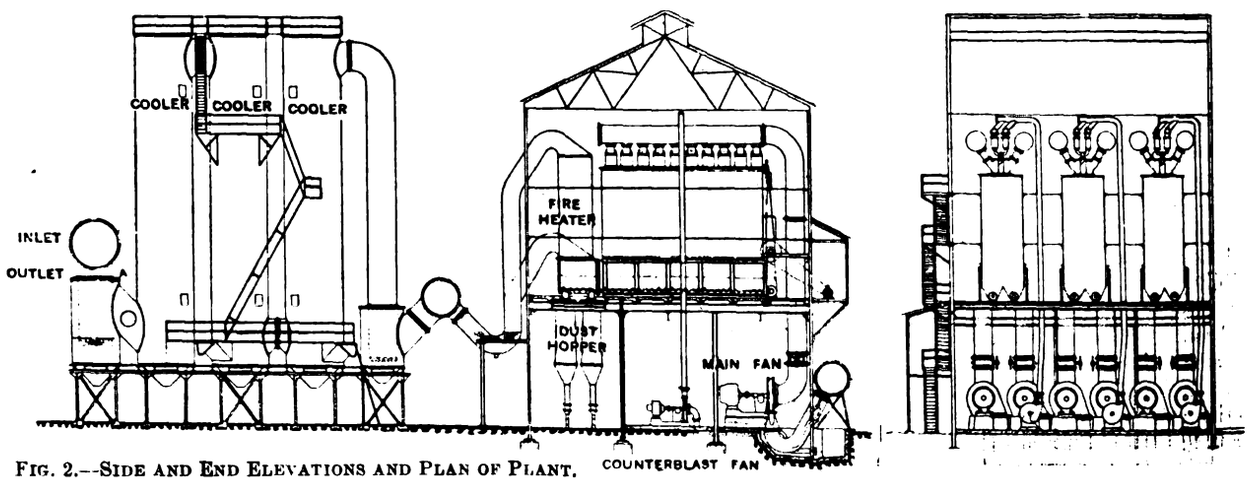
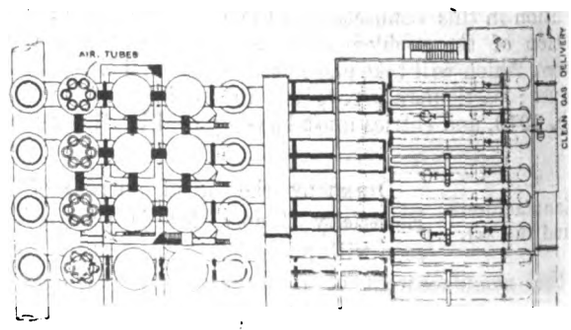


Fig. 2.—Side and End Elevations and Plan of Plant.



box divided up by one longitudinal plate running the full length of the box, and by shorter partition plates across the box, such that there are two double rows of 10 compartments in each filter box. In each compartment there are 12 open-ended bags, the lower ends being attached to rings which are rigidly fixed into a plate just above the dust-collecting chamber running the full length of the filter box. The tops of the bags are closed by means of steel caps with

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suitable attachments for hanging on to the shaking frame. To the centre of each of the latter is fixed a suspension bolt projecting through the top plate of the filter box, and made gas-tight by a suitable gland; these are connected to the shaking gear H, which is bolted to the top plate. Great care is taken in the manufacture of the shaking gear; every part is made to a jig, and is interchangeable.

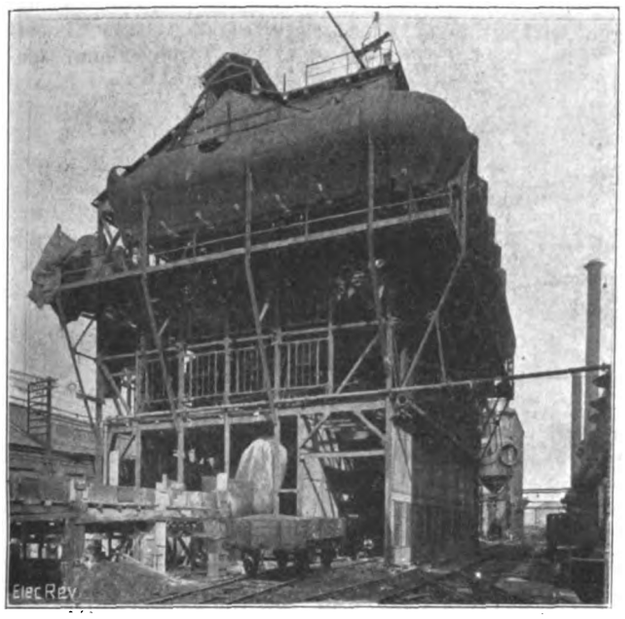

Fig. 3.—Gas-Cleaning Plant in Course of Erection; Capacity, 5,000,000 cb. ft.

The gas passing from the inside to the outside of the bags is drawn through the filter plant by means of one or more fans, E, which only deal with clean gas. Whilst the gas is being drawn through the filter bags, the dust settles on the inside, and a simple device automatically and thoroughly removes the dust. At regular intervals during the whole time the plant remains in operation, each chamber of 12 filter bags is, in proper sequence, cut out by means of the

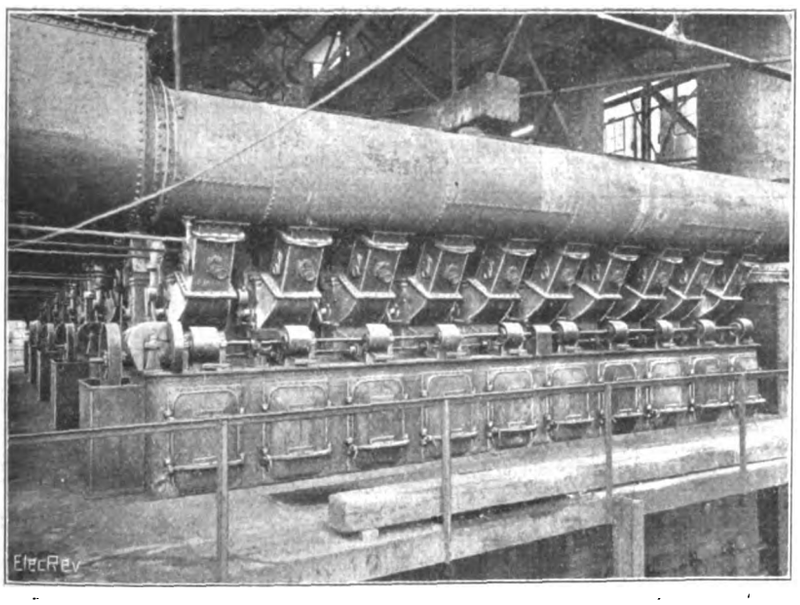

Fig. 4.—Filter Boxes.

valve G, which is automatically operated; this valve cuts off the fan which is drawing gas through the plant from the particular compartment and allows clean gas, at a higher pressure than that of the crude gas, to flow in the reverse direction into the filter chamber, and in passing from the outside to the inside of the bags, this blows the fine particles out of the mesh, and loosens the heavier particles clinging to the insides of the bags.

During the time that the counter-current of clean gas is flowing, the shaking gear comes into operation, and the frame, together with the 12 bags suspended therefrom, is raised and dropped about seven times, with the result that

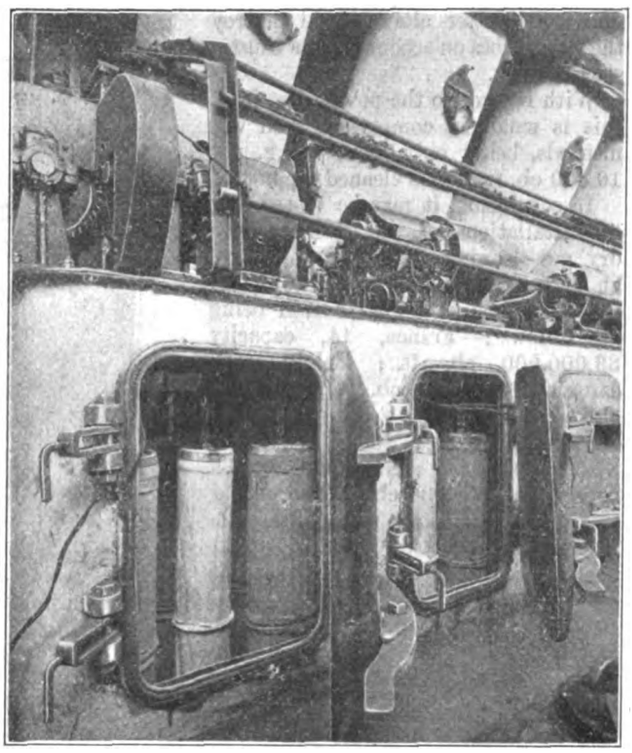

Fig. 5.—Shaking Mechanism, Top Inspection Doors, and Filter Bags.

the dust collected on and in the filter bags is shaken down into the chamber at the bottom of the filter box, which is provided with a spiral conveyor to deposit the dust in hoppers, these being emptied periodically direct into trucks. Immediately each section of bags has been cleaned, the top suction valve is automatically switched back into the forward position again. The whole operation lasts 15 to 20 seconds, and the process is repeated at intervals of about seven minutes. With an original dust content of about 6 grammes per m^3., the gas, after passing through the cleaning plant, will only contain about 0·01 to 0·02 gramme per m^3. This cleanliness is obtained in ordinary service; experience has shown, however, that as low a dust content as 0·001 gramme per m^3. is often continuously obtainable.

With regard to the superheating of the gas, the simplest medium is steam, requiring from 6 to 7 lb. of steam per 10,000 cb. ft. of gas per hour. With a well-arranged insulated superheater, B, and filter chamber, C, this consumption can be reduced. As an alternative, instead of using steam, the exhaust gases from gas engines, stoves, &c., can be used.

If the cleaned gas is intended for driving gas engines, the fact that its temperature on leaving the cleaning plant is at least 140 deg. F. necessitates cooling before use. This is carried out by a simple arrangement of coolers fitted with water sprays; the device is very efficient and economical, the water remains quite clean, and can, after spraying, be used for any other purpose without purifying. After the gas passes the final cooler it is arranged to pass through a water separator, and thence it goes on to the gas engines.

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The life of the filter bags is from 6 to 12 months, and the cost of replacing these is small. Actual experience has proved that the bags frequently last 18 months and even two years; the reason for their long life is the fact that the temperature of the gas is automatically kept at a little above the dew point. This prevents both the burning and clogging of the filter tubes by hot gas or wet dust; the latter alone would destroy the filter tubes on account of its caustic soda content.

With regard to the power required, this is small in comparison with wet methods, being only about 1 H.P. per 10,000 cb. ft. of gas cleaned per hour.

In conclusion, it may be stated that 59 installations of the Halberg-Beth dry gas-cleaning plant in Europe have an aggregate capacity of 174,000,000 cb. ft. per hour, the distribution being as follows:—France, 14, capacity 36,000,000 cb. ft.; Belgium, 4, capacity 8,700,000 cb. ft.; Germany and Luxemburg, 23, capacity 75,000,000 cb. ft.; Russia, 4, capacity 8,350,000 cb. ft.; Great Britain, 14, capacity 45,050,000 cb. ft. per hour.

We are indebted to Messrs. The General Electric Co., Ltd., for photographs and the particulars set out above.

On the occasion of our recent visit, at the invitation of the General Electric Co., to Messrs. Fraser & Chalmers's works at Erith, plant of the type described above was seen in course of manufacture as noted in our issue of November 14th, 1919. Fig. 9 is a view at Messrs. Palmers Shipbuilding and Iron Co.'s works, which we described in our last two issues, where gas is cleaned by the above process before being used in the gas engines.

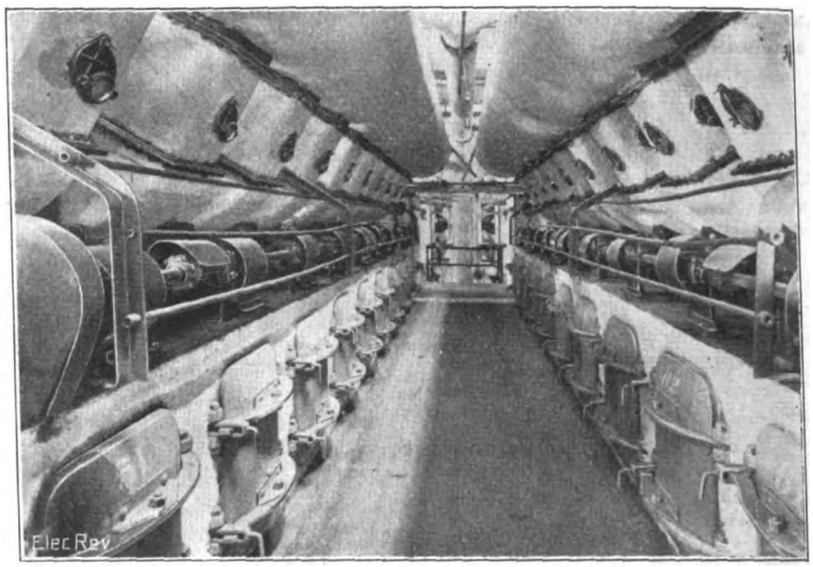

Fig. 6.—Filter Boxes, Shaking Mechanism, and Top Suction Pipes.

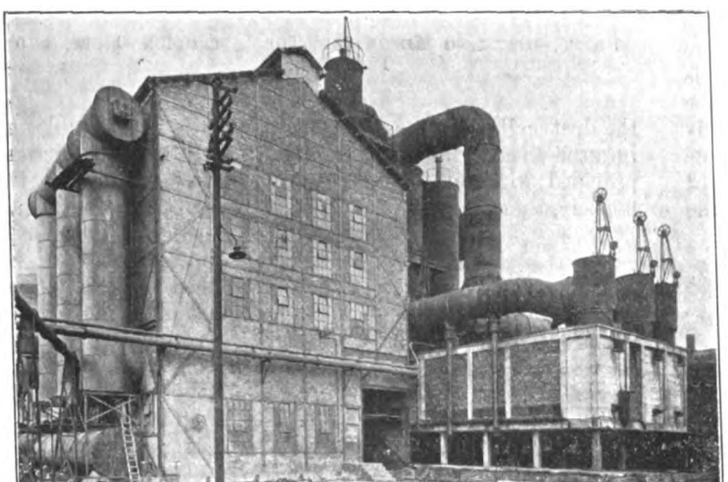

Fig. 7.—Economisers and Steel Coolers in Background.

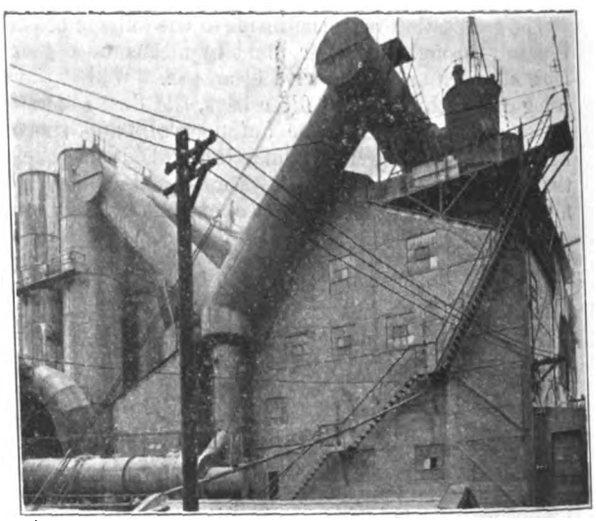

Fig. 9.—Steel Coolers, Cool Gas Inlet, and Main Water-Seal Valves over Filter House.

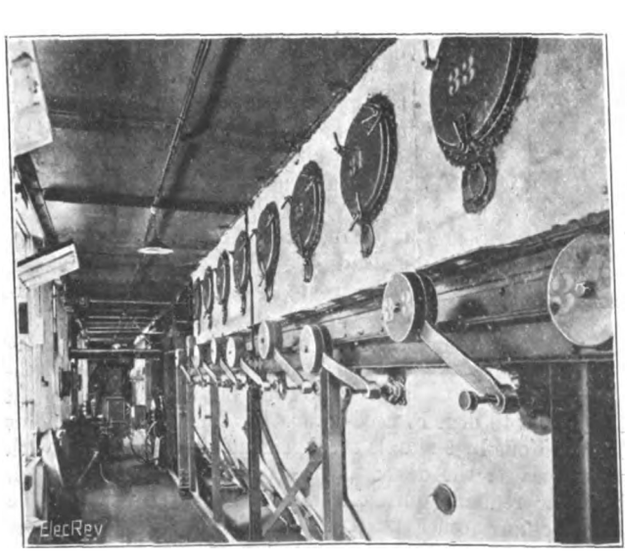

Fig. 8.—Bottom Filter Box Isolating and Inspection Doors.

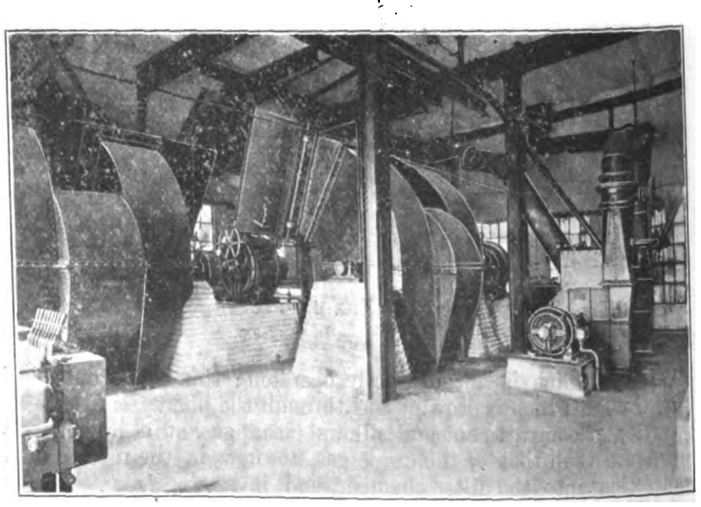

Fig. 10.—Fans and Motors

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THE COAL REBATE—A COMMENT.

By E. W. DOREY.

In your issue of January 16th you published details of the rebate to be granted to consumers of electricity for domestic or household purposes as a result of the reduction of 10s. per ton on the price of coal supplied to electricity supply stations and used for the generation of the electricity so supplied.

The basis of the reduction is sound, from the standpoint of the supply undertaking, in that it gives back to the consumer the *net* saving to the supply undertaking resulting from this 10s. per ton reduction, but it is to be feared that the consequent disclosure to the domestic consumer of the lb. of coal used per unit sold will give rise to trouble, for reasons which will now be gone into.

The formula quoted in your issue of the 16th inst. is as follows:—Rebate to consumer per unit metered (tons of coal used in quarter/units sold in quarter) × 114d.

Taking a concrete example, we have:—

(5,000 tons/3,000,000 units) × 114d. = 0·190d.

This assumes 600 units sold per ton of coal used, or 3·74 lb. of coal per unit sold, a figure which is obtainable in the larger stations, and on this basis the rebate would amount to 0·190d. per unit; with smaller stations burning 6 lb. per unit sold, the figure would be 0·305d. per unit.

Many supply undertakings are distinctly averse to divulging the lb. of coal used per unit sold, but, apparently, they will now have to "own up." For instance, if a quarterly account for 100 domestic units shows a rebate of 20d., by simple mathematics, we get—

Rebate per unit 20d./100 = 0·2d.

lb. of coal per unit = 0·2d. × 2,240 (lb. per ton)/114d. (rebate) = 3·93.

A consumer of 100 units, therefore, costing him perhaps 6d. per unit, viz., 600d., would get a rebate of 20d., the equivalent of a reduction of 3·33 per cent., indeed a cause for congratulation! How the accounts clerk is to be envied, now that he has one further complication to add to his burdensome duty.

It will be impossible to prevent the thinking consumer from comparing the "war" increase with the now "post-war" rebate. A good deal of propaganda was distributed by supply undertakings to make the consumer *au fait* with the reasons for the increase in rates, viz., rise in cost of fuel, wages, stores, &c., but now we have the first general decrease, and when it is considered that 10s. per ton is, on the average, one-third of the total cost per ton of coal to-day, delivered to the supply undertakings, and that this fact will be evident to the consumer, the reduction of a paltry, say, 3·5 per cent. only on the bill will need some explaining, even by those "skilled in the art."

Now that it is a question of reducing the rates, the absolute minimum is offered, and logically the consumer expects to find that when the supply undertaking imposed an increase, the absolute minimum was enforced—for how could a pious supply undertaking management be expected to stoop to profiteering?

An analysis of what has taken place will suffice to show whether the consumer is justified in his expectations, and for a basis to work upon reference will be made to the table, "Pre-War and Post-War Prices Charged for Electrical Energy," published by the Electrical Review.

The following extracts relate to three typical supply undertakings of considerable size:—

Undertaking.	Rates for lighting.		Coal per ton.		
	1914.	1919.	1914. s. d.	1919. s. d.	Increase on 1914.
A	3·5d.	+ 50 %	12 1½	26 2½	117 %
B	4d.–2·5d.	+ 100 %	14 1	28 4	101 %
C	3·5d.	+ 100 %	10 6	21 6	105 %

It is not unreasonable to take 70 per cent. of total costs as fuel costs, leaving 30 per cent. to cover "other costs," viz., stores, wages, &c. (these figures, of course, do not cover capital and other standing charges).

Using as a basis for the analysis a figure of 5·0 lb. of coal per unit sold (a liberal figure), the equivalent of 450 units per ton, we find, if we take example "C," the following. Coal cost per unit sold:—

Year 1919.—258d. (21/6)/450 = 0·575d. Year 1914.—126d. (10 6) 450 = 0·280d.; difference 0·295d.

The increased cost due to increase of fuel from 10/6 to 21/6, is, therefore, 0·3d. per unit sold. It will be seen that this undertaking "C" increased the rate from 3·5d. to 7·0d., *i.e.*, an increase of 3·5d. per unit.

If it be assumed that the "other costs" per unit are 30 per cent. of the total, and we take the 1919 figures, we find that the total generation cost per unit sold is 0·575/0·7 = 0·8225.

The "other costs," therefore, = 0·8225 − 0·575 (coal) = 0·2475d. per unit sold.

If it be allowed that these "other costs" are up 120 per cent. over pre-war figures, we find that they have risen by 0·135d. only, so we have a comparison between 1914 and 1919 as follows:—

Increase due to fuel	0·295d.
" " "other costs"	0·135d.
Total increase	0·430d.
"C" undertaking has charged an increase of	3·5d. per unit.
"C" undertaking's generation costs increased by	0·430d. "
Difference	3·070d. "

The figures of generation costs per unit sold do not cover standing charges, and the high cost per unit for domestic supply, when compared with a supply for power, is due to the heavy capital outlay necessary to afford the domestic supply. It is necessary, however, to remember that during the war the number of such consumers connected was strictly limited by the Government, and it is, perhaps, not unreasonable to suppose that about 70 per cent. of the present domestic consumers were connected in 1914, that is to say, the capital to afford these supplies was expended prior to the war. An increase of 100 per cent., to be justified, pre-supposes that the costs have gone up 100 per cent.; but how can such an increase be justified in the case of the 70 per cent. majority who were connected prior to the war, and for whom the capital was already expended in 1914?

Now that the basic facts and figures are to be given to the public, it is as well to face these facts seriously, and see exactly what the position in reality is. Perhaps one had better not even try to imagine what the average consumer will say when he sees the whole question in the light of day, but imagine yourself a pre-war consumer taking a supply from an undertaking as "C" above:—

1919 you paid	7·0d.	flat per unit.
1914 you paid	3·5d.	" "
Increase	3·5d.	" "
Supply generation costs have increased by	0·430d.	" "
Difference	3·070d.	per unit.

During the period 1914-1919 coal has risen 11s. per ton, and the increase enforced is 3·5d., and now coal has fallen 10s. per ton you get the magnanimous reduction of 114·450 = 0·254d.

What one is to say to the hypothetical consumer referred to above, is a question that perhaps some supply engineer can answer. In the interests of the electrical industry, it is very desirable that the reasons for these very heavy "war" increases of 50 per cent., 75 per cent., 100 per cent., &c., on pre-war rates should be known, as to-day it is not quite a "walk over" when competing with gas for domestic use.

It should be clearly understood that when quoting case "C" above taken from the Electrical Review table, the figures have been utilised only to construct a hypothetical case which is somewhere in the region of practical every-day life.

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THE NEED FOR A CHEAP HOUSE-SERVICE METER.

By C. W. MARSHALL.

The present extraordinary demand for household supplies of electricity makes it opportune to bring to general notice a subject which has occupied the attention of supply authorities for many years; this is the problem of reducing the capital charges on the installations to values in keeping with the revenue derived from them. There is much to be said in favour of charging systems which do not involve the use of meters at all for small consumers, but the leading engineers appear to be almost unanimous in desiring to get accurate records regarding all clients. In order to fulfil this requirement an integrating meter of some sort must be installed, and this is probably the most expensive item of the equipment.

On alternating-current systems the metering problem is comparatively simple, as the induction watt-hour meter is so excellent in its performance over a wide load range, and so simple in construction, that it seems to be merely a matter of scientific production to bring the cost of an instrument to a very low level.

With direct current it is an entirely different matter; D.C. watt-hour meters are far from satisfactory from the standpoint of accuracy under all conditions or over a long period, and the potential circuit losses are by no means negligible in most types of meter. An ampere-hour meter therefore appears to be the only practicable solution. The different types may be classified roughly under electrolytic meters, commutator-motor meters, and mercury-motor meters. At the first glance the electrolytic meter appears to give an immediate solution to the problem, but experience does not seem to justify this view, as such meters are not used to any great extent, while the British Engineering Standards Association does not recognise the type at all (Report 17, 1919, p. 7.)

Commutator-motor meters, although used to an enormous extent on the Continent and in America, have not made much progress in Britain, and at least one important firm has ceased to manufacture all its models of this type. Climatic conditions in northern Britain make the difficulty of producing a satisfactory commutator type meter almost insuperable.

The field is accordingly left almost clear for the mercury-motor meter. This class of meter has been developed to a stage of accuracy and reliability almost comparable with the A.C. watt-hour meter. The cost of such meters is, however, very high, and the present designs are not such as to allow much hope for great reductions even with the best mass production methods. It is unfortunate, too, that one of the most promising mercury meters was withdrawn at the outbreak of the war before it had attained a firm hold on the market. The present writer is of the opinion that the most hopeful way of developing the mercury meter would lie in designing an instrument of the utmost simplicity, shorn of all compensating devices, and in view of the great progress made in magnet production, this should now be within the bounds of possibility.

It is hoped that this article may help to stimulate those interested in the electricity supply industry to endeavour to solve the cheap meter problem, which may be stated as follows: "It is required to design a reliable electricity meter of the ampere-hour or watt-hour type for a maximum current of 5 amperes, which shall satisfy the Board of Trade requirements for accuracy, and which can be produced at a cost not exceeding £2." Those within the meter industry will probably follow more or less on conventional lines, but it is possible that laymen may be more successful in attacking the problem with fresher minds. The writer has already had some very novel suggestions from the latter source which may be published at a later date, but up till now the only practical result of these projected meter schemes has been to deepen his respect for what has been done by the pioneers.

The present-day costs of electricity meters are approximately as below:—

A.C. watt-hour meter, 5 amperes, 110 v. £3 10s. each.
D.C. commutator ampere-hour meter, 5 amperes, £2 10s. each.
D.C. mercury-motor ampere-hour meter, 5 amperes, £4 10s. each.

OUR LEAD SUPPLIES.

We invite the earnest consideration of all consumers of lead to the present position as disclosed by the Board of Trade returns for 1919.

The pre-war importation into the United Kingdom amounted to over 200,000 tons per annum, of which about three-fourths came from Australia and Spain. The average quantity from America was about 30,000 tons, all of which was obtained from Mexican lead desilverised in the U.S.A., and exported thence under the drawback system.

For the three years ending June last, the Government has been responsible for the total supply, nearly all of which was used for war purposes, domestic consumption being practically shut down.

The Government bought the whole of the Australian production, as well as huge quantities in Spain and America, and of necessity had to provide for war consumption many months ahead. The result was that when the Armistice was signed and war consumption ceased, the stock here in Government hands of about 60,000 tons, rapidly increased until by May, 1919, no less than nearly 130,000 tons was in store. In addition to this, the producers in Australia held a much larger quantity for Government account.

There was, therefore, at that time every prospect of a continued surplus of lead for a long time ahead, far beyond any possible requirements.

How is it, therefore, that there is now a prospect of such a serious shortage that trade may possibly be seriously crippled?

As we have said, the Government stock at the end of 1918 was about 60,000 tons. The imports last year amounted to 217,610 tons, against which 36,373 tons were exported, leaving 181,237 tons balance of imports over exports for home consumption, plus the Government stock. The outlook is serious, because our chief suppliers, the Australian mines, have been completely shut down since early in May last year, owing to the strike there, and there is no indication of the mines being re-opened. Thus for nine months a productive capacity of enormous proportions, and from which we received no less than 93,276 tons last year, has been for the time being eliminated. It is said that if the strike were to end to-morrow it would take four months before smelting could be fully resumed. Of the stock held in Australia in May last, very large shipments have been made to Japan and China, and what with this and the shipments to the United Kingdom, the balance is not more than sufficient to complete existing contracts, or, at any rate, there cannot be much free lead to count upon. Another serious point in the Australian position is that the miners have gone from Broken Hill in increasing numbers, and have been absorbed in other callings.

From Spain last year we received only 39,502 tons, a quantity far short of our normal supplies, and the principal producing company in Spain has recently given out that its total production for this year has been absorbed in the Continent of Europe.

In these circumstances, special attention is due to the imports for last year. Of the total of 217,610 tons, 152,258 were received in the first six months, and only 65,352 tons in the last half of the year. Of this latter total we received in November and December combined only 15,175 tons, and the exports of British and foreign combined were 12,267 tons for the two months. The Government stock is now under 30,000 tons unsold.

Consumption for domestic purposes must largely increase, and every country in Europe is short of lead. Germany, Holland, and France have imported considerable quantities from us in the past few months, notwithstanding the

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adverse rate of exchange, and America supplied us with only 1,868 tons in the three months ending December 31st last year.

Lead Statistics for 1919.

Imports—	Oct. Tons.	Nov. Tons.	Dec. Tons.	Total for the ye Tons.
Australian ...	8,852	2,104	5,635	93,276
Spain	7,058	200	3,252	39,502
United States ...	594	280	994	53,008
Others	1,614	95	2,615	31,824
	18,118	2,679	12,496	217,610
Exports—				
Foreign lead ...	3,181	2,576	2,449	10,803
	14,937	103	10,047	206,807
British	4,222	3,298	3,944	25,570
Net imports ...	10,715	—	6,103	181,237
Decrease in stocks...	...	...	...	7,877
	U.K. absorption		...	189,114

LEGAL.

British Thomson-Houston Co., Ltd. *v.* Corona Lamp Works, Ltd.

(*Continued from p. 139.*)

On Wednesday, Jan. 28th, Mr. Kerly, K.C., for defendants, said a statement had been got out by the plaintiffs' accountant showing the sales of lamps by three companies in what he called "the ring," viz., General Electric Co., Siemens, and British Thomson-Houston. He had no doubt that the figures were perfectly correct, but he would like to know what was the number of ordinary tungsten vacuum lamps sold in the same period, viz., the last five years. The defendants' estimate was that it would be about 60 millions.

Mr. Colefax, K.C., for plaintiffs, said the figure for gas-filled lamps was actually 5,905,932 for the last five years, viz., 1914-1919. There had been a very rapid increase in the sales. In 1914 they were 41,000, in 1915 280,000, 1916 452,000, 1917 1,109,000, 1918 1,727,000, and 1919 2,296,037. During the war there was great difficulty in getting the goods, because the manufacture of electric lamps was controlled. He happened to know, because he was the controller. One difficulty was the glass bulbs, and another difficulty was argon, which was made in Holland. With regard to the sale of tungsten vacuum lamps by the three companies, for 1919 the figure was 9,589,208. The total sales of all lamps for that year were 11,885,245.

Mr. Kerly, proceeding with his opening speech, said that with regard to the prior documents, he was not looking for a statement in words that one had to take a thick wire in one's gas-filled lamp, nor for a statement that one had to take a coil of wire, but he would say that he would find in plain language in those documents that if one had a gas-filled lamp one could run the filament to give a greater brilliance, and that because the lamp was gas-filled that could be done without undue danger to the life of the filament, and that it was the presence of the gas in the lamp which told one that one could run to a higher temperature with a corresponding higher brilliancy than was possible in a vacuum lamp. It was in order to get the possibility of that higher temperature without danger to the life of the lamp that one employed the gas, and it was for that purpose that it was employed in the prior specifications.

Mr. Ballantyne, an analytical chemist, and an expert on electric lamps, gave evidence. Dealing with the prior specifications, he said the idea of a gas-filled lamp and of a metal filament for a gas-filled lamp was not unknown at the date of the plaintiffs' patent.

On January 29th, in re-examination, Mr. Ballantyne said he knew of an article which originally appeared in the *General Electric Review*, entitled "Nitrogen-filled lamps."

Mr. Percy Rayner Smith, assistant to Mr. Atkinson Adam, gave details of comparative tests of a Mazda ½-watt lamp and a Corona lamp.

Mr. Atkinson Adam, giving evidence, said the tests were designed to show what efficiency the plaintiffs' lamp was giving.

At the conclusion of the evidence counsel addressed the Court, and the hearing was adjourned.

On Tuesday, February 3rd, Mr. Colefax summed up the plaintiffs' case, and at the close of his speech his Lordship said he would give judgment in a day or two.

Electric Drive for Mills in Foochow.—According to a U.S. Commerce Report, the Foochow Electric Co. has recently adopted the scheme of renting electrically-driven rice-milling machinery to small mills, thus securing a rental for the machines and a profit from the electrical energy consumed by the mills in running the machines.

CORRESPONDENCE.

Letters received by us after 5 P.M. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Coal (Pit's Mouth) Prices Order and Direction, 1919.

A point has been raised with regard to the question of "coal delivered during the month of December, 1919," as referred to in the Coal Controller's "prescription," and in reply to my query to the Coal Mines Department, I have been informed as follows:—

"Coal for electricity undertakings which was dispatched from the colliery prior to December 1st is not subject to the reduction of 10s. per ton under any circumstances.

"The term 'delivered' in the prescription was used in explaining the method by which the amount of deduction was to be computed, but the Coal (Pit's Mouth) Prices Order and Direction, 1919, makes it quite clear that only coal dispatched from the colliery on or after December 1st is subject to the reduction."

I shall be glad if you will kindly give publicity to this explanation.

T. W. Cole,
Secretary.
Provincial Electric Supply Committee of the United Kingdom.

London, E.C.
February 3rd, 1920.

Coil v. Magneto Ignition.

We were particularly interested in the article in your issue of December 12th on the above subject, in which Mr. A. C. Booth recorded the satisfaction derived by him from an American car purchased in 1915, and fitted with a Delco electric lighting and electric starting equipment. Our notice was especially drawn to his statement that the three cells have stood up to the four years' work, and have not so far required any attention other than a little distilled water once a month. This testimonial is the more gratifying insomuch that the battery in question is of the "Exide" type, manufactured in this instance in Philadelphia, but identical in every respect with the "Exide" cell manufactured at our works, Clifton Junction. This type of battery has been adopted as a standard by several of the leading British motor manufacturers.

The Chloride Electrical Storage Co., Ltd.

Clifton Junction.
January 29th, 1920.

The "Lesco" Lampholder.

With reference to Mr. A. Peden Rutherford's letter in your issue of the 23rd inst., we do not wish to take up your valuable space, nor do we think that any useful purpose would be served by either of us ventilating our personal grievances.

We quite admit that at one time we were in negotiation with Mr. Rutherford, but we should like to contradict his statement that such negotiations were broken off by us, as this was not the case.

Lesco, Ltd.
T. M. Kirkby, *Director.*

Manchester.
January 30th, 1920.

The correspondence relating to lampholders has, I think, proved both useful and interesting. In spite of the very good test obtained by Mr. Hope on a new holder, I still think that the two minute indentations on his holder are insufficient for the purpose. Where holders are turned out in large quantities it is well known that variations take place. Furthermore, it is by no means an uncommon thing for a wireman to take the top off one holder and put it on to another. In these circumstances one may be quite sure that some holders will be put up with a slack fit, and the force required to pull them apart will be much less than that mentioned by Mr. Hope. At seaside places, particularly, corrosion of the brass is by no means unknown, and I believe that this phenomenon sometimes occurs in other than seaside places. A very small amount of corrosion would very nearly abolish the indentations, in which case one might look out for trouble.

Some day I trust Mr. Wordingham's proposed proving house will be established by the industry, when holders of new and old patterns will be tested by independent experts and certified or rejected as the case may be. The certificate of the proving house would be a great benefit to the inventor, as it would give him a good start off, while the absence of a certificate would prevent things from coming on to the market which might be unsatisfactory in their performance. Seeing that everybody will gain by the proving house, one cannot but wonder why there is so much delay in establishing it.

C. Turnbull.

Electricity Works, North Shields,
February 2nd, 1920.

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NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

The Orling Jet Relay.

In a booklet issued by the Orling"s Telegraph Instruments Syndicate, Ltd., of 47, Victoria Street, S.W.1, an account of the Orling jet relay is given. The apparatus depends upon the principle that a fine jet of water may be deflected by the point of a needle, and that the angular movement of the jet is much greater than that of the needle.

An ordinary cable recorder coil of the usual 500 ohms resistance is stiffly suspended in a magnetic field of moderate strength. Attached to the top of this coil is an aluminium arm 30 mm. long, a waxed edge of which is brought into contact with a jet of slightly acidulated or salted water issuing from a tube. This jet is quite steady, and its angular movements are entirely controlled by the receiving coil.

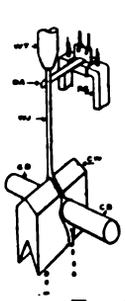

Fig. 1.

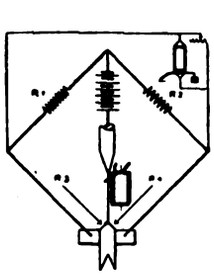

Fig. 2.

20 mm. below the arm a wedge-shaped piece of celluloid is clamped between two carbon electrodes, and is so placed that the jet falls upon the apex and is divided into two parts.

When in operation, the jet never leaves the apex of the wedge, across which it is always astride, signal impulses to one side or the other merely varying the position of the jet on the dividing edge of the wedge and causing more or less water to flow down one or other of the inclined sides of the wedge.

Fig. 2 shows the arrangement of the local circuit when the instrument is used as a magnifier, particularly for signals through long submarine cables.

It will be observed that R_3 and R_4, down which the divided parts of the jet flow, constitute one pair of arms of a Wheatstone bridge, the other pair being formed of the fixed resistances R_1 and R_2, whilst a siphon-recorder, or other instrument suitable for a local circuit, and the local battery are connected to complete the bridge arrangement.

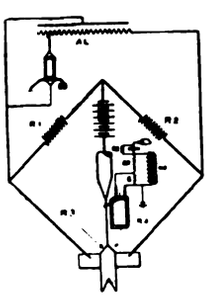

Fig. 3.

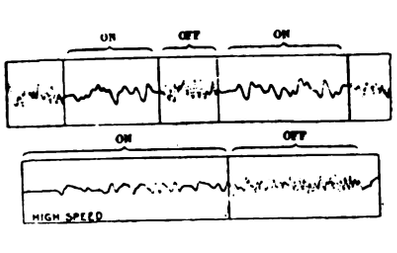

Fig. 4.

The recording instrument is actuated with precision and force by means of the local current, which flows when the balance is upset by the minute to and fro motion of the jet astride the wedge.

The balance of the local circuit is doubly differential in that the cross-sectional area on one side increases by as much as that on the other decreases. Thus the resistance is much less on the one side and much greater on the other.

By arranging the circuits as shown in fig. 3 a very useful discriminating effect is produced, whereby telegraphic signals are picked out and all disturbing currents of a rapidly varying nature are rejected.

Records of an experiment in which artificial electrical disturbances were applied to the circuit are shown in fig. 4. The sections marked "off" mark intervals of time when the instrument was out of the circuit and only the disturbances were then recorded. A photograph of the apparatus is reproduced in fig. 5, in which also may be seen the rotary pump driven by a small electric motor for furnishing a continuous supply of water to the jet.

It is claimed by the makers of this instrument that it has printed Morse signals on a Wheatstone inker with a current of 0.02 microampere at the rate of 450 letters per minute, the current strength in the receiving coil being as low as 4×10^{-13} ampere. They also state that, at experimental trials made at an Atlantic cable station shortly before the outbreak of war, as a simplex instrument with duplex connections the jet relay raised the previous safe-signalling maxima by 125 per cent. with perfectly defined signals.

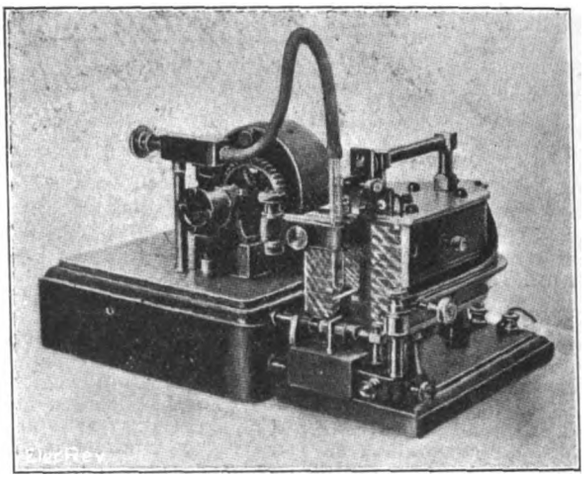

Fig. 5.—Orling Jet Relay.

On another cable of higher K.R. a speed constant of 1,500 was attained. The publication also gives an outline of several modifications of the same apparatus.

The "Albert" Current Limiter.

Messrs. Ward & Goldstone, Ltd., of Sampson Works, Salford, Manchester, are putting on the market a simple little device for preventing the consumption of current in excess of that intended for the circuit on which it is installed, as for instance in hotel suites, flats supplied through a common meter, and small dwellings not provided with separate meters. The controller, which is illustrated in fig. 6, consists of a trigger and a small electromagnet in series with the circuit; when the current exceeds the prescribed value, due to the switching-on of an extra lamp or other consuming device, the trigger releases a hammer which knocks off a switch and opens the circuit. To restore the supply, an external switch handle is turned to set the trigger, and at the same time opens the circuit at another point, so that it is impossible to obtain an excess supply by holding or tying the handle; on releasing the handle the circuit is completed, and if the offending lamp has been cut off, remains complete. Obviously the device functions also as a safety cut-out, taking the place of a fuse. It is enclosed in a cover which can be sealed. Provision is made for regulation over a wide range at the time of fixing the instrument, and five ranges are standardised, with maximum currents from 0.2 to 5 amperes. A single 30-watt lamp beyond the prescribed number on a circuit of any usual voltage actuates the device, which we have seen in operation.

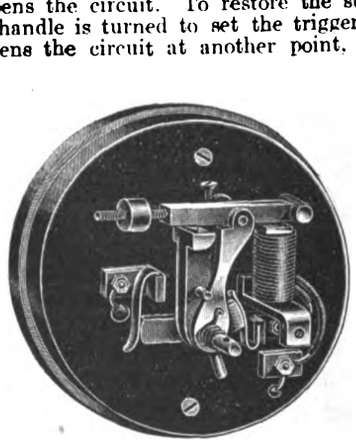

Fig. 6.—The "Albert" Excess Current Controlling Device.

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BUSINESS NOTES.

Electrical Trade of German-Austria.—The German Foreign Office has been drawing attention to conditions in the electrical trade of German-Austria. Austrian manufacturers have been following the example set in other countries during the war, and endeavouring to increase their production by means of standardisation and specialisation in certain works. No great progress has been made, but undoubtedly a great deal of capital has been invested during the past four or five years in electrical manufacturing in Austria. Moreover, many additional schemes of this nature are in contemplation. It is considered, however, that apart from the technical qualifications of those interested, which are undoubted, the success of such enterprises depends upon their relationship to the German electrical industry. The Germans are apparently dubious of the attitude of their former allies. Consequently, the German electro-technical industry is advised to be prepared for something in the way of a present sacrifice with a view to recouping itself in the future. It is recommended to give special attention to the German-Austrian market, and particularly to the opportunities existent there for the development of water power. It is pointed out that the completion of such an undertaking will inevitably place the electrical industry of Austria in a strong position, and permanently increase the demand for machinery and apparatus.

A Westinghouse Re-union Dinner.—Mr. W. W. Hughes presided over a gathering of 160 ex-British Westinghouse engineers at their annual reunion at the Holborn Restaurant, London, on Jan. 23rd. This is the second occasion upon which ex-B.W. men have foregathered since the formation of an association which has for its object the promotion and continuation of friendly relations between men who originally met under the British Westinghouse banner at Trafford Park. The proceedings commenced with a reunion in the reception room. At the dinner which immediately followed, the chairman read a letter from Mr. Newcomb-Carlton, now president of the Western Union Cable & Telegraph Co., expressing his deep regret at being unable to preside. The guests should also have included Baron Ashfield (Sir Albert Stanley), Mr. Bonar Law, and Mr. J. Annan Bryce, but business engagements prevented them attending; the chairman also said that the committee had received over one hundred letters from ex-B.W. men all over the country apologising for absence. After the loyal toasts had been honoured, Mr. P. A. Sanders, O.B.E., gave that of the ex-B.W. Association. He asked all ex-B.W. men to join because it was not a business association, but a medium through which old and new friends could be met. Mr. L. R. Morshead responded on behalf of the committee. The chairman then gave the toast of the guests, to which the only guest present, Lieut.-Col. Montague Craddock, C.B., C.M.G., an old and popular British Westinghouse director, replied, and in doing so made a pleasing reference to his friendship with the late Mr. George Westinghouse. During the speeches fitting testimony was given to Mr. L. S. Richardson, the hon. secretary, for his work in promoting the Association and organising the gathering again this year. The members were especially pleased with Mr. Richardson's treatment of the programme and toast list—a humorous production containing many telling skits on various members of the Association. The concert programme was contributed entirely by members of the Association. Mr. A. Simon accompanied, Mr. Pochobradsky played the violin, Mr. H. S. Aspinal and Mr. F. Ollerenshaw contributed songs, and the humorous items were furnished by Mr. Val Wood and Mr. E. H. Miller. Mr. Richardson again introduced the bombass, which was uproariously received. Membership of the Association is open to men who were employed on the staff of the British Westinghouse Co. for two years, and who completed two years' service prior to September 30th, 1919; the annual subscription is 2s. 6d., and the hon. secretary, Mr. L. S. Richardson, 14, Sydney Road, Richmond, Surrey, will be pleased to furnish full particulars to all ex-B.W. men who would like to join.

"Welcome Home" Party at Leigh.—On January 22nd the directors and management of Callenders Cable & Construction Co., Ltd., Leigh, gave a fitting welcome home to all the men now in their employ who served in H.M. Forces during the war. The invitations also included their wives and children (up to 14 years of age), members of the various committees representing the employés, and those who have administered to the welfare of the men and their dependents while the breadwinners were away. The company present numbered more than 300.

The decoration of the canteen, which was the work of Miss Casstles (the lady welfare supervisor) and the electrical staff, was greatly admired, the Christmas tree adding greatly to the charming effect. The event commenced at 6 p.m. with a "high tea." Prior to the entertainment which followed, Mr. Bowyer, J.P. (works manager), said that it was the fourth occasion on which the firm had entertained the service men and their dependents, and this time they had the great pleasure of welcoming "the boys" home. He gave them a very hearty welcome. Sir Tom Callender had come specially from London to welcome the boys home on behalf of the firm. Sir Tom Callender expressed the great pleasure it gave him to be present. In assuring the boys of a hearty welcome, he said that out of 856 Callenders' employés who had served in the war, no fewer than 260 joined the various branches of H.M. Forces from the Leigh Anchor Works, and they had served in almost every part of the world in which the war raged. Some had received distinguished honours, and others, alas, no fewer than 27 Anchor men, had paid the supreme sacrifice. His brother, Mr. James Callender, who had also passed away, always took the greatest interest in all that pertained to the welfare and happiness of the employés at Anchor Works. He (Sir Tom) was pleased to say that every pre-war employé of the Anchor Works who had been spared had been reinstated, and the remainder of the pre-war employés who had yet to return would be similarly provided for. The firm were grateful to those who had enabled them to carry on during the war, and to do so much to keep up the production of war-time essentials. He had brought with him a small contingent from London to join him in the welcome he extended to all concerned. Gunner W. Hampson, who had both feet blown off by a shell, had a great reception on rising to propose a vote of thanks to Sir Tom Callender, to Mr. Bowyer, and to the management. Second-Lieut. John Hodgson seconded the vote of thanks, not only for the welcome home, but for the many kindnesses extended to service men all through the war. Sir Tom Callender had said how glad the firm were to have the men back, and he would add that the men were quite as glad to be back again with the firm. Sir Tom Callender having briefly replied, Mr. C. Pipkin, with whom were associated Mr. Howard Foulds and Mr. Hunter, all of Callenders' London Office, led three cheers for the "Boys who had returned," on behalf of the London contingent. In the entertainment which followed, Mr. Arthur Guilford (Manchester) distinguished himself as a versatile comedian. Mr. Alfred Horrocks followed with a clever manipulation of his "fantastical fan," and greatly amused young and old with his "Punch and Judy" show. For the children the event of the evening was the arrival of "Father Christmas" (looking the part to perfection) in his motor car loaded with sacks of presents which he proceeded to distribute with unstinted liberality. A plentiful supply of toy instruments was reserved for the adults, the playing of which culminated in the formation of a huge Jazz band. From 9 to 11 p.m., to the strains of Ramsdales Band, dancing reigned supreme, Messrs. J. Graham, J. Hoyle, and J. C. Pass being the efficient M.C.'s.

During the interval fruit and sweets were served to the children, and each lady received the firm's gift of a ¼ lb. of tea, and the gentlemen tobacco and cigarettes. The singing of "Auld Lang Syne" appropriately terminated the proceedings.

Lead Reports.—Messrs. James Forster & Co., reported on January 31st:—

Early lead was adversely affected by shipments made by the Government from Liverpool to London, the market being unprepared for same. The strength of the position of the metal, however, has been clearly shown by the following days' markets, each day showing an advance until on Thursday £47 7s. 6d. was paid for January and February, £47 10s. for March, and up to £48 for May. There is no favourable news as to the position in Australia, and little chance of getting any material supplies from Spain. For some weeks now consumers have been buying very little in the hope of getting easier conditions, but, notwithstanding a free liquidation of "bull" accounts, we have had no set-back.

Messrs. G. Cawson & Co. on January 31st reported:—

There has again been a moderate inquiry from consumers, and also some little trade for export. The bulk of the business done, however, has again been almost entirely speculative. The position as to supplies remains unchanged; there is at present plenty of lead available for all requirements. Arrivals during the month have not been quite so heavy, but as Australian lead is still coming forward regularly and very considerable sales of Mexican bonded lead have been made, to come forward during the next two or three months, there seems to be no question as to any shortage in supplies. With the present high prices now ruling and also the record price of silver, Mexico and other countries will certainly increase their output. . . . Definite information as to the Spanish production and prospects of future output is difficult to obtain. The outlook for the time being seems to be fairly favourable, provided speculators continue to support the market—there is no valid reason why they should not do so, as it is not in their interest to allow prices to break away and go to a lower level.

French Orders for German Electricity Meters.—At its meeting in the middle of December, the Municipal Council of Metz considered the tenders sent in for the supply of 2,000 electricity meters. The French, English, and American tenderers asked for a delay in delivery of nine months to one year, and quoted round sums of 270,000 frs. The A.E.G. of Berlin offered to supply the 2,000 meters in six weeks, and quoted the low price of 165,772 frs. Considering the financial side of the question alone, the Municipality accepted the tender of the German firm. Very naturally the decision has passed under the scathing criticism of our contemporary *l'Electricité*; 1,500,000 killed, 200 milliards of damage and ruins have not, it says, weighed in the decision of these municipal councillors. A saving of 100,000 frs., a little delay in delivery—which it would be ill-beseeming to urge as a fault to the French industry, disorganised by five years of war—have been enough for these Lorraine councillors to prove their ingratitude to the nation's electrical manufacturers, who, throughout the war, have placed their works, their materials, their means, under contribution to save them from the clutches of the Teutons.

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Canning's Post-war Re-union.—On Saturday, January 24th the first post-war reunion of principals and employés of Messrs. W. Canning & Co. was held at the White Horse Hotel, Birmingham, Mr. E. R. Canning presiding.

During the smoking concert which followed the dinner, Mr. T. R. Canning, who has resigned from his position as head of the firm, received a presentation from the staff and employés. Mr. R. T. Gosling read the illuminated address, and asked Mr. Canning to accept it, together with a gold cigarette case and wristlet watch.

In responding, Mr. T. R. Canning first extended a hearty welcome to the men who had returned from military service, and voiced sympathy with the relatives and friends of those who had fallen. In thanking all for their kind expressions and present, he said it was nearly 40 years since he went to Birmingham as a youth of 14; a few years after he had completed his apprenticeship he was taken into partnership in what was then a small business. By hard work during long hours, and taking advantage of possibilities, the three partners were able to develop the business. In the middle 'eighties metal finishing and plating by mechanical means was introduced from the States, and very little was known of the various products used or how they were used. The firm, therefore, had to secure the confidence of manufacturers by putting in plant on trial and taking it back if it did not prove satisfactory. They were the oldest firm making and supplying electro-plating chemicals. Whatever claims might be brought forward, he asserted that Mr. W. Canning was making chemicals for silver-plating immediately after its introduction. Some of those present could recall Mr. John Thornton, to whom he owed his success in the business. He regretted the trend of thought which suggested that an employer's only object was to get all he could out of his employés. That had never been his principle. If a man showed himself capable of filling a better position he always gave him the opportunity when it arose. Many of those he saw around him came as lads. Their present chief, Mr. E. R. Canning, received his business tuition under him, and no one could say that he had not turned out to be a good business man. There was only one real way to success, and that was by hard work either with brain or hand. He did not mean to say that a man should always be at work, but he should work hard when at work and play hard when at play. If he could read the signs of the times the nation would have to work as hard as it had ever done, as he felt sure that in a few years competition would be as keen as it was before the war. His last wish was that employés, staff, and principals should work together, each doing what he could to further the interests of the business. The toast of "The Firm'" was proposed by Mr. P. Brotherton.

Mr. T. W. Senier, in seconding, said that so far as the London depôt was concerned, new premises had been obtained which would permit of that section of the business being remodelled. In his reply, Mr. E. R. Canning said that the firm would not have been in its present position had it not been for the part the women had played during the war. They had not found it necessary to discharge a single woman. Mr. Canning remarked that when his brother started the business the staff numbered only half a dozen; when he entered the business it had grown to ninety; and to-day it stood at upwards of six hundred. No fewer than 110 men left them to serve the country, but he was thankful to say that most of them had come through unscathed. Referring to the future, Mr. Canning said they were told the war would bring better conditions, but it seemed to him that during the last few months everything had gone astray. He was afraid we were in for troublesome times ahead, but he was still optimistic, as he believed that Englishmen who put their backs to the wall to win the war would again win through. Before peace and quietness was obtained the cost of living must be reduced. That was the crux of the position, and to reduce the cost of living more goods must be produced. They knew that the output per man could be increased, and while they did not get so much labour trouble as other firms, a solution had to be found to the question of production. If piecework prices were reasonable a man ought to earn as much as he possibly could, and it was up to the employers to see that those prices were not reduced. He appealed to them not to nurse grievances, as they would only grow, but to bring them forward for settlement.

The chairman then presented watches to nine members of the staff who had seen upwards of twenty years' service with the firm. Messrs. G. A. Pope, A. Butcher, and J. Wakefield, three of the recipients of long service awards, suitably acknowledged the firm's gifts, after which the chairman presented to each of the ex-service men present useful gifts as small mementos of the part they played in the war, on behalf of those who stayed at home. Capt. W. R. Pratt returned thanks on behalf of the ex-service employés.

From Recent Speeches.—Sir Auckland Geddes, President of the Board of Trade, has been speaking upon the importance of our reopening trading relations with Germany. In a speech delivered at the Plymouth Chamber of Commerce on Saturday last, he is reported to have warned the traders of the country against the weakness of giving way to international hatreds and spites. He would have thought any man would be satisfied with what we had done to our enemies. "Not as a matter of sentiment, not even as a matter of humanity—leave that out, if you will—but as a matter of plain self-interest, come forward, pick your late enemies up, and try to get them on their feet again. If we do not we shall leave Europe shattered, and the paralysis which has crept over them will creep over our national life, too." They were sometimes told the present Government had no policy, but on the trade side it had a very clear and distinct policy, from which it had never deviated one hair's breadth. That policy was to get the export trade of this country going now.

Here is another straw showing which way the wind is blowing:—

Mr. J. H. Thomas, speaking at the American Luncheon Club: "The first essential to a normal position the world over was to try, if possible, to forget that the war had taken place. Unless credit was re-established and we gave our late enemies an opportunity to work, there was no chance of them making reparation for the wrongs they had done. . . . Instead of having the recriminations of the past, employers and labour must be partners in industry. Each section must re-establish confidence in the other. The fatal difficulty of to-day was that labour mistrusted capital because of the differences of the past, and capital equally mistrusted labour. . . . There would be no solution of the labour problem until both sides trusted each other. . . . He wanted Americans to recognise their obligations to the world."

In one of his Paisley speeches, Mr. Asquith referred to the question of nationalisation. He said that the Labour Party in the long run were committed by their principles as a party to the ultimate ownership, control, management, and working by the State of the whole machinery of production throughout the range of industry. He referred to the great danger that this presented to the innumerable advantages which were derived from the free play of competition, of individual energy, of rival encouragement, from the influx of new processes and new inventions, and new methods of production. He was strongly of opinion that there was need for great and far-reaching reforms in our industrial system. "I think that the voice of Labour, the power of Labour to exercise a control or share in the control of what is, after all, a great partnership, or to the conjoint result of which it contributes in many cases the larger share, the claim of Labour upon that point is a claim which is quite irresistible." There is a third party in these great industrial combinations, whose voice also ought to be heard, and whose hand ought to be felt. That is the State, as representing the consumer. "One of the most formidable dangers, not only to individual liberty, but to the wise and equitable distribution of wealth nowadays, is the danger that springs from the growth of big combinations. They must be kept rigidly under control in the interest of the community at large, and unless kept under control, they will be masters of the community instead of being its servants."

In an address on "Industrial Unrest," delivered at the City Business Club, Glasgow, Mr. William Adamson, chairman of the Parliamentary Labour Party, said there had been too much tendency to put down the whole thing as being the aftermath of the war. He admitted, however, that the evil had been intensified during the five years of war to such an extent that unless a speedy and satisfactory solution were effected the stability of the State might be undermined. . . . During the war the worker was again and again promised, if he did his share in defending the country, that at its conclusion he would be living in a new world. The worker was looking for that promise being redeemed, but was still waiting on the delivery of the goods. As yet he saw very little sign of the promised New Jerusalem. The worker had got tired, and he had made up his mind he would be no longer content to go along quietly acquiescent in a system of industry conducted for the profit of the few. Employers in continuing to act as they were doing were acting foolishly, as they did not seem to realise that the industrial situation was a serious one, and a dangerous one. His own personal opinion was that the best means for effecting a better relationship between the various sections of the people was by evolution along constitutional lines.—*Daily Telegraph.*

Speaking on "A practical ideal for industry," at a meeting in Manchester of the North-western district of the Society of Technical Engineers, Mr. B. Seebohm Rowntree said that science would play an increasingly important part in industry in the future. The terrible wastage of wealth of the past five or six years had to be made up in the least possible time, for wealth was essential to progress; and therefore it was of supreme importance that industry should rapidly increase its efficiency. We could not carry on industry by the old rule-of-thumb methods; we should have to put into it the best brains and the best science that could be applied. The position of the chemist and the engineer was going to be much more important in the future than in the past. We should regard all industry as a form of national service. . . It was all nonsense to talk about over-production. It was impossible to produce too much wealth—what mattered was the manner of its distribution. Eighty shillings a week—representing 35s. 3d. a week in 1914—was the lowest sum on which a man could be expected to carry on a home and bring up an average family to-day, and yet industry in its present state could not stand such a minimum. It was, however, a mini-

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mum that should be aimed at, and that it might be secured more efficient production was necessary. In enabling the administrators of industry to produce more economically and efficiently engineers would be doing a great national service. —*Manchester Guardian.*

Sir Auckland Geddes, in a speech delivered on January 29th, said:—One of the greatest problems of the Government of the moment was how, under ordinary economic forces, gold in America could be got to flow across the Atlantic in an easterly direction. Until we do that, we cannot stop with any certainty the rise in the cost of living. There is only one way in which we can get a flow of gold to start from America: we should send across the Atlantic in a westward direction more goods—that is to say, goods of greater value than America is sending to us in the shape of raw materials and food, and if we can once get a bigger stream flowing westward than the values of the goods flowing eastwards, we should at once get a flow of gold eastwards to make up the difference. There was one solution for the present position—and that was that somehow, by hook or by crook, this country must get its volume of production enormously increased. There would then be bigger quantities week by week for export, and as the export of goods began to flow in increasing value, we might look for gold to begin to flow back, and quite a small trickle of gold coming back from the United States would begin to affect the cost of living.—*Financial Times.*

Sun Staff Dinner.—A very successful "Peace" dinner was held by the Sun Electrical Co., Ltd., at the Café Royal, Regent Street, on January 31st. Mr. A. G. Beaver, the general manager, presided, and the directors of the company and a great number of the members of the staff were present. Among the toasts were "Ours, who did their bit in the Great War," proposed by Mr. Beaver, and responded to by ex-Sergt. Wood, who expressed his appreciation of the way the company had dealt with the ex-Service men; "The Directors" (response by the chairman, Mr. Tweedy Smith); "The Indoor Staff," to which Miss Dewdney very ably replied on behalf of the ladies; "The Outdoor Staff and Agents," and "The Press." In proposing the health of the general manager, Mr. H. C. Weeks presented him with a piece of plate, a cigarette case, and a volume containing the signatures of the subscribers, as an appreciation of his valued leadership. Mr. Beaver spoke in glowing terms of the goodwill existing among all members of the staff, and attributed the company's success, in a great measure, to this spirit. He remarked on the fact that the company's "coming of age" occurred in August next, it having been formed in 1899. A well-arranged concert followed the dinner. Items of great artistic merit were rendered by Miss MayKearsey, Miss Norah Drake, and Messrs. Bret Hayden, Herbert Richards, Wilson Martell, and Max Templeton.

Accumulators in Australia.—The recent decision of the Commonwealth Government to encourage the development of the accumulator manufacturing industry in Australia by prohibiting the importation of secondary batteries except by licence has, judging from the news brought by the last mail, been the cause of considerable discussion. A writer in the last number to hand of the *Australian Motorist* remarks that "those who advocated an embargo on accumulators and batteries were apparently unaware that motor vehicles need them, and the whole of their arguments appeared to be based upon the opinion that electric storage batteries were only required for a few shire and municipal lighting plants, as well as for city electric lighting undertakings. There are upwards of 30,000 motor-cars running in Australia to-day, which are dependant upon specially designed batteries, which have not yet been produced in Australia beyond an experimental stage. The attempts to make automobile batteries in Australia have hitherto proved futile, for the reason that the Australian rubber companies have not been able to produce vulcanite cells, and the business is not sufficiently large for any battery concern to instal plant for making suitable rubber containers. Attempts to construct an Australian-made automobile battery have been abandoned by expert men for the reason that lead and celluloid cells have in past years been abandoned as 'useless' for automobile work, and these are the only cells so far produced in Australia. Those administering the Government Proclamation have eased the regulations considerably, after consultation with the Federal Council of Australian Motor Traders, by allowing motor chassis and cars to come in equipped with accumulators. Batteries not attached to complete cars or chassis can, however, still only be imported under licence."

Trade Announcements.—The Robinson & Hands Electrical Co., Ltd., have extended their premises in Barwick Street, Birmingham, by taking the adjacent building (No. 56), and thus doubling their warehouse and office capacity. Since the Armistice they have bought and equipped a large freehold works at Nechells, Birmingham, where they are manufacturing electric lampholders, fuseboards and accumulator switchboards on a large scale. At Ashton they have a well-equipped shop for the repair of electrical machinery.

The Enterprise Manufacturing Co., Ltd., have this week opened a branch in Bath Lane, Swansea. Telephone No.: Central 863.

Messrs. L. C. Spred and T. Healy, who for some years have been on the engineering staff of the Southport Corporation electricity department, have started in business as electrical and mechanical engineers at Princes Place, Hoghton Street, Southport. A private limited company—The West Lancashire Electrical Co., Ltd.—has been formed. They desire to receive manufacturers' catalogues, display cards, &c.

French Electrical Companies.—Under the style of L'Electro-Menuiserie, there has been formed at Paris a company for the manufacture and sale, in France and abroad, of wood furniture for electric installations. Its capital is 150,000 fr.

Launched by the Compagnie Française de Constructions Industrielles, and the Société d'Applications du Béton Armé, the Société d'Enterprises de Réseaux Electriques has for objects the erection of transmission lines, and the construction of iron, cement, and wooden standards, more particularly in the regions invaded.

In order to carry out various agreements come to with other companies serving the suburbs of Paris, the Union d'Electricité has decided to raise its capital to 125,000,000 fr. It will absorb the Energie Electrique de la Région Parisienne, paying for the transactions in 20,000 newly-created 500 fr. shares. It will join forces with the principal companies serving the suburbs—the Triphasé, the Ouest-Lumière, the Est-Lumière, and the Rive Gauche company. The new partnership and amalgamation share-capital created for these purposes will amount to 39,800,000 fr., while a sum in specie of 6,901,241 fr. will also be handed over.

The Société Algor is a company just formed at Levallois (Seine), with a capital of 600,000 fr. for the manufacture, purchase, and sale of electric lamps.

The Compagnie des Lampes et Appareils Electriques de Provence has just raised its capital from 600,000 fr. to 1,000,000 fr.

The Société Hydro-Electrique de Lyon has decided to raise its capital from 4,000,000 to 8,000,000 fr.

The Compagnie du Sud-Lumière, one of the companies serving the suburbs of Paris, has raised its capital to 10,000,000 fr., and has issued 20,000 500 fr. bonds.

The Marking of Goods.—The Merchandise Marks Committee are completing their arrangements for taking evidence before proceeding to consider their report. Associations and others who may wish to make representations on any of the matters which the Committee are investigating should communicate with the Secretary of the Committee at the Patent Office, 25, Southampton Buildings, W.C. 2, not later than February 14th.

The Committee, who were appointed by the Board of Trade, and sit under the chairmanship of Mr. Henry Greer, M.P., are dealing in particular with the following questions:—

1. Whether all imported goods, or particular classes of imported goods, should be required to bear on importation, or on sale in this country, a statement as to their origin; whether the statement should specify the actual country of origin, or should merely indicate that the goods are not of British, or not of United Kingdom origin; and whether any such requirement should extend to goods trans-shipped in this country, or re-exported from this country, to British possessions and foreign countries.

2. The advisability of encouraging the institution of an Empire mark to denote British origin; the utility and effect of national trade-marks and other similar collective marks; and whether any such mark, or marks, if used at all, should be administered by the Government, or by municipalties, or by associations of traders.

3. Whether any and what international action is necessary or desirable to prevent the false marking of goods with indications of British origin, and to protect regional appellations of origin.

A Phœnix Works Reunion.—The employés at the Phœnix Works, Bradford (English Electric Co., Ltd.), brought to a conclusion their activities on behalf of those who left the works to serve with the Forces, by holding a reunion in the King's Hall on January 27th. The Phœnix Relief Fund ceased to be contributed to on January 31st, 1919, when there was a balance in hand of £1,773. The sum of £20 only had been spent in the working of the scheme, and 12 persons were still getting relief. Of these seven were still serving with the Forces. A musical programme was given, after which the rest of the evening was taken up by dancing.

Dissolutions of Partnership.—Park Electrical Engineering Co., electrical and mechanical engineers, Westinghouse Road, Trafford Park, Manchester.—Messrs. W. J. R. Fox, G. L. Brown, and H. C. Jones have dissolved partnership. Messrs. G. L. Brown and H. C. Jones will attend to debts.

Riches & Reeves, milliners, art dealers and electrical contractors, 36, Harrington Road, South Kensington, S.W.—Messrs. V. Riches and H. A. Reeves have dissolved partnership. Mr. V. Riches will attend to debts.

Bankruptcy Proceedings.—C. Hellyar (A. Parker and Co.), electrical engineer and contractor, East Sheen.—First and final dividend of 3s. in the £, payable February 16th, at 132, York Road, S.E. 1.

Calendars.—From Messrs. J. Hopkinson & Co., Ltd., of Huddersfield, we have received a handsome wall calendar. Large daily slips, with red figuring, are mounted on a stout card showing Hopkinson valves in process of manufacture.

Messrs. Robt. W. Blackwell & Co., Ltd., of 36, Emperor's Gate, South Kensington, S.W. 7, have prepared a wall calendar comprising six two-monthly sheets, each of which has a humorous illustration, in colour, by Lawson Wood, giving advice gratis. Some desk blotting slips have also been received.

South African Electrical Imports.—The imports of electrical materials and machinery into South Africa during the nine months ending with September last attained a value of £741,755, as compared with only £372,305 in the corresponding period of 1918.

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German Trade with India.—The *Daily Telegraph* publishes a message from Bombay, dated January 28th, stating that the German invasion of the Indian market has begun. "The first shipload of German goods arrived to-day, consisting principally of glassware. Many Indian firms have received direct invitations to open up trade with Germany, and India is also exporting goods to Germany. During the last few weeks she has sent her large quantities of cotton."

A.S.E. and Amalgamation.—After expending over £7,000 on the delegate meeting, held in Manchester, to alter their rules, the Amalgamated Society of Engineers now find that all this was unnecessary, because of the new scheme to amalgamate the Unions connected with the engineering and cognate trades. The new Society, to be known as the Amalgamated Engineering Union, will come into existence on July 1st.—*Daily Dispatch.*

Electrical Trade with Scandinavia.—Mr. Montagu Villiers, Commissioner in Scandinavia for the Overseas Service of the Federation of British Industries, was in Birmingham last week, and interviewed many Midland manufacturers upon the possibility of trade with that country and Denmark. He emphasised that great use is made of water power electrically, and that at the present time unique opportunities are afforded for the development of trade in electrical engineering and accessories.

The Beama Rebate Proposals.—At Ilford Electricity Committee the electrical engineer submitted two letters from Mr. D. N. Dunlop (Beama) upon the subject of (*a*) rebate arrangements for inclusive purchase of electrical plant; and (*b*) rebate arrangements for non-inclusive purchase of electrical plant, the object of the arrangement being limited to the purchase for use of machines in Great Britain and Ireland, the Isle of Man, and the Channel Islands only. The electrical engineer further reported as to the objects sought to be achieved by the proposals set out in the letters referred to, such proposals being authorised by a schedule of firms appended to the communication, and including a number of manufacturers and sellers of electrical plant in this country. Before coming to any decision on the suggestions set out in the above letters, the Committee instructed the clerk to report upon the legal position.

Callender's Hospital Fund.—The seventeenth annual report of Callender's Hospital and Distress Fund was submitted and approved at the general meeting, held on January 31st, at the Belvedere Works, Sir Tom Callender presiding. The penny weekly subscriptions realised £346 at Belvedere, and during the early months of the year £16 at Picardy Works—total, £362, against £394 in 1918. Callender's Co. gave a donation of £50, and directors and others donated a further 23 guineas. To hospitals and other institutions there was distributed £376. The report showed the number of hospital and convalescent home letters, surgical appliances, spectacles, &c., issued, and the number of cases in which financial assistance had been rendered.

Private Meeting.—J. W. H. CALCOTT, electrical engineer, trading as the Western Engineering Co., 8, Lansdowne Road, and 87A, London Road, Sheffield.—The creditors interested herein were called together last week, at the offices of Messrs. Poppleton, Appleby & Turner, chartered accountants, of 155, Norfolk Street, Sheffield. According to the statement of affairs submitted, the ranking liabilities amounted to £1,587, of which £963 was due to the trade, while there were cash creditors for £150 and a bank overdraft for £473. The assets were estimated to realise £2,183, from which had to be deducted £67 for preferential claims, leaving net assets of £2,116. The estate thus disclosed a surplus of assets over liabilities of £530. Mr. C. Turner explained the statement in detail, and said that the cash claims all appeared in the books, and were in order. If the creditors agreed to the matter being dealt with under a deed of assignment, Mrs. Calcott would satisfy the claim of the bank. Under the circumstances, it appeared that all the creditors would be paid in full. Negotiations had already been entered into for the sale of the assets. After a short discussion, the creditors decided that the estate should be dealt with under a deed of assignment, with Mr. Turner as Trustee, and a Committee of Inspection was also appointed, consisting of the representatives of the General Electric Co., Sheffield; Metropolitan-Vickers Electrical Co., Manchester; Messrs. Drake & Gorham, London; and Mr. Albert Carr, Sheffield.

The Plata Telegraph and Telephone Co.—It is reported that the German South American Telegraph Co. has received an offer to take over the company's share-holding in the Companis Telegrafico-Telefonia de la Plata, of Buenos Ayres. It appears that the German banking group associated with the former company acquired about 84 per cent. of the capital of the Argentine company in 1911, and thereby obtained control of the company, which has a share capital of 500,000 pesos, and maintains services between Monte Video and Buenos Ayres. Between 1907 and 1911 the latter's dividends averaged 13 per cent., and in 1912 a rate of 5 per cent. was paid, but nothing has been distributed from 1913 to 1917 inclusive. As a consequence, the German company has formed a reserve fund against this investment, which amounted to 980,000 marks at the end of 1917.

The Belgian International Co.—It is stated that the COMPAGNIE INTERNATIONALE D'ELECTRICITE has concluded arrangements with a French and English group, which assure to the former a monopoly of the systems of the English Electric Co. (Dick-Kerr) for Belgium, Holland and Luxemburg, particularly for traction plant and the conversion of railways to electric locomotion.

The Board of Trade.—The re-organisation of the Board of Trade has been proceeding since June last. It is now announced that the duties of the Department are organised under two joint permanent secretaries: Sir Sydney Chapman, K.C.B., who deals with all questions affecting general policy; and Mr. H. A. Payne, C.B. (Controller), who deals with Administration and Finance. There are among the principal permanent Departments:—

Commercial Relations and Treaties.—Mr. H. Fountain, C.B., C.M.G. (Assistant Secretary).
Industries and Manufactures.—Mr. P. W. L. Ashley, C.B. (Assistant Secretary).
Industrial Property (including Patent Office).—Mr. W. Temple Franks, C.B. (Comptroller-General).
Power, Transport and Economic.—Mr. H. F. Carlill (Assistant Secretary).
Bankruptcy.—Mr. J. G. Willis, C.B. (Inspector-General).
Companies.—Mr. H. M. Winearls, O.B.E. (Comptroller).
Statistics.—Mr. A. W. Flux (Assistant Secretary).

The following are among the temporary Departments which at present form part of the Board of Trade:—

Profiteering Act Department.—Captain H. Hincks (Controller).
Export Credits Department.—Mr. L. A. Davis (Manager).
Clearing Office for Enemy Debts.—Mr. E. Spencer Grey (Controller).

The Department of Overseas Trade is under the joint control of the Foreign Office and the Board of Trade, its Parliamentary head, Lieut.-Col. Sir Hamar Greenwood, Bart., K.C., M.P., being an additional Parliamentary Under-Secretary of State for Foreign Affairs, and an additional Parliamentary Secretary to the Board of Trade. The permanent head of the Department is Sir W. H. Clark, K.C.S.I., C.M.G. (Comptroller-General). The principal sections of the Department are:—The Foreign Division, the Empire Division, the United Kingdom Division, the Exhibitions Division, the Overseas Services, and the Home Establishment Branch. Sir F. G. A. Butler, K.C.M.G., C.B., acts as Director of the Overseas Divisions. The overseas work of the Department in the collection of commercial intelligence is performed in foreign countries by the Commercial Diplomatic Service and the Consular Service, and in the overseas portions of the British Empire by the Trade Commissioner Service.

The Board of Trade are at present responsible for the organisation of the Coal Mines Department, which is attached to, but does not form part of the Board of Trade, and the President has arranged that Mr. W. C. Bridgeman, M.P., Parliamentary Secretary to the Board of Trade, shall act on his behalf in all respect matters relating to coal, subject to the authorisation of the President on questions calling for his decision. Mr. A. R. Duncan is Coal Controller, and the principal sections of the Coal Mines Department under the Controller, are as follows:—Production, trade, finance, household fuel and lighting, secretariat.

The President of the Board of Trade has established an internal Administrative Council which meets regularly and frequently to deal with current business involving questions of policy.

The Administrative Council here referred to is quite distinct from, and in no way supersedes, the Board of Trade Advisory Council, on which manufacturers, traders, and labour are represented.

Catalogues and Lists.—MESSRS. ALLOY WELDING PROCESSES, LTD., 14-16, Cockspur Street, S.W. 1.—*Bulletin* No. 24, a report on electric arc and oxy-acetylene welding tests carried out by the National Physical Laboratory, Teddington. *Bulletin* No. 27, illustrated price list and particulars of "A. W. P." electric arc welding plant. *Bulletin* No. 30, statement of tests applied, and results obtained, with "A. W. P." welding electrodes by the Admiralty at Portsmouth Dockyard. *Bulletin* No. 31, descriptive list and prices of oxy-acetylene welding rods and electrodes for arc welding. *Bulletin* No. 32, illustrated results of tests of "A. W. P." electric welding for Lloyd's Register of Shipping.

MESSRS. FERRANTI, LTD., Hollinwood, Lancashire.—Six catalogues (14 pp.) dealing with "Ferranti" house-service meters, switchboard instruments, and static transformers. These lists, which are fully illustrated, are identical, but in English, French, Italian, Spanish, Portuguese and Danish, and Messrs. Ferranti inform us that a Dutch translation is being prepared. All dimensions, &c., in the English edition are metric.

THE GENERAL ELECTRIC CO., LTD., Queen Victoria Street, E.C. 4.—Installation Leaflet D 17, describing the electrification of the works of the Halesowen Steel Co., Ltd., near Birmingham; illustrated by photographs of the works.

MESSRS. H. T. BOOTHROYD, LTD., Akenside Street, Bootle, Liverpool.—List of electric motors and dynamos (16 pp.), giving prices, dimensions, &c.; illustrated.

THE LEA RECORDER CO., LTD., 28, Deansgate, Manchester.—Technical Booklet (Civil Engineers' Edition), "Q 5" and leaflets "Q 6" and "S." The booklet provides information regarding the measurement of streams and rivers, sewage, supplies to reservoirs, &c., and contains illustrations of actual machines at work, indicating the various types of recording instruments required. The leaflets describe and illustrate the "Lea" recorder.

THE PEERLESS ENGINEERING CO., Cote Hill, Halifax, Yorks.—A descriptive catalogue (16 pp.) of the "Peerless" car lighting and starting systems. Priced and illustrated.

THE ESTERLINE CO., Indianapolis, U.S.A. Two copies of the "Esterline Graphic" advertising graphic recorders and permanent magnets.

Glassware Testing.—A new building for the testing of volumetric glassware has recently been completed at the National Physical Laboratory. A pamphlet entitled "Volumetric Tests for Scientific Glassware" was published in November last, giving information regarding methods of test, tolerances, test fees, &c. This may be obtained free of charge from the Director, National Physical Laboratory, Teddington, Middlesex.

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Copper and Lead Prices. — Messrs. James and Shakespeare report February 4th English pig-lead £48 15s., an increase of 20s. for the week. No changes are reported in copper.

Dance.—The Cryolite Athletic Association (London Staff of the British Aluminium Co., Ltd.) held a Fancy Dress Dance at the Cannon Street Hotel on Saturday last. Over 200 dancers, mostly in gay array, spent a thoroughly merry evening. Mr. W. Murray Morrison (president), and Mrs. Morrison, Mr. A. W. Tait, O.B.E. (chairman of the company), and others prominent in the aluminium world were present.

Book Notices.—"Mathematics for Engineers," Part II. By W. N. Rose. Pp. xiv + 419, 142 figs. London: Chapman and Hall. Price 13s. 6d. net.

"Beama." The Beama Journal, Vol. vi, No. 1, January, 1920. London: Oakley House, Bloomsbury, W.C. Price 1s. 6d. net.

"Despositivo para Hogares." By José Cervera Alsina, Paseo Alfonso XII, 25, Vigo, Spain. A pamphlet describing a method of facilitating the combustion of small coal.

"The Speed of Electricity." By A. E. Kennelly, D.Sc., A.M. 7 pp. A reprint from *The Wireless Age*.

"Alternating-Current Planevector Potentiometer Measurements at Telephonic Frequencies." By A. E. Kennelly and Edy Velander. 36 pp. Massachusetts Institute of Technology.

"Vickers News." Vol. I, Nos. 7 and 8. London: Vickers, Ltd.

"Pitman's Business Man's Encyclopedia and Dictionary of Commerce." Part I. London: Sir I. Pitman & Sons, Ltd. 1s. 4d. net.

"Foster's Pocket Reference Books." We are asked to state that the full address of the publisher of these books (reviewed in our last issue), is 98, College Road, Whalley Range, Manchester.

Patents and Designs Acts.—The Sections of the Acts of 1907 and 1919, dealing with the power of the Crown to use inventions and to dispose of such articles as are no longer required by the Crown, came into operation on January 21st.

The Economic Position.—"Stability as the Basis of Industrial Peace," is an eight-page pamphlet containing a reprint of an article written for *Ways and Means* by Mr. E. W. Petter (of Messrs. Vickers-Petters, Ltd.) The pamphlet is issued by the Industrial League and Council, 82, Victoria Street, S.W. 1, and a copy will be sent to anybody interested in exchange for two penny stamps to cover postage. Whatever Government we may have, we shall all have to face the economic issue. Governments are helpless; the only remedy for the present situation is for us to export manufactured goods. The author suggests the stabilisation of wages for a fixed period—say a year—unrestricted production, and real national unemployment insurance. Prices continue to soar; if ships fetch meat from South America, and they return in ballast empty, we pay double freights for one cargo. Everybody must get to understand the present position, and the peril of it. The circulation of literature of this kind, at a time when the serious rate of exchange problem is before all the nation, may do something to avert disaster if only it is read and believed by the right people.

Metal Prices and Cable Tenders.—The sudden rise in the copper and lead markets resulted in the Dundee Corporation having to pay £1,975, or 17½ per cent. increase in the cost of cables, and at a meeting of the Electricity Committee, it was agreed to recommend that the engineer be given power to notify acceptance of tenders immediately, in order to lessen the risk of the markets rising.

Conference of Manufacturers and Producers.—A National Conference of manufacturers and producers will be held at Kingsway Hall, London, W.C. 2, for two days, commencing at 10.30 a.m. on February 10th. Mr. W. Peter Rylands (president of the Federation of British Industries) will take the chair, and the deputy chairman will be Mr. E. Manville, M.P. (president of the Association of British Chambers of Commerce). The following well-known organisations will be taking part in the proceedings:—The Association of British Chamber of Commerce, National Confederation of Employers Organisations, Coal Association, British Engineers' Association, National Federation of Iron and Steel Manufacturers, Glass Bottle Manufacturers' Association, Chemical Manufacturers' Association, British Empire Producers' Organisation, and the British Commonwealth Union; also the big textile associations. The following are the subjects down for discussion on the first day after the chairman's opening speech:—Export trade and foreign exchanges, prices and profits, Government finance and expenditure. The subjects for discussion on the second day will be:—Nationalisation, transport, fuel, education, research, and housing.

Socials.—A social, organised by the Blackpool Electricity and Tramways Institute, was held on January 28th. There was an attendance of about 1,000.

After a war-time lapse of four years, the 150 trolley boys in the Salford Tramways Department were entertained by the Committee last week, Alderman Linsky presiding. Mr. G. W. Holford, general manager, and Mr. W. Blakemore, traffic superintendent, were also present.

French Trade Combination.—After having constituted, at the end of 1918, the Union des Syndicats de Ingénieurs, comprising the three syndicates of chemical engineers, electricians, and mechanicians, the Union is proceeding a step further, and aims to form a Federation of Technicians, whose object will be, while leaving to each syndicate the care of its own special interests, to co-ordinate the efforts of all the syndicates for the general welfare. A conference was recently called in Paris, with the view of incorporating this Fedération des Technicians de l'Industrie.

LIGHTING AND POWER NOTES.

Barrow.—Loans.—The Town Council has considerably exceeded its borrowing powers in providing additions to the electricity plant, and further extensions are necessary. Application is therefore being made to the Electricity Commissioners for increased borrowing powers.

Birmingham.—Extensions. — The demands of prospective consumers will entirely absorb the power available from the new station at Nechells, and further extensions are thought necessary.

Blackburn.—Mains Extensions.—The Town Council is applying for sanction to borrow £130,000 for laying additional mains in connection with the new generating station at Whitebirk, and three housing schemes, together with provision for power consumers and future extensions.

Bolsover (Derbyshire).—Electricity Supply.—The Urban District Council is approaching the Stanley Coal and Iron Co., Ltd., to ascertain the terms upon which it would be prepared to supply the district with electricity for lighting, &c.

Bradford-on-Avon.—Time Extension.—The Board of Trade has extended the time for effecting the transfer authorised by the Bradford-on-Avon Electric Lighting Order, 1914, until July 30th, 1920.

Bury.—House Lighting.—The electrical engineer has been instructed to proceed with the installation of the cables for the new Walmesley housing scheme.

Canada.—Water Power.—At a Deep Waterways Convention at Winnipeg a resolution was adopted in favour of the reconstructing the St. Lawrence River with locks, so as to supply navigation facilities equal to those of the Welland Canal, and the public ownership of all water power available on Canadian waterways.—*The Times*.

Colne.—New Plant.—The Town Council has received the report of the deputation which waited upon Sir John Snell, Chief Electricity Commissioner, regarding the position of the electricity undertaking. Sir John sanctioned the installation of a turbo-alternator and an additional water-tube boiler to provide for next winter's demand on the understanding that arrangements for inter-connection between Nelson and Colne were still to hold good. The tender of the Stirling Boiler Co., for the supply of a water-tube boiler, including steam pipes and feed pump, at £4,443, was accepted, and a 2,000-kw. turbo-alternator is to be purchased from Stockport Corporation for £10,000. A scheme for the erection of a sub-station in Dockray Street is to be proceeded with, and application is being made for additional borrowing powers to the extent of £20,000.

Continental. — Italy. — According to the American Consul at Venice, the hydro-electric industry of Venice is chiefly under the control of a financial group headed by the Società Adriatica di Eletricità. The "Adriatic" company is endeavouring to provide hydro-electricity to the Julian Veneto, the Trentino, Istria, and possibly to the city of Fiume. It has been announced that a contract has already been entered upon to supply electricity to the commune of Trieste. Although several of the principal generating stations of the Veneto fell into the hands of the Austro-Hungarian invaders during the autumn of 1917, they were finally retaken by the Italians in a much more satisfactory condition than was expected, as the enemy's retreat was so rapid that systematic destruction was not possible.

The Società Idro-Elettricale Monte Viso (with a capital of 25,000,000 lire), is constructing a large station in the upper valley of the Po. The power will be supplied by means of an artificial lake at a height of 900 metres, having a capacity of 25,000,000 cb. metres; 50,000 h.p. will be developed, and power supplied to the works situated in the vicinity, and also to the city of Turin. Prior to the war this district was being exploited by a German firm.

Holland.—The estimated power requirements of Holland, according to the report of a Committee appointed to deal with the question, amount to 1,000,000,000 kw.-hours per annum, allowing 100 kw.-hours per head for a probable future population of 10,000,000. The system of generation proposed is by means of central stations erected in carefully-selected localities, such as Amsterdam and Rotterdam, capable of supplying 75,000 kw. each. A national scheme is recommended, under the supervision of a Government Council.

Germany.—Owing to coal shortage, the Maschinen- u. Dampfkessel-armaturen-Fabrik Schaeffer und Budenberg G.m.b.H., Magdeburg, has been obliged to stop work at three foundries. The closing down of the whole undertaking is to be reckoned with shortly, whereby 2,600 persons will be thrown out of work.—*Economic Review*.

A similar measure to the British Electricity (Supply) Act is shortly to be introduced, which will divide the country into districts under corporations, for supply purposes, the whole being controlled by the State.

Switzerland.—The *Basler Nachrichten* states that the whole course of the Reuss from the Schöllenenschlucht to Amsteg is to be used for generating electricity. The firm of Escher, Wyss and Co., of Zürich, and the Swiss Military Department are interested in the scheme, the latter having obtained a concession for the upper portion of the Schöllenen in order to provide the Gotthard forts with electric power.

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Cork.—TRANSFER OF UNDERTAKING.—The Corporation, pursuant to the Cork Electric Lighting Order of 1896, is seeking the consent of the Electricity Commissioners to transfer its powers, duties, and liabilities to the Cork Electric Tramways and Lighting Co., Ltd. The period for which such transfer from the Cork Corporation to the Tramways and Lighting Co. is to be made is 40 years. the company undertaking (*inter alia*) to expend a sum of £20,000 within three years on the purchase of new plant and buildings, and to undertake the proper and adequate maintenance of the electric tramway service in Cork City and the lighting and power supply.

Coxhoe (Co. Durham).—ELECTRIC LIGHTING.—In connection with the proposed joint electric lighting scheme, a meeting of representatives of the Coxhoe, Hassop, and Kelloe District Councils has decided to ask Messrs. W. Scott, Ltd., and Messrs. Bell Bros., colliery proprietors, who have offered to provide and erect poles, lamps, &c., and supply power in their respective districts at a charge of £5 per lamp per annum, to submit drafts of agreements for confirmation by the respective Councils and the joint body.

Derby.—INQUIRY.—On January 30th, an inspector of the Ministry of Health held an inquiry into the application of the Corporation for loans of £3,803 for the purchase of property to be used as offices, showrooms and workshops, and £2,500 for the erection of a garage. The electrical engineer stated that his department sold a large quantity of electrical fittings, and the buildings would prove of considerable value.

EXTENSIONS.—The Electricity Committee has recommended the borrowing of £15,000 for mains extensions, £1,000 for motors, and £1,200 for an electric delivery vehicle. It is estimated that a total of £140,000 will eventually be required, £35,000 of which will be expended during the ensuing financial year.

Edinburgh.—EXTENSIONS.—The Electricity Committee recommends an expenditure of over £60,000 on extensions. The proposals include two additional boilers for the Dewar Place station, and a 2,500-KW. turbo-alternator for the M'Donald Road station, as well as the installation of feeder cables in outlying districts.

Glasgow.—MAINS EXTENSIONS.—The Clyde Valley Electric Power Co. has intimated that it is willing to extend its mains to Giffnock, if a minimum income is guaranteed.

Ireland.—WATER POWER.—Many Irish towns are making inquiries regarding the cost of electricity, and find that generation is too costly in several cases. The recent heavy floods of the Shannon, Bann, and other rivers, suggest to the public that there is a very great amount of water power that can be developed, but the minimum flow, on which estimates must be based, leads to a very different conclusion. The Irish Water-Power Resources Committee is conducting exhaustive inquiries into the matter.

Kilmarnock.—YEAR'S WORKING.—The accounts for the year ended May 15th, 1919, show that the total revenue was £59,576, and the expenditure £35,529, leaving a gross profit of £24,047. After payment of loan interest, &c., the net profit was £5,858, as compared with £5,475 for the previous financial year.

King's Langley.—MAINS EXTENSIONS.—The Council has asked the Watford Electric Lighting Co. to obtain powers to extend its mains to the parish.

Leeds.—EXTENSIONS.—The Corporation is contemplating a big development scheme at an early date. Besides additions to buildings and the installation of generating plant, a considerable extension of the mains is to take place. The whole of the scheme will cost three-quarters of a million sterling.

London.—ST. PANCRAS.—The electrical engineer has recommended mains extensions at an estimated cost of £5,450.

The Council has agreed to pay Messrs. Bruce, Peebles & Co., Ltd., £400 above the contract price for the 1,000-KW. motor-converter installed at the Tavistock Place sub-station a short time ago.

BETHNAL GREEN.—The Borough Council has applied for sanction to borrow £20,011 for the installation of mains (£17,033), meters (£1,300), and house services (£885).

SUPPLY FAILURE.—All public and private electric lighting in the area with Piccadilly Circus as its centre, failed at 8 p.m. on Tuesday night for about 15 minutes. The interruption in the supply was caused, it is reported, by the breakdown of a generating set in the power station of the St. James and Pall Mall Electric Light Co.

Reigate.—EXPERT ADVICE.—The Town Council has asked Messrs. Handcock, Dykes & Trotter to report upon the systems in vogue for encouraging the use of electricity by owners and occupiers of cottage property by free wiring, upon deferred payment systems, or otherwise, and upon various methods of supply.

Sligo.—LIGHTING SCHEME.—A scheme for lighting the town by electricity has been proposed. Councillor Jackson is taking steps to secure the use of water power for the purpose.

Stalybridge.—DEFICIT.—In order to cover an estimated deficit of £3,000, the Stalybridge, Hyde, Mossley, and Dukinfield Tramways and Electricity Board has decided to make a levy of £750 upon each of the constituent Corporations. The total loss on the undertaking since its inception in 1901 is stated to be £110 000.

Tasmania.—HYDRO-ELECTRIC DEVELOPMENTS.—The Minister of Public Works reports that 70,000 H.P. is available from the Great Lake supply. It is proposed to develop this by means of a 12,000-H.P. plant near the present intake, and a 58,000-H.P. station at Waddamana. Much of the machinery for the latter plant has already been ordered, and 26,000 H.P. will soon be available. The scheme includes the erection of five sub-stations to be situated at Risdon, Hobart, Launceston, Electrona, and Bridgewater. The estimated yearly profit is £3,300.

Tidal Power.—It is reported in the daily Press that work is about to begin in an attempt to harness the tidal power on the Dee and Severn. It is stated that models have been set to work within the last few months, from the working of which it is estimated that electrical energy can be produced in this manner at a cost of ½d. per unit.

West Ham.—LOAN SANCTION.—The Town Council has received sanction to loans amounting to £140,317 for electricity purposes.

Whitehaven.—PRICE INCREASE.—The Town Council has advanced the price of electricity for power supplied to factories by 10 per cent.

TRAMWAY AND RAILWAY NOTES.

Barrow.—NEW CARS.—The tramway manager recommends the purchase of 10 new cars in order to provide an adequate summer service.

Blackpool.—YEAR'S WORKING.—Blackpool, St. Annes, and Lytham Tramways Co., in its annual report, states that the total traffic receipts were £67,409, out of which £22,342 was paid to the Corporation of Blackpool. Traffic expenses amounted to £15,509, and, after other expenses had been met, there was a balance of £10,094. During the year negotiations proceeded with St. Annes Urban District Council for the purchase of the undertaking, resulting in an offer by the Council of £135,000. A preliminary agreement has been entered into, and approved of by the stockholders and shareholders. The St. Annes Council will promote a Bill in the next session to carry out the agreement.

Burnley.—NEW CARS.—The Town Council is purchasing five additional single-deck cars at an estimated cost of £16,000.

Brighouse.—OPPOSITION TO BILL.—The Town Council is opposing the Parliamentary Bill promoted by the Halifax Corporation, which, among other things, proposes to extend the latter authority's powers over the tramways by 30 years.

China.—RAILLESS FREIGHT LINE IN SHANGHAI.—Negotiations are said to be in progress between the Shanghai Tramway Co. and the Municipal Council of Shanghai for an extension of the present railless traction facilities. If the necessary street improvements are made and three wooden bridges replaced with steel structures, a freight service will be introduced connecting the railway freight station in Chapei with the Yangtzepoo district. The new freight cars will be provided with storage batteries, enabling them to make side trips into the yards of manufactories. These plans involve the addition of from 12 to 13 miles of new routes to the present system, requiring about three years for completion.

Continental.—HUNGARY.—A group of Belgian financiers has made an offer to purchase the Budapest tramways. It is probable that the offer will be accepted, since the two tramway companies in the city were socialised under the Soviet régime, and show a deficit of Kr. 150 mill.—*Economic Review.*

ITALY.—The decision of the Government to organise the electric conversion of some 6,000 kilometres of railways (either directly or through private initiative under State control) will involve the placing of large orders abroad for rolling stock and other material which the Italian industry will be unable to supply. The material will comprise turbines, dynamos, transformers, conductors, insulators, posts, standards, &c., to carry distribution lines, trolleys, motors, measuring apparatus, &c. The general plans for the electrification of the railways rest with the Italian Ministry of Transportation, which is advised by a Commission for Railway Electrification. New hydro-electric stations, extensions to existing plant, new transmission lines, sub-stations, electric locomotives, and all kinds of accessory plant and equipment will be required, much of which will have to be imported. The system so far employed is three-phase, 16 cycles. On mountain lines, locomotives with direct-connected motors, with power applied to all the wheels, have been employed with success. The general speed was 38 miles an hour, or about 19 miles per hour when hauling trains of 500 tons on 30 to 35 per cent. gradients.

Dublin.—TRAMWAY OWNERSHIP.—The Corporation is considering the municipalisation of the tramway system, which is at present undertaken by a company, to which the track is leased.

Halifax.—CARRIAGE OF MINERALS.—A majority of ratepayers has approved the Bill, which (*inter alia*) will enable the Corporation to utilise the tramways for the conveyance of minerals and other goods.

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Huddersfield:—Extensions.—The extension to Longwood is being proceeded with. The scheme for the construction of a railway from the Midland Co.'s premises to the gas and electricity works has been abandoned.

Kilmarnock.—Year's Working.—The total revenue for the year ended May 15th, 1919, was £14,178, and the total expenditure £12,539, representing a gross profit of £1,639. The net result, after payment of interest, &c., was a deficit of £2,483. The loss on the working for the previous year was £3,356.

London.—At the meeting of the East London Railway Co., Mr. Murray Griffith said that the increase of passengers since the electrification had far exceeded the expectation of the directors. In 1912 they were carrying, under various difficulties, about 4,500,000 passengers, and in 1918 they carried 10,569,000. During December last they carried 1,275,000 passengers, which was over 15,000,000 per annum. They had brought the line to the position of being a necessity, in that it afforded a link for traffic crossing London. The Government, in taking over the line, stipulated that it should be handed back in the same condition in which it was received. It seemed to him impossible that the Government would leave them in the lurch with regard to the interest on the electrification expenditure. When they came out of Government control, he thought they would find their property in the same position as when they went in, plus the fact that since electrification they had established a through service with the main lines both on the north and south sides of London.

The Ministry of Transport has held a conference of Greater London municipal tramway authorities with regard to the financial position of the undertakings.

Maidstone.—Women Employes.—The Corporation, in reply to a local Trades Council deputation, stated that it declined to dismiss the women conductors, as they only required a maximum wage of £2 2s. weekly.

Middleton.—Fare Increase.—On January 29th the Light Railway Commissioners conducted an inquiry into the Tramway Co.'s application for authority to increase its fares. The Commissioners' decision is to be communicated later.

St. Helens.—Extensions.—The borough engineer has been instructed to invite tenders for the supply of 350 tons of rails and the necessary material for the construction of 10 loops.

New Cars.—The tramway manager reports that work on the new cars has been delayed on account of failure in the supply of material.

Fares.—The Tramways Committee is seeking powers to increase workmen's fares from ½d. to 1d. per mile.

Yorkshire.—Storm Damage.—During the recent storms the Huddersfield tramway service was severely handicapped by the accumulation of snow, and in the Spen Valley townships many of the services were entirely dislocated.

TELEGRAPH AND TELEPHONE NOTES.

"Admiralty" Lines.—A conference was held in the office of the Scottish Board of Health recently under the chairmanship of Sir George McCrae, chairman of the Board. Representatives of the Board of Health, the Board of Agriculture and Fisheries, the Education Department, the Ministries of Food, Labour, and Pensions, the Meteorological Office, the Air Ministry, and the General Post Office met, at the request of the Secretary for Scotland, to consider the question how far certain telegraph and telephone lines erected by the Post Office for the special use of the naval and military authorities during the war could be retained and adapted for civil purposes. The lines in question are mostly in the Highlands and islands. Some of the lines have already become part of the permanent system of the Post Office, but there are others that are considered to be of much importance from the point of view of improved communications, and especially in connection with medical and nursing services in certain isolated districts and in islands where there are no resident medical practitioners. Arrangements, it is hoped, can be made, with the co-operation of the Post Office, for the retention of the lines that would be likely to serve any really useful civil purpose. The recommendations of the conference will be embodied in a report to the Secretary for Scotland at an early date.

Alsace-Lorraine.—The French telephone system is to be extended, and a new direct line between Strasbourg and Paris will be installed. Hitherto Metz has had no direct telephonic connection beyond Nancy and Mulhouse, and only one as far as Belfort.

Canada.—A wireless telephone system throughout the northern territory of Manitoba, to bring it into touch with the cities of the West, is recommended by the Commissioner.—*The Times.*

Cheap Wireless.—At a meeting of the Wireless Society of London, held at the Institution of Civil Engineers, on January 29th, Mr. R. C. Clinker, of the British Thomson-Houston Co., showed a wireless receiver which can be installed in the home for about £30. The apparatus, which will take messages from all the principal wireless stations in Europe, is contained in a box 15 in. wide, 12 in. broad, and 5 in. deep, and light enough to be carried by a leather handle. Mr. Clinker explained that this portable receiver was originally intended for receiving time signals from Paris, and for the use of clock-makers and others, to whom a knowledge of the exact time was of importance. No external aerial wire is required.—*The Times.*

Denmark.—A dispute in the Danish telephone industry is in progress. The companies which hold State concessions have based their wages offer on the State Wages Law of September 12th, 1919, while the Central Organisation of Telephone Workers demand rates approaching those paid in private concerns. The Copenhagen Telephone Co.'s proposals would involve an annual expenditure on wages of Kr. 8 million, or Kr. 80 per subscriber; the workers' demands would mean a wages bill of Kr. 13.7 million, or Kr. 137 per subscriber. A strike was declared at midnight on New Year's Eve, involving some 4,000 workers, of whom 2,000 are in Copenhagen.

Germany.—A large and representative meeting of the German Press organisations met the postal authorities on December 22nd to discuss the results of some months of tentative experiments in the matter of disseminating news to the various agencies by wireless telegraphy, and came to the conclusion that in its present state wireless telegraphy could not meet the needs of the Press. On the other hand, it appeared suitable for dispatching generally interesting news in duplicate. The assembly was also of opinion that dispatch of such news could take place to a large extent if wireless telegraphy were replaced by wireless telephony to obviate the necessity for appointing special wireless telegraphists. The assembly will meet again in a few weeks to report on the further development of experiments with telephony.

Elektriska Industri A.-B., in Stockholm, and the Berlin firm Dr. Erich F. Huth Gesellschaft für Funkentelegraphie, have come to an agreement as to a mutual exchange of patent rights in connection with wireless telegraphy and telephony. The agreement is expected to prove of great value to Sweden, especially as regards wireless telephony.—*Economic Review.*

New Swedish-American Cable.—It is announced from Stockholm, says the *Economic Review*, that a group of Americans intend to lay a direct cable between the U.S.A. and Sweden.

Newfoundland.—A company has been formed in Newfoundland to install a new telephone system, to give a service to the city of St. John's and long-distance service between St. John's and various points in Conception Bay and Ferryland district. This is a long-felt want, as the service in this city at present is totally inadequate. The capital for this enterprise is placed at $200,000 common stock and $200,000 preferred. An attractive offer is being made of a 7 per cent. preferred stock, which has an additional advantage of sharing with the holders of the common stock in the surplus earnings of the company over the guaranteed 7 per cent.

Storm Damage.—The storm of January 28th did considerable damage to the telephone and telegraph lines all over the country, especially in the North and Midland Counties. Overhead communication between several large towns and London was interrupted: between Durham and Stafford many miles of wire came down, and only two or three out of the 25 telephone lines between London and Manchester were working. The telephone dislocation quickly showed itself on the automatic system at Leeds, where about 1,000 lines were out of use the next morning. Bradford Exchange was out of touch with a considerable number of sub-exchanges. For a time Leeds was almost entirely cut off from outside communication. At Todmorden nearly all overhead lines were down, including 16 trunk services.

United States.—An Act, No. 100-66th Congress (H.R. 9822) has been passed authorising the President to arrange and participate in an international conference to consider questions relating to international communication. The conference is to be held in Washington, and will consider all international aspects of communication by telegraph, telephone, cable, wireless telephony and wireless telegraphy, and to make recommendations with a view to providing the entire world with adequate facilities for international communication on a fair and equitable basis. A sum of $75,000 has been voted for this purpose, but no part thereof "shall be used in entertainment or for the purchase of medals and badges." The Act was approved on December 17th last.

The Chesapeake and Potomac Telephone Co. is preparing plans for the substitution of the automatic telephone for the present system at Baltimore.

West Indies.—The last issue of the *West India Committee Circular* contains a leader on the condition of telegraphic communication in the West Indies. Interruptions to cables have been frequent of late, and some of the islands and British Guiana were for a period completely isolated. Strong complaint is being made.

Wireless Telephony in Germany.—The German Commonwealth Post Office authorities, in conjunction with the firm of C. Lorenz & Co., have been conducting wireless telephony experiments between Berlin and Constance which have had very satisfactory results. It is hardly likely, however, says the *Deut. Allg. Ztg.*, that it will be possible for technical reasons to introduce wireless telephony for general use at present.—*Economic Review.*

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CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the ELECTRICAL REVIEW in which the "Official Notice" appeared.)

OPEN.

Aberdare.—Urban District Council. Electricity and Tramways Department. Stores for 12 months, including cables, meters, joint boxes, electric lamps, &c. (See this issue.)

Aldershot.—February 17th. Urban District Council. Electricity Department. Geared turbine and generator, condensing plant, pumps, water-tube boiler and superheater, cables, &c. (January 23rd.)

Australia.—MELBOURNE.—March 30th. City Council. 12,000 metal filament incandescent lamps. (See this issue.)

April 12th. City Council. Two 2,000-KW. rotary converters; H.T. switchgear, 6,600 v.; D.C. switchgear, 600 v. (January 30th.)

ADELAIDE.—February 1st. P.M.G.'s Department. Telephone material (schedules 539 and 540). (January 30th.)

Bedford.—February 21st. Electricity Department. E.H.T. cable and transformers, E.H.T. switchgear. (See this issue.)

Belfast.—February 14th. Tramways Committee. Tramway stores, including electrical accessories, cable, lamps, carbon brushes, trolley wire, &c. (January 23rd.)

Belgium.—February 27th. Municipal authorities of Villers-le-Peuplier (Province of Liege) are inviting tenders for the concession for the supply of electrical energy for lighting and power purposes in the district.

Bedwas (Mon.).—March 4th. Bedwas Navigation Colliery Co., Ltd. Six months' supply of stores, including electrical goods, &c. (See this issue.)

Bristol.—February 23rd. Electricity Department. One 2,000-KW., single-phase, 2,200-v. turbo-generator, complete with condenser and auxiliaries. (See this issue.)

Chester-le-Street (Co. Durham).—March 3rd. Urban District Council. Underground mains and all equipment for lighting district by electricity. F. J. Gray, Clerk, Council Offices.

Edinburgh.—February 9th. Electricity Supply Department. One overhead travelling crane. (January 16th.)

Keighley.—February 10th. Electricity Department. One 900-KW. rotary converter, complete with transformer. (January 30th.)

Kings Lynn.—February 20th. Electricity Department. One Lancashire boiler, superheater, piping, &c. (January 30th.)

Lincoln.—March 2nd. Electricity Department. One automatic battery, for St. Swithin's Power Station. (See this issue.)

London.—H.M. Office of Works. February 13th. Supply of electric cable and wire during period ending December 31st, 1920. (See this issue.)

CAMBERWELL.—St. Giles' Board of Guardians. Three 5-H.P. and 15-H.P. A.C. motors, and one fan. (See this issue.)

Manchester.—February 17th. Tramways Committee. (*a*) Steel girder tramway rails; (*b*) tramcar trucks; (*c*) controllers for tramcars. Mr. J. M. McElroy, General Manager.

February 21st. Corporation Waterworks Committee. Water turbine, dynamo and switchboard, &c.; storage battery, reversible booster, motor generator, switchboard, D.C. motors, starting panels, &c.; L.T. paper-insulated lead-covered cables. (See this issue.)

February 25th. Electricity Committee. Three three-wire balancers, and the necessary switchgear. (See this issue.)

Plymouth.—February 16th. Corporation Transport Department. 20 motor chassis, 20 enclosed omnibus bodies, 11 double-deck tramcars, 100 tons steel rails, six tons fish plates, one motor generator set, one 5 cwt. power hammer. (See this issue.)

Salford.—February 9th. Corporation Tramways Department. Stores for 12 months. General Manager, 32, Blackfriars Street.

St. Helens.—February 7th. Electricity Committee. One steam-driven turbine feed pump. (January 30th).

Warrington.—February 10th. Electricity and Tramways Committee. Two water-tube boilers; two mechanical stokers (underfeed type); water softener. (January 23rd.)

York.—February 27th. Electricity and Tramways Committee. One 3,000-KW. turbo-alternator, with condensing plant; three water-tube boilers, with mechanical stokers, &c. (See this issue.)

CLOSED.

Australia.—SYDNEY.—City Council. Accepted:—
3,000 yd., ·3 L.T., "A." class cable, £3,857.—W. T. Henley's Telegraph Works Co., Ltd.
5,000 yd., ·25 5,000-v. cable, £5,592.—Noyes Bros.
—Tenders.

Barnstaple.—Trade Council:—
Fire-call installation at firemen's houses.—H. F. James, Exeter, £63.

Colne.—Town Council. In connection with the linking-up with Nelson Town Council:—
Water-tube boiler, including steam pipes and feed pump, £4,448.—Stirling Boiler Co., Ltd.

Coventry.—Board of Guardians:—
Electric installation.—G. R. Marson, Ltd., No. 1 block, £107: No. 2 block, £199.

Croydon.—Corporation. Tender of Mr. S. E. Hunt, Croydon, for electric light wiring of the first 125 houses has been accepted.

Folkestone.—Education Committee:—
Electric installation, Dover Road Schools.—Webster & Son, £94.

Halifax.—Tramways and Electricity Committee. Provisionally accepted:—
One marine-type boiler, economiser, forced draught and induced draught fan, chimney, &c.—Babcock & Wilcox, Ltd., £15,695.
Low tension connections for the 1,500 KW. rotary convertor.—British Thomson-Houston Co., Ltd., £770.

Hammersmith.—Electricity Committee. Recommended:
Mains extensions. Supply of cable, 1,250 yards various sizes, £1,800.—Union Cable Co., Ltd.
1,000 yards each 3-in. single and 3-in. two-way cable ducts, £420.—T. Wragg & Son.
Work in connection with linking-up Fulham and Hammersmith generating stations, £15,905.—W. T. Henley's Telegraph Works Co., Ltd.

Hull.—The Electricity Committee has received the undermentioned tenders for new plant, which have been referred to the City Electrical Engineer to tabulate and report upon:—

CONTRACT 82.
TURBO-ALTERNATOR.

Name.	Price.	Delivery.	Alternator.
Adamson & Co., Ltd. ..	£49,465	14 working months and 10 weeks.	General Electric
Belliss & Morcom, Ltd. ..	£50,414	14 months.	General Electric
British Thomson-Houston Co., Ltd.	£51,619	90 weeks.	—
English Electric Co., Ltd..	£48,484	About 10 mths. after termination of moulders' strike.	—
Fraser & Chalmers Eng. Works	£49,095	14 months.	General Electric
James Howden & Co., Ltd.	£48,020	14 months.	General Electric
Met.-Vickers Elec. Co., Ltd.	£48,290	11 mths. subject to conditions	—
Ateliers de Construction Oerlikon, Switzerland ..	£48,550	16½ months.	—
C. A. Parsons & Co., Ltd...	£50,350	14 months and 2 weeks.	—
Richardsons, Westgarth & Co., Ltd.	£42,965	12 months.	General Electric.

CONTRACT 83.
CONDENSING PLANT.

Name.	Price.	Delivery.
D. Adamson & Co., Ltd.	£19,883	About 12 months.
W. H. Allen, Son & Co., Ltd. ..	£17,750	9 mths., subject to condition.
Belliss & Morcom, Ltd.	£18,250	10 working calendar months.
Cole, Marchant & Morley	£16,750	40 weeks without guarantee.
English Electric Co., Ltd.	£19,000	About 10 mths. after termination of moulders' strike.
Hick, Hargreaves & Co., Ltd. ..	£17,965	10 months.
Metrop.-Vickers Elec. Co., Ltd. ..	£18,410	11 mths., subject to conditions.
Mirrlees Watson Co., Ltd... ..	£17,286	10 months.
C. A. Parsons & Co.	£18,700	12 months and two weeks.
Richardsons, Westgarth & Co. Ltd.	£17,734	Ex. works 9 months.
Worthington-Simpson, Ltd. ..	£15,722	9 months.

Leyton.—Urban District Council:—
E.H.T. main cables.—W. T. Henley's Telegraph Works Co., Ltd., £6,151.

London.—POLICE LANTERNS.—Messrs. Greenwood and Batley, Ltd., have recently received the sole contract for the supply of their "Bipol" accumulators for use in the new electric lanterns with which the Metropolitan Police are being supplied.

Salford.—Tramways Committee. Accepted:—
One double-deck motor-omnibus, and one type "G." chassis, £1,890 less 10%.—Leyland Motor Co.
70 weldless steel poles, £2,676.—British Mannesman Tube Co., Ltd.

Electricity Committee. Accepted:—
Additional switchgear at the Trafford sub-station.—Bertram Thomas.
5,000-KW. turbo-alternator set, complete.—Metropolitan-Vickers Electrical Co., Ltd.
1,500-KW. rotary-converter set.—Metropolitan-Vickers Electrical Co., Ltd.

Stafford.—County Education Committee:—
Wiring of electrical laboratory at the Engineering School.—J. Richards and Co., £88.

Tasmania.—Government Hydro-electric Department. The following contracts have recently been placed for new plant and equipment:—
Three 8,000-H.P. turbines.—Boving & Co.
Three 7,050-K.V.A. generators.—Australian General Electric Co.
15 2,333-K.V.A. transformers.—Metropolitan Vickers Electrical Co.
300-amp.-hour battery.—Tudor Accumulator Co.
—Tenders.

LAUNCESTON.—Town Council. Accepted:—
48 electric motors and starters, £1,949.—G. Weymouth Pty. Meters for ditto, £98.—Australian General Electric Co.
Switchgear, £803.—W. McLean & Co.
—Tenders.

Tipperary.—Board of Guardians:—
Electrical plant at the workhouse.—Ferguson & Benty, £970.

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FORTHCOMING EVENTS.

Chief Technical Assistants' Association.—Saturday, February 7th. At Anderton's Hotel, Fleet Street, E.C. At 3 p.m. Discussion on "The Design and Equipment of Sub-stations," to be opened by Messrs. Bowden and Ingram.

Society of Engineers.—Monday, February 9th. At Burlington House, Piccadilly, W. At 5.30 p.m. Presidential address by Mr. B. Geen. Presentation of premiums awarded in 1919.

Association of Engineers-in-Charge.—Wednesday, February 11th. At St. Bride's Institute, E.C. At 7.30 p.m. Paper on "Coal Saving by Scientific Control in the Boiler House," by Mr. D. Brownlie.

Saturday, February 14th. At St. Bride's Institute. At 7.30 p.m. Social and Dance.

Edinburgh Electrical Society.—Wednesday, February 11th. At the Philosophical Institute. At 8 p.m. Lecture on "The History and Development X-Ray Apparatus," by Mr. Law.

Institution of Electrical Engineers.—Thursday, February 12th. At the Institution of Civil Engineers, Great George Street, S.W. At 6 p.m. Paper on "The Protection of Alternating Current Distribution Systems Without the Use of Special Conductors," by Major K. Edgcumbe, R.E.

(**North-Eastern Centre**).—Monday, February 9th. At the Armstrong College, Newcastle-on-Tyne. At 7.15 p.m. Paper on "Transformers for Electric Furnaces," by Mr. J. L. Thompson.

(**North Midland Centre.**)—Tuesday, February 10th. At the Royal Victoria Hotel, Sheffield. At 7 p.m. Lecture on "The Rotherham Power Station," by Mr. E. Cross.

(**North-Western Centre**).—Tuesday, February 10th. At the Engineers Club, Manchester. At 7 p.m. Lecture on "A Critical Survey of Power Supply in the Rhine Valley," by Lieut.-Colonel F. C. Aldous and Mr. A. E. Leigh Scanes.

(**Scottish Centre**).—Tuesday, February 10th. At 207, Bath Street, Glasgow. At 7.30 p.m. Paper on "Transformers for Electric Furnaces," by Mr. J. L. Thompson.

(**South-Midland Centre.**)—Wednesday, February 11th. At the University, Birmingham. At 7 p.m. Informal discussion on B.E.S.A. Specification No. 72.

(**Students' Section**).—Friday, February 13th. At the Royal Technical College, Glasgow. At 7.30 p.m. Paper on "The Electrical Equipment of Cranes," by Mr. G. W. Turner.

Association of Engineering and Shipbuilding Draughtsmen.—Lectures will be given at Chesterfield and Liverpool on February 12th.

Royal Institution of Great Britain.—Thursday, February 12th. At 3 p.m. At Albemarle Street, W. 1. Lecture on "Recent Progress in Applied Optics," by Prof. A. E. Conrady (Lecture II).

Saturday, February 7th. At 3 p.m. Lecture on "The Astronomical Evidence Bearing on Einstein's Theory of Gravitation," by Sir F. W. Dyson.

Liverpool Engineering Society.—Thursday, February 12th. At the Exchange Station Hotel. At 7.30 p.m. Annual dinner.

Salford Technical and Engineering Association.—Saturday, February 14th. At the Royal Technical Institute. At 7 p.m. Paper on "Liquid Air," by Mr. J. L. Duckworth.

"Daily Mail" Ideal Home Exhibition at Olympia.—Open to February 25th.

Electro-Harmonic Society.—Friday, February 13th. At the Holborn Restaurant (Venetian Chamber). At 8 p.m. Concert. (Ladies' night.)

NOTES.

Notice to Readers.—It appears that some of our readers are experiencing difficulty in securing their copies of the ELECTRICAL REVIEW regularly and promptly through the ordinary distribution channels, owing to transportation and other matters. We would, therefore, again urge the wisdom of their becoming subscribers, either yearly or half-yearly.

Subscription orders should be sent direct to the Publisher, ELECTRICAL REVIEW, 4, Ludgate Hill, London, E.C.

We give on advertisement page No. 28 to-day an order form for the convenience of intending subscribers.

Telegraph Wire Destruction.—At Fermoy, Co. Cork, Quarter Sessions, before the Recorder of Cork, last week, the Postmaster-General applied for £70 compensation for the malicious cutting and destruction of a large number of telegraph and telephone wires on the public road between Cork and Midleton, and Queenstown, on the night of January 3rd, on which occasion an attack was made on the police barracks at Carrigtwohill. The wires were all repaired at a cost of £47, and the Recorder granted compensation for this amount.

Electric Starters for Marine Motors.—At the Scottish Motor Show some large size C.A.V. electric starters were exhibited, which have been used, it is stated, on marine engines up to 200 H.P.

A New Federation.—As the result of a preliminary conference of members of professional and supervisory associations which was held on November 22nd, a meeting is to be held to-morrow (February 7th), at the Essex Hall, Strand, London, of representatives of such societies with a view to inaugurating a "National Federation of Professional, Technical, and Supervisory Workers," for the purpose of safeguarding the interests of the members of the affiliated associations, and of promoting friendly relations between them and the industrial workers' organisations. Some 40 societies have been invited to send delegates to the conference, including the Association of Engineering and Shipbuilding Draughtsmen, the Society of Technical Engineers, the Electrical Power Engineers' Association, the National Association of Supervising Electricians, the Electricity Supply Commercial Staffs' Association, and the National Union of Scientific Workers.

Australian Engineers.—The Victorian section of the Electrical Association recently merged itself into the newly-formed Institution of Engineers of Australia.

Educational.—UNIVERSITY OF LONDON.—At a recent meeting of the Senate several gifts were acknowledged, and thanks accorded to the donors. A sum of £50,000 was given by the General Committee to promote the institution of degrees in commerce, and the organisation of commercial education in the City of London and throughout the Empire, to be devoted to extensions of the School of Economics.

Messrs. S. B. and J. B. Joel presented £20,000 to provide a University Chair of Physics at the Middlesex Hospital Medical School. This will bear the name of the donors.

An offer of £150 a year for three years from the Rhodes Trustees, in aid of the work of the Professor of Constitutional Law at University College, was gratefully accepted.

CORRESPONDENCE TUITION.—We have received from University Engineering College, London, a copy of Prospectus No. 8, giving particulars of the "U.E.C." system of technical training by correspondence, and details of the standard courses which have been organised. These include all branches of electrical engineering, elementary and advanced, as well as mathematics and physics, civil and mechanical engineering, and special courses leading to the London University B.Sc. degree, and the examinations of the engineering Institutions, the City and Guilds of London Institute, the Board of Education, and Government service.

The Education Department of the Metropolitan-Vickers Electrical Co., Ltd., has just published a circular giving a list of lectures for its staff and workpeople. The lectures deal with economics, engineering, &c., and should prove of great value.

FARADAY HOUSE ELECTRICAL ENGINEERING COLLEGE.—The annual examinations for a Faraday Scholarship of 50 guineas per annum, tenable for two years in college and one year in manufacturing works, and for a Maxwell Scholarship of 50 guineas per annum, tenable for one year in college and one year in works, will be held at Faraday House on April 13th, 14th and 15th. Particulars can be obtained from the Secretary, Faraday House, Southampton Row, London, W.C. 1.

British Oil.—The report of the Petroleum Executive on the last year's progress contains interesting particulars of new borings. In Derbyshire, the Hardstoft bore gave more satisfactory results than the first observations seemed to indicate. By keeping the oil level at a depth of 1,000 ft., a daily yield of 20 barrels (700 gallons) was obtained, and at a level 3,000 ft. below the surface the supply was 35 barrels (1,225 gallons) a day.

Summer-Time on the Rhine.—By order of the Inter-Allied Rhineland High Commission, summer time in the German occupied territory came into effect at midnight, January 31st—February 1st.

Appointments Vacant.—Assistant lecturer and demonstrator on electrical engineering (£300), for the Sheffield University Faculty of Engineering; cable jointer, for the Todmorden Corporation Electricity Works; laboratory steward (42s. + 20 per cent. + 23s.), for the Paddington Technical Institute; meter fixer and tester (73s.), for the Colne B.C. Electricity Works; telegraph inspectors (£200 + £65), for the Posts and Telegraphs Department, German East Africa; shift engineer (79s. 6d.), for the City of Peterborough Electricity Department; mains superintendent (£300), for the South Shields Corporation Electricity Works; fitter driver, for the Shoreditch Borough Council Electricity Supply Department; shift engineer (£234) for the Doncaster Corporation Electricity Department; mains engineer (£390) for the Walsall Borough Council Electricity Supply Department. See our advertisement pages to-day.

Pulverised Coal.—The central power station of the Puget Sound Traction, Light, and Power Co., at Seattle, U.S.A., has been converted from fuel oil to pulverised coal, using the waste from a local mine of lignite coal, the coal having a calorific value of 9,000 B.TH.U. and the culm a value of 7,300 B.TH.U., with 25 per cent. moisture, 28 per cent. volatile matter, 26 per cent. fixed carbon, and 20 per cent. ash. Bottom dump wagons operated by an electric locomotive deliver the culm to a bin, from which it is fed to a conveyor belt feeding a single-roll crusher, which is driven by a motor and reduces the material to ¼-in. size, this product being conveyed by an elevating conveyor to a bin. Two conveyors feed the crushed coal to a pair of driers of the Fuller indirect-fired rotary type, fitted with baffles, and having an induced draught created by a fan. Each drier can handle 7 to 10 tons per hour, reducing the moisture to 2·25 per cent., with the outgoing material at a temperature of about 240°. In passing from the driers, the coal slides down chutes, where magnetic separators remove any iron scrap, &c. The dry coal goes to a bin, from which it is fed to a set of Fuller fan pulverisers and a Raymond impact pulveriser. The pulverised coal is delivered to bins over the boilers, and flows by gravity to screw feeders, which convey it to the burners, which discharge it into a combustion chamber 14½ ft. × 8½ ft. and 5 ft. high. There are 10 boilers of 300 H.P. to 600 H.P., the smaller ones being fitted with superheaters. The ash ranges from dust to soft and hard clinker, the latter being crushed and all delivered by a conveyor to an ash-bin.—*Engineer.*

Accident.—At Ashton-under-Lyne, on January 30th, Lance-Corporal Thomas Bent was crossing Whitesere Road, when he came in contact with a "live" electric tramway wire, which was lying in the road. He was thrown to the ground and rendered unconscious. He was taken to the District Infirmary, but did not regain consciousness for several hours.

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The Metric System.—Continuing its energetic propaganda for the metric system, the World Trade Club of San Francisco is sending a large number of letters to British addresses, enclosing postcard petitions addressed to the Board of Trade and to President Wilson.

The Secretary of the Decimal Association has undertaken the counting and classification of the petitions received by the Board of Trade, and the Association hopes that all who receive these letters from the World Trade Club will sign and forward the petitions.

The Telegramaphone.—According to the *Daily Mail*, Major Lionel Guest and Capt. H. O. Merriman have succeeded in producing a device whereby it is possible to dictate a message into a telephone receiver at one end of a wire, and at the other end an automatic recorder inscribes the message on a gramaphone record for later reproduction. The blurring or metallic tone effect is said to be practically eliminated.

Engineering Research in France.—The metallurgical and engineering firms in the Grenoble district are showing a commendable exhibition of independent initiative. Without waiting for a Government vote of credit, more or less problematical, they have gathered together the funds to found a mechanical and metallurgical research laboratory. The laboratory itself is secured, and they have appointed a competent local man as its head. There only remains the acquisition of the needful machinery equipment. This is to be attained partly by purchase and partly by gifts, which have been invited.

Fatalities.—In an attempt to help his mate, who had become entangled with "live" wires, brought down by the storm at Wakefield on Thursday morning last week, near the Kirkgate L. & Y. station, William Riley, railway goods guard, of Wakefield, was killed. His mate, Sam Parks, and he were approaching Kirkgate about 3 a.m., from a passage, when Parks became entangled in telephone wires which were highly charged. Riley, who went to help his mate without regard to his own danger, was himself caught. The telephone wires crossing the street had been broken by the snow, and had fallen across the live overhead wires of the tramway in Kirkgate. A Corporation sub-station attendant, named John Hawkins, came and cut and cleared the wires, but Riley was found to be dead. Parks had been able to get clear by crawling out, and he escaped with burns on the leg and hands. The dead man was 30 years of age. A similar fatality occurred at Huddersfield, where J. Spivey (62) stepped amongst broken wires which had come in contact with an electric street lamp.

Gloucestershire Joint Electricity Authority.—In our report of the proceedings at the meeting of electricity supply authorities at Bristol, in our issue of January 9th, the names of the members of the Committee appointed to draft a scheme were given; to these should have been added that of Mr. J. Herbert Edwards, a director of Stroud Electric Supply Co., Ltd., who represented the company undertakings on the Drafting Committee.

Agricultural Research.—A research department has been established by the Olympia Agricultural Co., Ltd., which is farming no less than 20,000 acres; the director of the department is Dr. Charles Crowther, late Professor of Agriculture in the University of Leeds. It is to be hoped that the various applications of electricity to agriculture will find place amongst the subjects investigated.

Refrigeration.—At a conference held in Paris recently an International Institute of Refrigeration was formed, under the directorship of M. Emile Gouault, the Secretary-General of the French Association of Refrigeration. Seven Special Committees were appointed to deal with various aspects of the Institute's activities—scientific questions, refrigerating materials, general application of refrigeration, transport, instruction and propagation and general economics and statistics. An international convention was drawn up at the conference, copies of which are to be submitted for ratification to all Governments interested in the proposals.

Electric Police Lamps.—The familiar bull's-eye oil lamps used by the London police are to be replaced by electric lanterns. The distribution commenced on January 29th, and will continue daily till the entire force of 20,000 is equipped with them. The lanterns are compact, with two flat sides and a hook for the belt. The accumulators are recharged every day.

The Electrical Treatment of Sewage.—The following is an abstract of a paper on the Landreth direct-oxidation process of electrical treatment of sewage contributed to the *Journal* of the Franklin Institute by Messrs. H. J. M. Creighton and B. Franklin.

In the Landreth direct oxidation process for the treatment of sewage, both electricity and lime are employed. The efficacy of the process depends upon the combination of these agents, neither electricity nor lime alone producing such good results. The electric current liberates at the electrodes oxygen and hydrogen which in the nascent state are claimed to promote the destruction of pathogenic bacteria, and a reduction of the nitrogenous organic matter to albuminoids, peptones, and amino compounds, which are subsequently oxidised to nitrites, nitrates, and carbon dioxide. The presence of lime furnishes not only an alkaline medium which lowers the electrical resistance of the sewage and renders the electrodes passive, thus very greatly decreasing the quantity of iron which passes into solution from the anode, but it also aids in sedimentation. The process differs from others that employ electricity, in that purification is effected neither by the action of dissolved iron as a coagulant, nor primarily by the disinfecting action of nascent chlorine produced by electrolysis.

In the spring of 1918 a million-gallon plant was erected at Easton, Penna., by Mr. Landreth, for demonstrational purposes. Its location in the heart of the residential district and the entire absence of complaints and unfavourable comments indicate that the plant is not considered a nuisance, and that the nearby residents are not annoyed by odours or other objectionable features.

The cost of operating a two-million gallon per day plant is about $31.97, or 58 cents *per capita* per year (20,000 population), of which about 51 per cent. is for labour alone. The number of units can, however, be largely increased without any appreciable increase in the amount of labour necessary to operate the enlarged plant. The *per capita* cost of construction of a direct oxidation plant compares favourably with that of any other process, and the economy resulting from the use of this process is effected largely through a saving in the cost of construction.

Electric Vehicle Progress.—The Bradford Corporation has invited tenders for the supply and delivery of two electric battery locomotives, 60 c.m. gauge, with a haulage capacity of about 10 tons on the level. Six electric vehicles are to be obtained by the Ilford Urban Council for refuse collection purposes. The cost is placed at £1,325 for each vehicle. The County of London Electric Supply Co., Ltd., has placed an order with the General Vehicle Co. for two electric vehicles—a 3½-tonner and a 2-tonner—for coal cartage purposes. The vehicles will be fitted with Craymer unloading gear. Six "G.V." electrics, each of 3½ tons capacity, have been ordered by Whitbread's Breweries, London. The whole of these vehicles will be equipped with Ironclad-Exide batteries. The Electricity Committee of the Manchester Corporation has invited tenders for the supply and delivery of a 2-ton electric lorry and a 10-15 cwt. electric vehicle of the van type. Two "G.V." electrics, each of 2-ton capacity, have been ordered by the Nottingham Corporation Cleansing Department for early delivery. An electric vehicle is to be purchased for use by the Wolverhampton Cleansing Department. The Watford Urban council is considering a proposal for the introduction of a fleet of electric vehicles for refuse collection. Estimates prepared by the surveyor for the provision of a garage, necessary machinery, and electric vehicles are as follows: Four 3½-ton electric vehicles, with bodies, at £1,485 (£5,940); one interchangeable body, £260; one motor generator, £500, switchgear, £200, erection, £100 (£800); garage and generator house, £4,000. The committee anticipates that each electric vehicle will do the work of no fewer than three horses. The recommendation of the committee was that application be made to the Ministry of Health for sanction to a loan not exceeding £11,000, to cover the estimated expenditure.—*Electric Vehicle.*

Electrical Signalling on Railways.—In *La Technique Moderne* for November, 1919, the methods of repeating mechanical signals on locomotives which have been tried in France are reviewed, and a new system of wireless communication, designed to obviate the troubles inherent to mechanical contact devices, is described. This system has been developed by M. Augereau, and is to be installed on the State railways. Alongside of the mechanical signal a simple wireless set similar to that used by the army in the war is fixed; it consists of a small induction coil giving a 3-cm. spark with an 8-volt battery, a spark gap, and an antenna consisting of a copper wire 15 m. long, supported horizontally parallel to the track at a height of 1.5 m. One pole of the battery is earthed; the other is connected to an insulated rail by way of the primary of the coil, and a switch connected with the signal closes this circuit when the signal is put at "danger." No current passes, however, until the insulated rail is earthed by the passage of a train over it, when the coil is energised and hertzian waves are emitted. As the passage of a long train would operate the apparatus for an unnecessarily long time, two "economy treadles" are inserted in the primary circuit at a suitable distance apart, and are provided with dash-pots which delay their action, so that the signal is only given, and the battery is only in operation whilst the leading wheel is passing from one treadle to the next. On the locomotive a local battery, an electromagnet, and a coherer are connected in series, and a copper antenna is connected to the coherer, the other pole of which is earthed. As the antennæ are close together when the locomotive is passing the signal, the coherer is excited by the electric waves and permits the battery current to flow through it, actuating the electromagnet, and thereby tripping mechanism which sets a steam whistle in operation. A rather complicated locking apparatus is associated with the system, for the purpose of registering on the speed-recorder the operation of the signal, and its cancellation by the driver; it will be observed that the system only functions when a locomotive *runs past* a signal which is at "danger."

Many accidents have taken place on the French railways through failure to observe the mechanical signals, and the Ministry of Public Works has therefore decided to install the Augereau system on all the State railways and locomotives as soon as possible.

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Load Dispatching in Central-station Systems.—A description is given in the *Electrical World* of the system operator's department in the Philadelphia Electric Co.'s system. The principle of controlling the equipment under the orders of a load dispatcher was inaugurated ten years ago, when there were only two generating stations and a dozen sub-stations in the system. There are now ten generating stations, 28 regulator sub-stations, and 45 industrial sub-stations. An automatic record chart is provided in three large panels, containing in symbolic form every single apparatus with which the operator is concerned. There are about 800 signal lights on this board, denoting the various pieces of apparatus in service. These lamps are operated from a key-board in the load-dispatcher telephone exchange, and provide an extra representation of the whole system at every moment. In addition to complete telephone communication, a telautograph system is provided, and the whole equipment is considered to be a good model to follow in organising a load dispatching system for a complex network. The network controlled by the Philadelphia system covers an area of 245 square miles, and includes a generator capacity of 240,000 K.V.A. The load dispatcher's responsibility extends from the boilers to the distribution circuits, and includes the generation, transmission, and distribution of the proper amounts of energy. The dispatcher computes the demand to be met, schedules it on to the various stations, ascertains that each station has sufficient steam and electrical capacity to carry the proposed load, and that there is sufficient reserve equipment in each station. In order to do this, he maintains records showing the load required by each sub-station and distribution circuit. No switching is done without his instruction, except the standardised operations provided for emergencies. No set is started or stopped, and no apparatus is worked upon without a permit from the dispatcher, who is also responsible for all blocking and for the testing of new and repaired equipment.

Electrified Seed.—The January number of the *Journal* of the Ministry of Agriculture contains, among other interesting features, a report by Mr. E. J. Russell, Director of the Rothamsted Experimental Station, relating to the electrolytic treatment of seeds (Wolfryn process), described in our pages on several occasions last year. The writer states that during the past three seasons there has been offered to farmers seed treated by this process which, it is claimed, causes marked increase in yield. The cost of the treatment in the case of wheat seed is about 28s. per quarter, which works out at about 7s. to 10s. 6d. per acre. Mr. Russell, after examining the results of experimental tests, concludes that the failure of electrified seed to give any increase in yield under the carefully controlled conditions of an experimental station trial, shows that the process lacks certainty. "It cannot be compared in effectiveness with manuring, which succeeds nearly every time if properly done." The risk of failure seems so great, he adds, that the farmer should look upon it as an adventure which may or may not prove profitable.—*Morning Post.*

INSTITUTION NOTES.

Institution of Electrical Engineers.—The annual dinner of the North-Eastern Centre was held in Newcastle-on-Tyne on January 30th, under the presidency of Mr. W. Cross, the local chairman, who was supported by the Lord Mayor of Newcastle (Mr. Walter Lee) and Mr. Roger T. Smith, President of the Institution. The loyal and patriotic toasts were honoured, the chairman remarking upon the many applications of electricity made during the war. Mr. A. P. Pyne then gave the health of the President and the Council of the Institution, who devoted a large part of their energies to looking after the interests of electrical engineering, and particularly those of the 8,200 members. The President, in replying, said that during the war the idea of service gripped the individual of almost every class, but now, probably through re-action, the idea of service seemed to have departed altogether from the ideas of the wage-earner. The wage-earner had demanded a shorter day, and very rightly, but in order that he might enjoy that shorter day, professional men and members of the middle classes had had to work longer hours without any extra pay. The intellectual Socialists had always claimed that service for the State was the ideal, and even some of the members of the Miners' Union had stated that if the mines were all nationalised the miners' hearts and ideas would be changed by some miracle, and they would at once give willing and full service and increase the output of coal. That, he thought, had to be taken with a grain of salt, and it seemed to be left to the professional and middle classes, and to those to whom service for their country was a sort of family tradition, to refute the doctrine that organised selfishness was the only way in which they could continue their social and industrial life. He believed that service and sacrifice were alone worthy of the highest condition of a civilised state. Speaking of the work of the Institution, he said their greatest asset was the Territorial Centres, and the increase, or decrease, of the value of that asset depended very largely upon the Centres themselves. Its value would be best increased if the members of the Territorial Centres would keep before them the ideal of service for the Institution and the industry which the Institution represented.

Mr. H. W. Clothier proposed the toast of "The City of Newcastle." He said that the huge electrical developments emanating from the men of Newcastle were maintaining the city's name for originality and greatness. In that district they had an electric power system covering 1,000 sq. miles, with a huge mesh-work of copper connections, and the system was becoming a model not only for England but for the whole world.

The Lord Mayor responded, and alluded to the part played by the members of the electrical profession in the war.

The health of "The Guests" was submitted by Mr. J. R. Beard, to which Mr. H. Shaw and Mr. Ll. B. Atkinson responded.

Liverpool Sub-centre. — As reported in our issue of January 30th, this Sub-centre was opened on January 19th, when Prof. Marchant, D.Sc., delivered his inaugural address. The Vice-Chancellor of the University (Dr. Adami) heartily welcomed the members, and said that electrical power and transmission was a question of great importance to the University. Mr. Roger T. Smith, President I.E.E., referred to the activity of the Institution, indicated by the way in which branches had sprung up in so many parts of the country. He reminded his audience that the future of the Institution was, to a great extent, in the hands of these Centres and Sub-centres, and he hoped that the members would feel that it was their duty to support the Council and President in every way possible. Mr. Smith said that Prof. Marchant was a very valuable member of the Council, and the members were to be congratulated upon securing him as chairman. Mr. C. H. Wordingham, C.B.E., said that the primary reason for the formation of sub-centres was that it was as impossible for many members to attend Territorial Centres as to meet in London. It was undesirable to form new *centres* for these districts—first, on account of the comparatively small number of members, and also because, under the constitution of the I.E.E., the chairmen and past chairmen of Centres were entitled to seats on the Council, and, therefore, if there were too many centres, the elected members of the Council would be entirely outnumbered. He recommended specialisation in wireless telegraphy and the equipment of ships, as being the most important branches of electrical work for Liverpool. Dr. Marchant then read his address, of which an abstract appeared in our last issue. Mr. Dickinson proposed a vote of thanks to the chairman, which was seconded by Mr. G. H. Nisbett. Prof. Marchant, in his response, said that thanks were due to the Vice-Chancellor and Messrs. Roger T. Smith and C. H. Wordingham for attending and addressing the meeting. He regretted that Mr. J. H. Robertson, the chairman of the North-Western Centre, was forced to be absent on account of a prior engagement.

Informal Meeting.—On Monday evening last there was a full attendance to hear Major T. Rich's paper on "Engineering Experiences During the War." The author dealt largely with the administrative system which was in force on the Western Front, and levelled a telling indictment against the methods adopted in connection with the Engineering Department, which only too often resulted in the appointment of officials who were wholly ignorant of their functions, the employment of apparatus utterly unsuited to its purpose, and an appalling amount of inefficiency and wanton waste of money. The enemy, on the other hand, not only employed competent engineers, but also gave them adequate authority to carry their plans into execution, with the result that the resources of engineering were utilised to the full against us; the French also attained a high standard of efficiency in their engineering work. Major Rich made it clear that his criticisms were directed not against the *personnel* of the Royal Engineers, but against the effete system of training and administration which made such things possible, and which unquestionably greatly prolonged the war, besides adding to the cost enormously. He also gave an account of the electrical engineering methods and apparatus that were employed in the field. An interesting discussion followed, in which many members who had been actively engaged in engineering operations in the various fields of war took part.

Western Centre.—At the meeting at Cardiff on Monday evening last, the chairman (Mr. Arthur Ellis) presided over an excellent attendance, and stated that the suggestion of holding a summer meeting of the Institution in the area covered by the Western Centre had received a most gratifying reception at headquarters, and the details for arrangements had been relegated to a Sub-Committee. The date provisionally selected was Monday, July 12th, and the proceedings would last until the following Friday. Members were urged to use every endeavour to ensure the success of the meeting. In consequence of continued pressure of business, one of the joint hon. secretaries (Mr. A. J. Newman) had found it necessary to resign the duties appertaining to that office, and Mr. A. J. Ostler (Bristol Corporation Electricity Department) had accepted the vacant post. After the transaction of routine business, the paper of Messrs. A. G. Ellis and J. L. Thompson on "Large Power Transformers" was read by Mr. A. G. Ellis, and discussed. Prior to their departure for Bristol, the members and visitors from that city enjoyed the hospitality of the chairman.

East Midland Sub-Centre.—A sub-centre has been formed, with headquarters at Loughborough, and Mr. F. S. Grogan, M.I.E.E., has been invited to act as chairman. Meetings will be held at Loughborough, Derby, Nottingham, and Leicester. The inaugural meeting took place on February 3rd, at the Technical College, Loughborough.

Association of Mining Electrical Engineers.—At a meeting of the Birmingham Branch on January 24th, Captain Douglas Wilson read a paper on "The Semi-Diesel Crude Oil Engine." The speaker pointed out the incorrectness of the name applied to the engine, and said it was preferable to describe it as a surface ignition engine, having as an essential feature an uncooled portion of the combustion chamber normally at high pressure, which augmented the heat generated by compression. Mr. E. P. Hollis, who presided, spoke upon "The Advantages of the Oil Drive."

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Edinburgh Electrical Society.—On January 28th a paper on the "New Regulations for Electrical Ship Equipment" was read by Mr. D. S. Munro, M.I.E.E., and discussed by the members present. In view of the inability of Mr. Plucknett to have special petrol-gas plant forward for demonstration in time for the next meeting, his paper has been postponed. Mr. Law, of the Royal Infirmary, has volunteered to deliver a lecture on Wednesday, February 11th, the subject being "The History and Development of X-Ray Apparatus." The lecture will be of special interest, and is to be illustrated by lantern slides. It will be held at the Philosophical Institute at 8 o'clock.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Mr. E. W. SELLS, manager for Oswald Jones & Co., electrical and power engineers, of Maidstone, has returned from service in Mesopotamia and rejoined the business.

Colonel H. C. SPARKS, C.M.G., D.S.O., M.C., M.I.E.E., M.I.Mech.E., has been appointed a governor of Faraday House Engineering College, where he was a student from 1891-1892.

Friends of Mr. J. WILKINSON, M.I.E.E., M.I.Mech.E. (who recently resigned his position of tramways electrical engineer to the City of Hull Corporation), will be sorry to learn that he is at present undergoing a serious operation at the Royal Infirmary, Hull.

Mr. J. H. CASTELL has resigned his position with the British Thomson-Houston Co., Ltd., after 15 years' service at Rugby and Willesden. Upon leaving he was presented with a gold watch by his colleagues. Mr. Castell is taking up steelwork and foundry agency work at Clun House, Surrey Street, Strand, W.C., and will represent, amongst others, Messrs. S. Wheeler & Co., constructional engineers, Smethwick.

Mr. E. KILBURN SCOTT, who has been in New York for the past two years, was in Canada last month on a visit, and on January 6th he was to deliver an address at a meeting of the Canadian Club at Owen Sound, Ont.

Over 200 applications have been received for the post of an engineer to supervise the mechanical and electrical engineering work at Edinburgh, particularly in connection with the baths and wash-houses. A sub-committee of the town council is to draw up a short list.

Mr. F. WALTON, of Bradford, has been appointed chief constructional engineering assistant to the Southend-on-Sea Corporation Electricity Works, at £400 per annum.

Mr. Y. SAVILLE has been appointed assistant manager of the Plymouth tramways undertaking.

Burnley Town Council has decided to increase the salary of Mr. H. MOZLEY, tramways manager, from £500 plus £75 war bonus per annum, to £675 per annum including bonus.

Burnley Electricity Committee has recommended the following increases: Mr. J. E. STARKIE, chief engineer, from £674, including £73 bonus to £800 per annum; Mr. T. B. NUTTER, chief assistant, from £330, including £80 bonus, to £360 per annum.

The salary of the tramways manager at Haslingden has been increased to £350 per annum.

Commander J. R. SCHOFIELD, principal of the Swansea Wireless Training College, has been presented by ex-service students of the college with a barometer.

Newport (Mon.) Electricity and Tramways Committee has recommended that the salaries of Mr. A. N. MOORE, electrical engineer, and Mr. N. J. YOUNG, tramways manager, be increased, as from January 1st last, to £800; from April 1st to £850, and from January 1st, 1921, to £900.

Mr. S. G. POOLE, shift engineer at the Peterborough Corporation electricity works, has been promoted to the position of second assistant engineer.

For the post of assistant engineer to the Willesden District Council electricity department, 130 applications were received. Three were selected to appear before the Electricity Committee, and Mr. I. D. SPARKS was appointed.

Mr. FRANK H. GALE informs us that owing to ill-health he has resigned his position with Messrs. Isaacson & Brown, Ltd., with whom he has been for fourteen years.

The St. Helens Town Council is recommended to increase the salary of Mr. B. T. HAWKINS, the Corporation electrical engineer, from £500 to £600 per annum.

Obituary.—MR. J. W. PENFOLD.—The death occurred on January 28th of Mr. James William Penfold, who was chairman of Messrs. Page & Miles, Ltd., electricians, of Brighton. He served on the Town Council for over 15 years.

MR. W. J. KEMBER.—We regret to learn that Mr. William James Kember, of The Nest, Finwood Hill, Warwickshire, died of pneumonia on January 27th, aged 67 years. He was well known to manufacturers in the metal trades throughout the country as a representative of Messrs. W. Canning and Co., of Birmingham, having been in their service over 26 years until his retirement in 1918.

THE PROGRESS OF AUTOMATIC SUB-STATIONS IN U.S.A.*

THE first automatic sub-station control was put into operation on Christmas Eve, 1914, in the Union sub-station of the Elgin and Belvidere Electric Railway, and in the following August the two remaining sub-stations of this road were equipped. The success of the venture immediately attracted the attention of railway engineers, so that several automatic-control equipments and complete sub-stations were purchased and installed in 1916. It is of interest to note that the second railway company to install an automatic railway substation decided to operate a semi-outdoor station, provision being made for housing only a 500-KW. rotary converter, the switchboard and the drum controller. At this time two other systems decided to install a total of 12 automatic equipments. One of these early installations was the first portable automatic sub-station. In 1917 the first installation involving the operation of two synchronous converters in series was made, and in 1918 two synchronous converters were first automatically operated in parallel. Two more portable automatic sub-stations were put into service in this year. Four and one-half years after the first experiment was made there were 35 full-automatic and two semi-automatic, or remote-controlled sub-stations in actual operation, and an additional 31 automatic and four semi-automatic equipments stood on order with manufacturers. These 72 equipments control several types of synchronous converters and motor-generator sets of capacities varying from 200 to 2,000 kilowatts.

On May 1st a number of control equipments sufficient to control 37,500 KW. of rated machine capacity had been purchased. Thus far the tendency has been to apply automatic control more generally to machines having rated capacities of 500 KW. and under, the total number of machines coming within this range being 58. This number includes twenty 300-KW. and twenty-eight 500-KW. units. A good start is, however, being made on machines of larger capacity, as one 1,000-KW. synchronous converter is now operating automatically and six 1,000-KW. synchronous converters, one 1,000-KW. motor-generator set, two 1,500-KW. synchronous converters, and one 2,000-KW. motor-generator sets are on order, and will probably be put in service before the close of 1919.

While 44 stations are to receive 25-cycle energy, a total of 18 stations are to receive 60-cycle energy, and eight stations will operate at odd frequencies, including 30, 35, 40, and 50 cycles. The high-tension line voltage varies from 2,200 to 66,000. The trolley voltage supplied is generally standard at 600 volts direct current, excepting one 1,200-volt direct-current system and one 1,500-volt direct-current system.

While the largest synchronous converter yet to be automatically controlled is a 1,500-KW. machine, and the largest motor-generator set a 2,000-KW. machine, there is at the present time in operation a 3,000-K.V.A. synchronous condenser. The first automatically controlled waterwheel generating station, which contains three 500-KW. generators arranged to operate in parallel either under the influence of full-automatic control at the generating plant or controlled if desired by an operator in the main steam-generating station at a distant point, was put in operation in 1918. The success of this installation without question makes possible the development of a considerable number of small water powers that otherwise could not be developed because of the cost of operating labour.

Several companies have chosen automatic equipment in consideration of the saving possible from the elimination of light load losses, as well as from a consideration of saving in labour. The largest figures received gave an estimated saving of $400 per annum on a 300-KW. station, and $700 on a 500-KW. station. One company installed a 250-KW. automatic station to replace a floating battery between two sub-stations ten miles apart, in preference to spending $5,000 for necessary repairs to the battery. When some of the automatic sub-stations were built in new locations, however, it was in several cases possible to remove feeder copper which possessed a value sufficient to offset in part the cost of construction of the sub-station building with its equipment. In an exceptional case the cost of construction of a two-unit sub-station containing two 300-KW. synchronous converters was more than offset by the value of the feeder copper that was removed from the distribution system, and a more satisfactory line voltage was maintained on the line as a whole. The most notable saving in copper was made in Des Moines, where, through the installation of a system of automatic sub-stations, an amount of feeder copper was taken down which, at 20 cents per pound, was worth $90,200, and at the same time a sub-station and distribution system were obtained which cost according to estimate $141,700 less than an equivalent system to give the same voltage regulation would have cost, had additional manually operated synchronous converters been placed in the central power station and additional feeder copper put up on the outside lines. As an example of another exceptional case, it has been estimated that one important interurban line in central New York

*Abstract in *Power* from the report of the Committee on Power Generation presented at the convention of the American Electric Railway Engineering Association, at Atlantic City, N.J., October, 1919.

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State, "because of its surplus feeder capacity can, by adopting automatic sub-stations and removing part of this copper, make an annual saving of $24,000 with approximately zero investment." These examples are unusual, but are given to illustrate the possibilities that are offered in not a small number of cases.

It was brought out in the discussion on this report that at the present time the economic limit in automatic sub-station capacity is about 6,000 KW.; above 6,000 KW. it is more economical to install manually operated equipment.

NEW COMPANIES REGISTERED.

W. B. & J. Bain, Ltd. (10,912).—Private company. Registered in Edinburgh January 21st. Capital, £7,000 in £1 shares. To acquire the business of general and electrical engineers and merchants, agents for manufacturing engineers, carried on by W. B. Bain and J. Bain, at 52, Robertson Street, Glasgow, as W. B. & J. Bain. The subscribers and directors (each with one share) are: W. B. and J. Bain, engineers, both of 52, Robertson Street, Glasgow. Secretary: A. McLean. Registered office: 52, Robertson Street, Glasgow.

Bernard Tomlinson, Ltd. (10,911).—Private company. Registered in Edinburgh January 21st. Capital, £3,000 in £1 shares. To acquire the business of a heating engineer formerly carried on by the late B. R. Tomlinson in Glasgow. The subscribers (each with one share) are: Mrs. A. Tomlinson, 969, Argyle Street, Glasgow; and J. E. Polding, 54, Hyde Street, Townhead, Glasgow, heating engineer and manager. The directors are: Mrs. A. Tomlinson, J. E. Polding and P. Daly, jun., 3a, Great Hamilton Street, Glasgow. Solicitors: Donaldson & Turnbull, 97, Willington Street, Glasgow

Staffordshire Electrical Accessories Co., Ltd. (163,356).—Private company. Registered January 27th. Capital, £6,000 in £1 shares. To take over that portion of the business belonging to H. F. Howells and A. Douglas which relates to the repairing and overhauling of dynamos, motors and all kinds of electrical apparatus, electrical wiring, buying of motors and dynamos for sale, and sale of electric light accessories, carried on at 21a, Lichfield Street, Hanley, Staffs. The first directors are: H. F. Howells, 40, Lichfield Street, Hanley; A. Douglas, Norrisdene, Imperial Road, Matlock, Derbyshire. Solicitor: R. W. Beswick, 4, Bagnall Street, Hanley. Registered office: 21a, Lichfield Street, Hanley.

Brolt, Ltd. (163,372).—Registered January 28th. Capital, £50,000 in £1 shares. Objects: To take over the business of electrical and mechanical engineers, and manufacturers of and dealers in electrical apparatus, plant, fittings and apparatus of all kinds, carried on by Brolt, Ltd. (incorporated in 1911), at Birmingham and elsewhere. Minimum cash subscription 7 shares. The first directors are: B. Brooks, Blackwell Court, near Bromsgrove, Worcs.; A. C. Johnson, Napur, Wylde Green, Birmingham; A. Brown, Sayling Hurst, 138, Stamford Hill, N.; E. Brown, 2, Chesterfield Gardens, Hampstead, N.W.; H. W. Alexander, 83, Bunbury Road, Northfield, Birmingham. Solicitor: R. Pinsent, 6, Bennetts Hill, Birmingham.

Small Power Dynamo and Motor Co., Ltd. (163,409).—Private company. Registered January 28th. Capital, £5,000 in £1 shares. Objects: To take over the business of electrical and mechanical engineers, carried on by A. Radcliffe and F. S. Blakey at 129, Old Lane, Higher Openshaw, Manchester, as the "Small Power Dynamo and Motor Co." The subscribers (each with one share) are: A. Radcliffe, 18, Ackeroyd Avenue, Gorton, Manchester, electrical engineer; F. S. Blakey, Rosslyn, Grangethorpe Drive, Levenshulme, Manchester, electrical engineer. Permanent directors: A. Radcliffe and F. S. Blakey. Qualification, £100. Registered office: 129, Old Lane, Higher Openshaw, Manchester.

British East Africa Power Development Co., Ltd. (163,345).—Private company. Registered January 27th. Capital, £1,000 in £10 shares. The company is formed as a subsidiary company to the British Water Power Development Co., Ltd., to acquire, and if necessary extend (1) the Thika Sisal Hydro Electric plant; and (2) the head works and rights of Messrs. Swift, Rutherford & Co. on the Maragua River, both in Fort Hall District, British East Africa; to acquire all present and future rights, contracts, licences and concessions for the supply of hydro-electric power in British East Africa; to promote the development of hydro-electric, electric, hydraulic and water power (primarily in East and Central Africa), &c. The first directors are: D. Spencer, 1, Hall Place Gardens, St. Albans, director, British Water Power Development Co., Ltd.; R. H. Mackenzie, 5, Gordon Road, Ealing, W., director, British Water Power Development Co., Ltd.; W. F. Harwar, 10, Dulta Road, New Wandsworth, S.W., secretary, British Water Power Development Co., Ltd., and secretary, Tripline Investment Corporation, Ltd. Solicitor: L. M. Parkin, 114a, Chancery Lane, W.C. Registered office: 41, Parliament Street, S.W.1.

Power-Rectifiers, Ltd. (163,400).—Private company. Registered January 28th. Capital, £20,000 in £1 shares. To carry on the business of electrical and mechanical engineers, manufacturers of and dealers in transformers, mercury-arc rectifiers and accessories appertaining thereto, &c. The first directors are: G. Boner, Baden, Switzerland, manufacturer; A. C. Eborall (managing director), 9, Old Queen Street, Westminster, S.W., electrical engineer. Solicitor: W. T. Holland, 65, Bishopsgate, E.C.

Petter Gauge and Precision Tool Co., Ltd. (163,458).—Private company. Registered January 29th. Capital, £100 in £1 shares. To carry on the business indicated by the title. The subscribers (each with one share) are: V. G. Medley, 23, Austin Friars, E.C., chartered secretary; J. E. Batey, Greencroft, Old Farm Road, Sidcup, engineering works manager. Table "A" mainly applies. Secretary: V. G. H. Medley. Registered office: 23, Austin Friars, E.C.

Paxton's (Cardiff), Ltd. (163,221).—Private company. Registered January 23rd. Capital, £3,000 in £1 shares (1,000 founders). To take over, as from February 1st, 1919, the business of electrical engineers carried on by A. Paxton and H. W. C. Hinchley at Regal Works, Whitchurch Road, Cardiff. The first directors are: A. Paxton, 82, Westbourne Road, Penarth, engineer; H. W. C. Hinchley, 348, Whitchurch Road, Cardiff. Solicitor: A. Giles, 34, Queen Street, Cardiff.

National Electric Signs, Ltd. (163,301).—Private company.—Registered January 26th. Capital, £5,000 in £1 shares. To carry on the business of electric and illuminated sign manufacturers as formerly carried on by H. H. Scott and G. I. Scott at 57-59, Long Acre, W.C., as the "National Electric Sign Co." The subscribers (each with one share) are: W. J. Hosea-Ward, 20, Aylestone Avenue, Brondesbury, N.W.6, manufacturer of electrical goods; H. H. Scott, 59, Long Acre, W.C., electric sign manufacturer. The subscribers are to appoint the first directors. Registered office: 61 and 62, Lincoln's Inn Fields, W.C.

T. C. Smith, Ltd. (10,917).—Private company. Registered in Edinburgh January 23rd. Capital, £50,000 in £1 shares. To acquire from J. Duncan Nos. 21-25, Bon-accord Street, Aberdeen, the business carried on by him there as a motor and electrical engineer, &c., under the name of "T. C. Smith & Co." The subscribers (each with one share) are: J. Duncan, Tillycorthie, Odny, Aberdeenshire, mine owner; E. Milne, 21, Bon-accord Street, Aberdeen, manager; R. Watt, Bon-accord Street, Aberdeen, banker. The first directors are: J. Duncan, E. Milne and R. Watt. Registered office: 21, Bon-accord Street, Aberdeen.

Cowlishaw, Walker & Co. (1920), Ltd. (163,075).—Registered January 21st. Capital, £150,000 in £1 shares. To take over the business carried on at Etruria, Staffs, by Cowlishaw, Walker & Co., Ltd., and to carry on the business of manufacturers of and dealers in engines, boilers, colliery plant, brick and tile machinery, builders' plant, pumps, hoists, cranes, electrical appliances, &c. The directors are: E. W. Haig, Gatehampton House, Goring-on-Thames, director of Industrials, Ltd.; F. W. Poynor, 10, Gerrard Road, Barnes, S.W., director of Robert Warner & Co. (Engineers), Ltd.; W. A. Hunter, Charlton Lodge, Thornton Heath, managing director of Industrials, Ltd.; J. A. Edmondson, Woodville, Trentham Road, Stoke-on-Trent, joint managing director of Cowlishaw, Walker & Co., Ltd. Solicitors: Slaughter and May. Registered office: 14-16, Cockspur Street, S.W.

British Generator Co., Ltd. (163,515).—Private company. Registered January 30th. Capital, £5,000 in £1 shares. To take over the business of an electrical and mechanical engineer carried on by W. A. Hymas at 481, Oxford Road, Reading, as "W. A. Hymas & Co.," together with the rights of the said vendor in an invention for an electric lighting apparatus. The first directors are: W. A. Hymas, 481, Oxford Road, Reading; J. S. Mills, Woodview, Newton Abbot, Devon. Solicitor: F. J. Radcliffe, 1, Blagrove Street, Reading. Registered office: 481, Oxford Road, Reading.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Reform Lighting Co., Ltd.—Satisfaction registered December 19th, 1917, of £900, balance of charge for £2,750, registered March, 1913.

Browning & Lambert, Ltd.—Mortgage on Manor House stables, Folkestone, registered December 17th, 1919, to secure all moneys due or to become due from the company to L.J.C. & Midland Bank, Ltd.

English Electric Co., Ltd.—Mortgage on the company's undertaking and property, present and future, including uncalled capital, registered December 16th, 1919, to secure all moneys due or to become due from company to Lloyd's Bank, Ltd., not exceeding £500,000.

Cutting Bros., Ltd.—Particulars filed December 12th, 1919, of £20,000 2nd debentures, charged on the company's undertaking and property, present and future, including uncalled capital, amount of present issue being £12,000.

CITY NOTES.

Anglo-Argentine Tramways Co., Ltd.—In reply to many inquiries, the directors announce that the Municipality of Buenos Ayres, recognising the justice of the claim to an increase of fare to meet charges which were never contemplated when the concession rate was fixed, have sanctioned a conditional increase from 10 cents (the fare fixed by the company's concession) to 12 cents. It is hoped that the increase, which is to come into operation 90 days after promulgation of the ordinance, will place the company in a position, in the near future, to meet the pressing demands of Labour for increased wages, the cost of the reduction of the working day to eight hours, and its obligations under the new Pension Law, besides contributing materially towards the extra cost of working for which the abnormal price of fuel is largely responsible. The increased fare cannot affect the accounts for the year 1919 (which have had to bear the burden of heavy fuel charges), but will be in force during the major portion of the current year. The directors hope the alteration will enable them to resume, at an early date, payment of dividends on the first preference shares, which, since July 1st, 1917, have been passed.—*Times*.

Stock Exchange Notice.—Application has been made to the committee to allow the following to be officially quoted:—

Melbourne Electric Supply Co., Ltd.—£12,674 consolidated ordinary stock.

Llandudno & Colwyn Bay Electric Railway, Ltd.—For the year ended November, 1919, the profit was £5,196 (plus £387 brought forward), after providing for debenture charges. £1,860 is put to sinking fund, a dividend of 4 per cent. per annum (less tax) requires £2,785, and £940 is to be carried forward. There have been heavy increases in operating charges, owing to additions to pay and in maintenance charges, owing to exceptional expenditure upon repairs to and renewals of rolling stock and permanent way. The existing rolling stock is now in sound condition, and a small addition to the number of cars is now under consideration. The sinking fund instalment due on January 1st has been charged against the revenue for the year, and no further provision has been made for depreciation of the system.

Capital Increases in Germany.—The directors of the Bergmann Electricity Works Co. ask for authority to issue debentures up to 20,000,000 marks in case of necessity. The Duisburg Cable Works Co. propose to raise the share capital from 3,000,000 to 6,000,000 marks by the emission of new ordinary shares, each having triple voting powers. The share capital of Max Schorch & Co., of Rheydt, is to be increased from 2,625,000 to 10,500,000 marks; and an augmentation from 6,000,000 to 12,000,000 marks is to be carried out by the Dr. Paul Meyer Co., of Berlin.

Western Telegraph Co., Ltd.—The directors have decided to pay in March a dividend of 2½ per cent., and in the subsequent quarter a similar dividend, the intention being to pay a final dividend of 3½ per cent., making 10 per cent., free of tax, for the year, paying no bonus. 100,000 ordinary shares are to be issued to meet expenditure which is being incurred to add to and improve the cable services. They will be offered at par to shareholders.

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Eastern Telegraph Co., Ltd.—The directors have decided to pay in May a final dividend for 1919 of 5½ per cent., making 10 per cent. for the year, free of tax, paying no bonus. £1,000,000 ordinary stock is to be issued to meet expenditure which is being incurred to add to and improve the cable services. It will be offered at par to holders of the ordinary stock.

Eastern Extension Australasia and China Telegraph Co., Ltd.—The directors have decided to pay in May next a final dividend for 1919 of 5½ per cent., making 10 per cent. for the year, free of tax, paying no bonus. 100,000 shares are to be issued to meet expenditure which is being incurred to add to and improve the cable services; they will be offered at par to shareholders.

City of Buenos Ayres Tramways (1904) Co., Ltd.—Balance dividend 1s. 3d. per share, making 5 per cent. per annum, less tax. To general amortisation fund, £6,200; carried forward, £138.

Mann, Egerton & Co., Ltd.—For the year ended September, 1919 (that is prior to the issue of the recent prospectus), dividend of 40 per cent. on 30,000 ordinary shares, carrying forward, subject to excess profits duty, £48,684.

Westminster Electric Supply Corporation, Ltd.—Dividend for the half-year ended December, 1919, at the rate of 13 per cent. per annum, less tax, making 10 per cent. for the year.

Calcutta Electric Supply Corporation, Ltd.—Units sold to consumers during four weeks ended December 26th, 1919, 2,224,603, compared with 2,000,352 in 1918.

STOCKS AND SHARES.

TUESDAY EVENING.

THE difficulty this week is to know where to begin. Through all the ten decades—as they seem—that this hand has weekly (*sic*) written under the above heading, no one week can be recalled in which there have occurred such dramatic rises in cable stocks and electricity supply shares simultaneously. Eastern Telegraph went up 30 points last Thursday. City of London Electric ordinary has gained a pound per share in two days. And there are other rises to match. However cramp-ridden the hand, the thrill of such sensations reaches it. There is a genuine glow of satisfaction at being able to chronicle price-movements that must bring so much pleasure to the real investor; nor is the satisfaction lessened by the fact that it is purely sympathetic, and (unhappily), impersonal.

All of which, the Able Editor may parenthetically and chillingly remark, is distinctly out-of-place in an ordinarily staid, slightly dull feature of this paper.

Eastern Telegraph ordinary touched 220, a rise of 50 points, in a day. Eastern Extensions at 22 were 5½ up, Westerns at 23 showed a gain of the same amount, and Globe ordinary at 21 were about 5 better. The market, indeed, went off its head. Certainly there had been no expectation of the dividends going up to 10 per cent. on Easterns, Chinas and Westerns. Such a thing was not so much as intelligently forecast in these columns. But, of itself, the increase in the dividends would not have had an effect like this. It is the announcement of the new stock and shares to be offered at par which provides the cause of the excited rises. This is melon-cutting to some purpose, and if it be due in any way to a desire to get ahead of Budget possibilities, the cable companies' proprietors may feel that there yet remains balm in Gilead.

The full extent of the rises has not been held, as references to our tables show, but the net result of the week's work is startling enough to leave a feeling of the gratitude which is a lively sense of further favours to come, in the minds of those who await the substantial premiums which will be established, as a matter of course, upon the new issues after the preliminaries are over and the allotments make their appearance.

And should any investor, who has perhaps been moved to put money into these securities upon the strength of suggestions frequently made here, ask whether the present profit should be taken, the reply is that it would be difficult indeed to replace the stocks with anything equally sound.

Great Northern Telegraphs are £3 up, and Telegraph Constructions gained another 10s. at 27½. Henleys are 3-16 higher at 2 9-16 and Callender's ⅛ at 9¾, all of which advances are due to the strength of the Eastern market. Anglo-American deferred is 1½ better. United River Plate Telephones have recovered 2s. 6d. Automatic Telephones, after a dip to 30s., rallied to 34s. 6d. The report is due next month. Some of those who know—and Stock Exchange experience counsels especial caution in such a case—speak of a probably poor, or at best colourless, report, after which it may be right to "take your seats for the rise" if the price goes back at all. Last year the dividend was 6 per cent., the 1s. 2½d. being paid in March.

The all-round advance which has occurred throughout the list of electricity supply shares is due in the first place to the increased dividend declared by the Westminster company, which has led to expectations of similar improvements in the cases of the other companies. City of London ordinary has risen a pound this week to 14, because of the expectation of a bonus, so that those who bought the shares when this idea was first mooted in these columns three or four weeks ago have now a substantial profit. Nearly all the ordinary shares in the group are higher. With the outlook changed for the better, it is not surprising that holders decline to sell, the result being that there is little supply of stock available, and consequently prices are quick to respond to any demand.

The manufacturing list is generally good. As already noted, Callender's and Henley's have followed the rises amongst cable issues. Metropolitan-Vickers preference jumped 5s. to 3 1-16. Electric Constructions are better at 25s. No particular change has occurred in General Electrics. The air continues thick with gossip about amalgamations and new issues, and is rendered exhilarating by various denials. So prompt are the latter as a rule that it would appear to be simply asking for contradiction if the possibility were suggested of the General Electric Co., for instance, making a new issue next month of ordinary shares at 27s. 6d. per share, to be offered to shareholders in the proportion, shall we say, of one new share for every three at present held. The engineering group is also hard, Babcock's improving to 3½.

Bombay Electric Trams have further soared to 112, and the preference at 15¼ are £1 up. Some people think that there is more than a fight for control going on. The Mexican list is heavy, and British Columbias have given way after their big rises. Brazilian Tractions recovered a point. Anglo-Argentines are a little easier. Rubber shares are somewhat colourless. Amongst armaments, Vickers & Armstrong display firmness. The Home Railway market is irregular, with Undergrounds flat on the uncertainty that envelopes the future of the Tubes.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1917.	Dividend 1918.	Price Feb. 3, 1920.	Rise or fall.	Yield p.c.
HOME ELECTRICITY COMPANIES.					
Brompton Ordinary	10	8	6	+ ½	£6 13 4
Charing Cross Ordinary	4	4	3⅝	+ ⅛	5 18 6
do. do. do 4½ Pref.	4½	4½	2½	—	8 8 8
Chelsea	5	3	3½	+ ½	4 12 4
City of London	8	8	14	+1	5 14 4
do. do. 6 per cent. Pref.	6	6	9⅝	+ ½	6 4 8
County of London	7	7	9⅝	+ ⅛	7 5 5
do do. 6 per cent. Pref.	6	6	9	+ ⅛	6 13 4
Kensington Ordinary	7	6	5	+ ⅛	6 0 0
London Electric	Nil	Nil	1⅛	—	
do. do. 6 per cent. Pref.	5	6	8½	+ ⅛	8 11 6
Metropolitan	4	5	3⅝	+ ⅛	6 18 4
do. 4½ per cent. Pref.	4½	4½	2⅞	—	7 16 6
St. James' and Pall Mall	9	10	6⅝	+ ⅜	7 17 0
South London	5	5	2⅝	—	7 12 8
South Metropolitan Pref.	7	7	1	—	7 0 0
Westminster Ordinary	9	8	6	+ ½	7 10 0
TELEGRAPHS AND TELEPHONES.					
Anglo-Am. Tel. Pref.	6	6	91½	+1½	6 11 2
do. Def.	1½	88/6	21¼	—	7 1 2
Chile Telephone	8	8	6⅜	—	6 5 6
Cuba Sub. Ord.	7	7	10⅜	—	*6 18 4
Eastern Extension	8	8	20½	+4½	*4 17 7
Eastern Tel. Ord.	8	8	200	+34½	*5 0 0
Globe Tel. and T. Ord.	7	8	20	+3½	*4 18 6
do. do. Pref.	6	6	9½	—	6 6 4
Great Northern Tel.	22	22	26½	+8	8 6 0
Indo-European	18	18	48½	—	6 18 4
Marconi	20	25	4⅛	— 1/16	6 8 6
Oriental Telephone Ord.	15	10	2 0 xd	—	4 16 0
United R. Plate Tel.	8	8	8½	+ ⅛	*4 18 6
West India and Panama	1/8	1/8	1⅛	— 1/16	5 9 6
Western Telegraph	8	8	20½	+ 3	*4 17 7
HOME RAILS.					
Central London Ord. Assented	4	4	58½	—	6 16 9
Metropolitan	1	1½	23	— 1½	5 8 8
do. District	Nil	Nil	20½	— ⅛	Nil
Underground Electric Ordinary	Nil	Nil	2½	— ⅛	Nil
do. do. "A"	Nil	Nil	5/6	—2/-	Nil
do. do. Income	4	5	81	—2½	*6 3 5
FOREIGN TRAMS, &c.					
Adelaide Sup. 6 per cent. Pref.	6	6	87	—	7 14 10
Anglo-Arg. Trams. First Pref.	5½	Nil	37⅛	— ⅛	—
do. do. 2nd Pref.	—	—	8⅝	—	—
do. do. 5 Deb.	5	5	65½	—	7 12 8
Brazil Tractions	—	—	57	+1	—
Bombay Electric Pref.	6	6	15¼	+1½	3 18 8
British Columbia Elec. Rly. Pfce.	5	5	64	—	7 15 0
do. do. Preferrred	Nil	2½	57½	—2	8 13 10
do. do. Deferred	Nil	Nil	52½	—3	5 14 3
do. do. Deb.	4½	4½	64	—	6 15
Mexico Trams 5 per cent. Bonds	Nil	Nil	46	—	Nil
do. 6 per cent. Bonds	Nil	Nil	85½	—	Nil
Mexican Light Common	Nil	Nil	22½	—	Nil
do. Pref.	Nil	Nil	35	—	Nil
do. 1st Bonds	Nil	Nil	52½	—	—
MANUFACTURING COMPANIES.					
Babcock & Wilcox	15	15	3½	+ ⅛	*4 5 9
British Aluminium Ord.	10	10	13	—	5 14 3
British Insulated Ord.	25	12½	2	—	5 14 2
Callenders	25	25	9½	+ ⅛	6 8 2
,, 6½ Pref.	5	6½	4½	—	7 2 1
Castner Kellner	25	20	4	—	—
Crompton Ord.	7	10	21/6	—	9 6 0
Edison-Swan, "A"	—	10	1	— 1/16	7 12 4
do. do. 5 per cent. Deb.	4	5	79¼	—	6 5 9
Electric Construction	10	10	1½	+ 1/16	8 0 0
Gen. Elec. Pref.	6	6½	19/6	+6d.	6 13 4
do. Ord.	10	10	41/-	—	*4 15 3
Henley	25	25	2	+ 1/16	5 14 2
do. 4½ Pref.	4½	4½	3½	—	6 4 2
India-Rubber	10	10	16	—	*6 5 0
Met.-Vickers Pref.	—	—	3	+ ⅛	4 17 10
Siemens Ord.	—	10	28/	—1/6	*7 2 10
Telegraph Con.	20	20	27½	+ ⅛	*4 3 8

* Dividends paid free of Income Tax.

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WIRELESS DIRECTION FINDING.

By Capt. H. J. ROUND.

(*Abstract of paper read before the* Institution of Electrical Engineers.)

The major portion of this paper is confined to a sketch of the war developments of wireless direction and position finding, the general ideas involved in which are fairly well known now.

Early in September, 1914, possible uses of direction finding began to be evident to us, and we decided to try to improve the Bellini-Tosi arrangement. At Broomfield, standard Bellini-Tosi radiogoniometers were connected up to the receiving gear which was arranged to use either crystal only or valve plus crystal. When using the valve, reaction effects did not appear to cause serious trouble. Other troubles, however, were apparent. Owing to the short distance over which it was possible to receive signals on a frame when using only a crystal as a detector, only the very strong signals could be received. When starting work with the valve plus crystal, I found great divergence between the observed and true directions. Directions were taken when using crystals only, and also with valve plus crystal. In each case the observed directions agreed, which pointed to the fact that the errors were probably not due to the valve. Finally, nearly all errors were put down to two causes:—(1) A coupling between the two aerial systems not due to the search coil. This gave maximum errors in the plane of either aerial. (2) Incorrect tuning and consequent mis-phasing of the two aerial systems. This gave maximum errors in the plane of 45 deg. between the two aerials.

The first difficulty was overcome by setting out the aerial systems accurately and by more accurate manufacture of the radiogoniometers. The second, by abolishing the double condenser, which pretended to tune the two aerials simultaneously, and using two separate condensers. Tuning and phasing was done by means of a small buzzer-transmitting radiogoniometer coupled to the aerial systems.

The correction of the first error, until quite recently, always gave us trouble, particularly with short waves, owing to the electric coupling between the two aerials. The methods of checking that this coupling was zero were rather troublesome. Another series of errors appeared afterwards, due to badly constructed aerial-tuning condensers, and to very puzzling dielectric losses. The condensers first used had ebonite as the dielectric, and any small difference in the internal losses was swamped by the large internal loss. Other dielectric losses, such as those in walls and tables, were not noticeable until later when the aerials were made larger with respect to the wave length, and the potentials at the ends of the aerials consequently became higher. The introduction later of condensers having air as the dielectric gave trouble, owing to the type used being a built-up aluminium-vane condenser. It was found practically impossible to avoid resistance in the condenser, as contact to the aluminium vanes could never be made perfectly good. We therefore reverted to brass vanes solidly soldered up, and after this all trouble vanished from a condenser resistance point of view.

Multi-turn frames were seldom of any use in Bellini-Tosi work; a condenser could always be inserted to tune up one-rotating-frame work, is not required. Multi-turns, even if used in parallel to reduce inductance, have the disadvantage turn frames and direct connection with the aerials, as in that the inductance varies in windy weather. Single-turn frames chiefly used were:—

Wave length.	Shape.	Height.	Diameter.
200-400 metres	Diamond	50 ft.	50 ft.
400-800 „	(1) Square	60 „	60 „
	(2) Diamond	90 „	90 „
800 upwards	(1) Square	120 „	120 „
	(2) Diamond	170 „	170 „

Any larger sizes than these became difficult to handle, owing to the self-capacity of the frame becoming large compared with that of the tuning condenser. Actually, with modern amplifiers these frames give all that can be required in the way of signals.

During the war we made practically no alterations in the dimensions of the radiogoniometer coils designed by Bellini, except in the number of turns on the windings. Many were the schemes evolved both for tuning to the enemy wave-length and for taking his direction rapidly, say, all in the space of a few seconds. The difficulty was enormously increased by the extreme care with which the aerials had to be balanced. We found that if the aerials were tuned to, say, 800 metres and carefully balanced or phased, then by retuning the intermediate and final circuits, but without altering the aerial tuning, signals could be received with only a slight falling off in strength, from 200 metres below to 200 metres above this tune. This was due to the tight coupling of the radiogoniometer. If the final jigger coils were made of sufficient length, they worked over a big range without a condenser in parallel with them. With only the reaction coil and intermediate condenser to handle, operators became very expert at searching over considerable ranges of wave-length.

Aside from the above-mentioned errors, other errors were not at first serious. I had modified Franklin's reaction circuits for spark reception to give simpler tuning arrangements, and these circuits, when added to the Bellini-Tosi system corrected as above, made a very good direction finder. It was probably fortunate in the first year of our work that we used the soft valves, because no hard valve has been constructed which can compare with these "C" type valves as high-frequency magnifiers. They necessitated, however, trained men in their manufacture, and trained operators for their efficient use.

Fig. 1 shows characteristic curves of a "C" valve for comparison with that of a modern hard tube. The comparison will show that the "C" valve is equal in magnifying power either to 16 hard French valves in parallel, or to three in cascade. Actually, when used by a skilled operator, it is better than three in cascade in an amplifier having aperiodic intervalve connections. Some of the apparent amplification shown by the characteristic curves is actually not obtainable because, on account of grid conductivity, a large ratio of capacity to inductance is required in the grid tuning circuit. The use of this large ratio in the direction-finding receiving gear accidentally avoided for us the serious error known as "vertical," which was afterwards obtained with hard valves. With the "C" valve the average high-frequency magnification when using reaction was about 150. With high-frequency magnification the receiving power of the frame and Bellini-

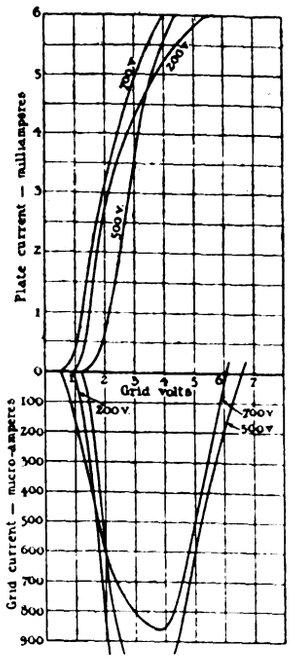

Fig. 1.

Tosi system at once became almost equal in value to that of the vertical aerial. In practice, it is possible to amplify up frame signals to a strength even greater than those of a vertical aerial, for owing to the frame's localised receptive diagram there is liable to be less interference. Fig 2 gives a diagram of one of the first circuits in use. Capt. Tremellen was very fond of the ingenious double-magnification circuit (fig. 3), due to Schlomilch, as was also the original high-frequency magnification without reaction. I usually preferred a single low-frequency amplification after the crystal.

The production of valves at that time was a terrible process. Again and again we lost the knack of making good ones, owing to some slight change in the materials used in their manufacture. A thorough investigation was impossible, as all hands were out on the stations. On several occasions we were down to our last dozen valves. This type of valve had been tested out on long waves at Clifden for quite long runs, and on those circuits it was very steady. The shorter waves necessitated higher values of filament current and lower values of vacua, thereby shortening the steady life considerably. It is, however, pleasant to record that "Methuselah" was removed after 8,500 hours, only to make room for a new circuit with hard valves, and this to the regret of the operators. Everything suggests that a long ageing is necessary to produce a steady valve, unless success is obtainable with a gas such as helium or neon. A spectrum analysis of

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an old valve never showed anything but hydrogen, but with hydrogen I was never able to make a valve that was any good. A few valves were obtained which, after 1,000 hours, would run indefinitely as amplifiers or oscillators without any filament battery. The filament was apparently being heated by the H.T. battery, which was usually 400 volts.

Early in 1915 another error appeared which we nicknamed "Vertical." The two zeros of the polar diagram of reception were seldom opposite to another another. This was traced to a small "vertical aerial" receptive power, chiefly due to the difference in the capacity of the grid of the valve to earth, and of its battery to earth. I can probably explain the meaning of the error by taking the case of a frame directly connected to a valve (fig. 4), which, if not connected to the receiver, gets energy induced in it which gives a potential difference between the terminals A and D of the condenser. This potential difference is the correct cosine function of the direction. If now a valve grid G (fig. 4*a*) is connected to D, and the valve-filament battery B to A, the capacity of G is usually small compared with B, and, besides the true directional reception of the frame, there is a reception due to these

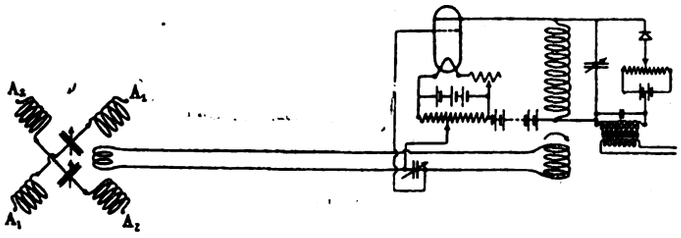

Fig. 2.

capacities to earth, I have redrawn this arrangement in fig. 4*b*, which shows the action of the wave in alternating-current form. Fig. 4*c* shows the arrangement in bridge form. Unless the capacity C is equal to the capacity H, a current will flow through the condenser AD, meaning that there is potential difference across the terminals A and D, which is independent of the directional properties of the frame. The result of this circular reception on top of the directional reception is a "cottage loaf" shaped diagram of reception, the minima of which are not opposite to one another.

With the use of hard valves, and the consequent high insulation of grids, these "vertical" troubles increased a great deal, and they increased still more when the "aperiodic" aerial was brought into use. Probably it has occurred to some that the extraordinary variation of signals at night might be accompanied by variations in apparent direction. In December, 1914, we erected in France, at Blendecques, near St. Omer, and at Abbeville, the first two war direction-finding stations, these making the first position-finding group erected by us during the war. Blendecques had a fixed daylight error which puzzled us, and not until Abbeville was constructed did Capt. Tremellen note that night directions did not maintain the constancy of day readings. The first station concerning which he noticed this effect was KAV, the old German press station, and fig. 5 is a copy of his original curve taken of KAV's movements during a sunset period. This curve is typical of a sunset movement, but I still cannot say whether

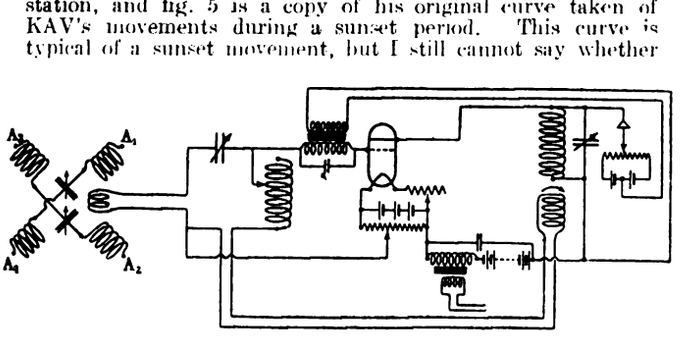

Fig. 3.

any such apparent regularity exists as a general thing, and certainly we were never able to arrive at any system of correcting bearings by using the idea of regularity. Night variation remained throughout the war a serious defect in direction-finding work. Capt. Tremellen and Lieut. Adcock in France among others, and particularly Lieut. Eckersley in Egypt and Salonica, succeeded in obtaining valuable information, the latter in conjunction with experiments developing the theoretical side. The work of these men suggests possible improvements in apparatus which will eliminate a great deal of the night trouble.

The German Navy directed its Zeppelin fleets by direction-finding from land stations. It also used a method of intercommunication between their land stations by wireless telegraphy. The Germans, in raids on England, suffered from a bad base-line, and this, in combination with night effects, made their directional apparatus useless on many occasions. The Germans had two wireless "light-houses" for enabling their Fleet and submarines to determine their positions in the North Sea without having to transmit. These wireless "light-houses" in effect consisted of a rotating frame continually sending during rotation. A signal was sent to give the zero of time, and any ship noting the time interval between this zero and the zero of signals could then determine its angular position from the station. The fact that a frame transmits vertically as well as horizontally, and that at different points in its rotation the vertical radiation is polarised in a different direction, should lead one to expect curious results at night. Owing to the continuous rotation of the transmitting frame, very strong signals were necessary to take quick bearings at a direction-finding station. Notwithstanding the difficulty, Capt. Tremellen was able to note a large variation of the apparent direction of these stations at night as the frame rotated. This was done by reading the minimum on his own radiogoniometer, and not by noting the minimum of signals with his search-coil stationary.

With regard to night effects, (1) Large swing readings are better than minimum readings. To obtain readings of the actual minima at night is very difficult. Fig. 6 represents a

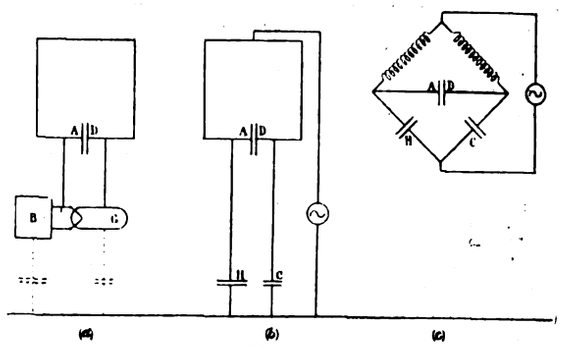

Fig. 4.

typical night minimum. This effect is sometimes very marked from Telefunken stations. Even with a swing reading, a very distinct difference of note will often be obtained at the positions A and B, the note on the one side having obviously fewer harmonics, *i.e.*, being duller in sound, than the note on the other side. This again adds to the difficulty, and the reason for the effect is not at all obvious. In England and France, errors on swing readings on spark stations are at present up to 7 deg. at night. Eckersley's results in the East indicate much greater changes than these; he has told me that at Salonica, Sofia would sometimes shift through 90 deg. The directions change fairly rapidly when bad night effects are present. Two or three degrees in a minute would, however, be considered to be fast. Nearly always, but not invariably, night variations are accompanied by bad minima.

(2) Continuous waves give much greater variations than spark waves, and with them it is quite definite that directions

Fig. 5.

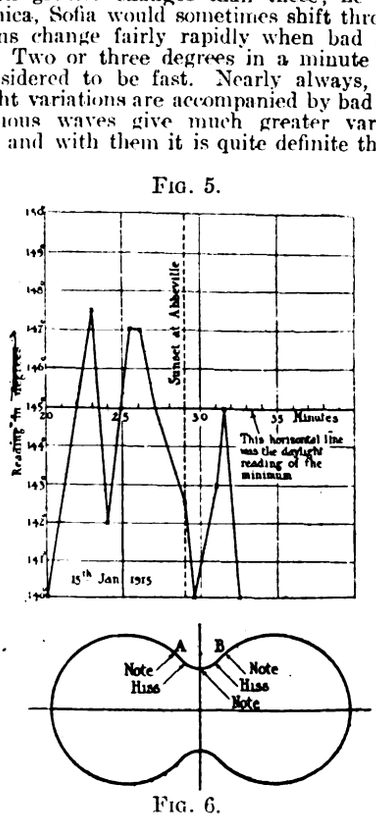

Fig. 6.

are seriously wrong even when the minima are extremely sharp, although bad minima do occur at other times. Capt. West brought to my attention a very pretty case of variation which indicates that the apparent direction is a function of the wave-length. Horsea arc station sent its Press programme at 10 o'clock nightly during parts of the war, and it sent with a spacing wave as well as a marking wave. These two waves sometimes gave two directions differing by 30 deg., each wave giving a perfectly sharp minimum. This point may be intimately connected with the results obtained at San Francisco by Dr. Lee de Forest some years ago on interference effects.

(3) There is no strong evidence to show that the night variations on long waves are greater than those on short.

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(4) In England, variations from east to west are certainly greater than those from north to south, but I do not think that this result agrees with results from the East and from America. Malta was a peculiar station, which in England apparently never varied seriously.

(5) When signals come oversea from moderate distances, and practically no land intervenes, results are then the most reliable. If, however, there is land anywhere near either the transmitter or the receiver, or between the two, results become very troublesome.

The minimum distance at which night effects have been noticed in England or France is about 15 miles. Capt. Tremellen noticed quite early that when two transmitting stations with differently shaped aerials were side by side, the directions obtained at night by a Bellini-Tosi station were different. Mountainous country between stations seems to give the very worst night effects. Eckersley's theoretical and experimental work on night effects in the East, and with aeroplanes—also, quite independently, Adcock's work in France on aeroplanes—both suggested apparatus which should, when developed, improve our work at night.

(*To be concluded.*)

THE INSTITUTION OF ELECTRICAL ENGINEERS.

NORTH MIDLAND CENTRE.

The Chairman's address, of which the following is an abstract, was delivered before the above centre of the Institution by Mr. W. M. Selvey, M.I.E.E., at Leeds, on November 11th, 1919.

While many members have had the supreme privilege of serving at the Front, there have been many war-time activities of the members remaining at home. I wish to refer pointedly to the work of those local members which has resulted in that excellent report known as the "Report of the Yorkshire Electric Supply Linking-up Committee." This report, it is hoped, ultimately will be accessible to all members, and they will then see how carefully matters connected with Yorkshire have been considered. The phenomenal expansion of the Sheffield undertaking is almost a romance in itself.

We are also proud in referring to the first station on what is now known as super-station lines, viz., that at Rotherham, where is now being installed the largest set (30,000 kw.) yet built for this country. The Yorkshire Electric Power Co. has also made most effective progress, not only in largely extending its generating capacity, but also in wonderfully extending its system of overhead mains. There is no other system in this country which can show anything like such progress in this direction. The Leeds extensions are also somewhat noteworthy. Other large extensions have been projected, but war circumstances have delayed them in many cases. In Yorkshire in 1918 the generated units were over 520,000,000, with a maximum demand of over 160,000 kw. Personally, I expect that during the next ten years Yorkshire, with its woollen, steel, and coal industries, will become the most highly organised electrical area in any part of the world.

Another phase of activity in which the members of this centre have been largely employed is that of giving assistance to the Coal Controller. There were over 25 of the members of this centre who assisted in this voluntary work. Should the principle of nationalisation become more extended the electrical engineer of a district could, with a maximum advantage to the community, become responsible for the whole use of power in his district, either if such power is taken from the public mains, or is generated by a private plant whether by steam or gas. Such a scope would lead to balanced thought and a proper perspective with regard to the interests of the community. If the members had previously been only half convinced of the value of a generous electricity supply to the community they must have become wholly convinced by their experience in this work. The waste of fuel, the carelessness, indifference, and the ignorance of power users in many lines of industry were most disturbing. The training of the electrical engineer in power generation has been shown to be exceedingly helpful in dealing with all questions where the combustion of fuel is concerned, whether for power or other purposes.

The past year is especially notable with regard to influence on the future of the Institution arising from the efforts of our most able past-president, Mr. C. H. Wordingham, C.B.E. He has given us all a new idea of what the Institution may be and, may I say, shall be in the lives of all its members. We must all join in making our new president realise that he has the whole-hearted feeling of the members behind him.

After dealing with Institution affairs, Mr. Selvey gives a number of technical calculations relating to high-pressure and high-temperature steam with interheating for power generation, which are intended to be read as an appendix to Mr. J. H. Shaw's paper.* The author keeps very closely to the figures used by Mr. Shaw; he gives tables and figures defined by the nature of steam, and independent of any form of apparatus, which can be used in any particular case by taking into account the efficiency of the apparatus. The schedules are accompanied by temperature-entropy and interheat diagrams illustrating some of the tables.

Schedule 1 relates to diagram efficiencies obtainable with steam initially at 500 lb. per sq. in. absolute, total temperature 688 deg. F., where the steam after expanding and doing work to certain selected pressures is again heated to the original temperature and then further expanded down to vacuum pressures. The figures represent what could be obtained were it possible to build a heat engine of 100 per cent. mechanical efficiency, and if there were no losses of pressure in conveying the steam to be reheated from and to the engine. It will be easy to find the influence of such losses as are inevitable by means of curves drawn from the data given in this and the other schedules. The best circumstances for interheating are by expanding to a pressure in the neighbourhood of 200 lb. per sq. in. before reheating, and the possible gain in efficiency is of the order of 2½ per cent.

Schedule 2 takes the same circumstances with the difference that while expanding to the same set of pressures the steam is not reheated to its original temperature, but only to its original superheat. All practical cases must lie between these two limits. Under these circumstances the best pressure for a single interheat is above 200 lb., and the possible gain in efficiency is of the order of 1½ per cent.

Schedule 3 shows that there is a fairly wide range of choice for two interheats for which the efficiency remains sensibly constant, the most favourable of these conditions being an expansion first to 215 lb., reheating, and then an expansion to 70 lb., and further reheating with a final expansion from 70 lb. to the vacuum pressure. These calculations show a possible gain in efficiency over plain expansion of about 1½ per cent.

Schedule 4 shows clearly that the value of interheating is greater in proportion as the initial pressure is lower. Expansion from 500 lb. with an interheat to the original temperature at 150 lb. shows a gain for plain expansion from 500 lb. of only 2.4 per cent. Steam originally at 150 lb. interheated at 50 lb. to the original temperature of 688 deg. F. shows a gain over plain expansion from 150 lb. of 7.2 per cent.

Schedule 5 shows the value of pressure alone for the constant top temperature. The absolute pressure of 215 lb., that is of 200 lb. gauge, is taken as a basis. The figures show that at 500 lb. the gain is 11 per cent., whereas at 70 lb. pressure there is a deficit of 15 per cent.

Schedule 6 gives the same set of figures, but with the superheat kept at the constant figure of 219.3 degrees F. It is seen that the gain of 500 lb. over 215 lb. is as much as 13 per cent.

Schedule 7 compares the main efficiencies with those obtainable with a perfect fluid between the same limits of temperature. The author then gives temperature-entropy and interheat diagrams which show more quickly what the variations of efficiency mean, and concludes that in the near future the steam turbine may equal, if not surpass, the gas engine in efficiency, the competition being still more severe in overall efficiency since the efficiency of large boilers in the most modern practice is now showing a margin of nearly 10 per cent. over the corresponding gas producer efficiency. The battle between these two methods of producing power may turn on the direct total utilisation of the rejected heat. It is along these lines one looks for progress rather than in much further improvement of the efficiency of these prime movers.

* Elec. Rev., July 19th, 1918.

An Ionisation Gauge.—The design of ionisation gauge used in the General Electric Co.'s laboratory consists, according to the *Journal* of the Franklin Institute, of two concentric tungsten filaments inside a coaxially situated cylinder. The inner filament is used as a source of electrons with the outer one as anode, while the cylinder is used as a positive ion collector. The gauge was calibrated by a "flow" method (based on Knudson's formula for the flow of gases through capillaries) for extremely low pressure, and it was found that the electron emission is proportional to the pressure over a range which extends from over 10 bars to 10^{-3} bars, and it is, therefore, probably certain that this same relation holds at the lowest attainable pressures. Calibration of the gauge with different gases led to the interesting relation that the number of positive ions formed at constant electron emission and constant pressure is proportional to the number of electrons per molecule of the gas ionised. It is possible, therefore, by this method to determine *molar numbers* for different gases, by which is meant the sum of the products, atomic number times number of atoms, taken for each element in the molecule. Thus the molar number of iodine is $2\times53=106$; and for HgI_2 it is $80+2\times53=186$. Vapour pressure determinations of both these substances gave results agreeing with the above values for the molar numbers. If it be assumed that ionisation is due to collisions between thermions and electrons in the atoms, it is possible to calculate the mean free path of an electron in any gas at a given pressure, and also the effective diameter of the electron. For argon at 1 bar pressure and room temperature, the mean free path is about 150 cm., and the diameter of the electron is calculated on this basis as about 4.4×10^{-9} cm.

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ELECTRIC ARC WELDING.

During the recent extension of the use of electric arc welding very considerable progress has been made in the development of suitable plant and equipment to provide the desired electrical conditions at the arc. It is now realised that reliable and consistently sound welded joints cannot be secured except by the use of electrodes capable of depositing metal of similar quality to the work, thereby permitting true fusion and furnishing a jointure with maximum efficiency. That such conditions are obtained we were last week able to see for ourselves, when a most interesting and instructive afternoon was spent at the works of Alloy Welding Processes, Ltd., where "A.W.P." electrodes and other welding products were seen in course of manufacture, and an opportunity was given of appreciating the general use and extent of service to construction and repair work offered by this process. This firm has made a special study of the requirements, and alloy rods and electrodes, specially prepared to enable true fusion to be obtained in joining together all kinds of iron and steel parts, including special alloy steels, are now available for use with either the gas blow pipe or electric arc respectively. It is perhaps unnecessary to point out the scope offered by electric arc welding for the carrying out of repairs of all descriptions, and the repair work undertaken at the "A.W.P." works for, amongst others, the L.C.C. tramways, London General Omnibus Co., and the Midland Railway, is of extreme interest both from the point of view of the success attained and the nature of the repairs carried out.

During the war period it was established that the electric arc welding process was sound and adequate by virtue of the experience obtained in the assembling of mines, bombs, tanks, and other munitions, besides the construction of seagoing craft entirely built by this means. This fact was further demonstrated by this method of construction having been approved by the Admiralty and Lloyd's Register of Shipping after extensive investigations and trial. Further, the lengthy recommendations that accompany the annual report by Mr. G. Scott Ram, H.M. Electrical Inspector of Factories, indicate the importance attached to electric welding as a recognised manufacturing method with considerable future possibilities.

The flux-covered electrode was not in the past appreciated to the extent it deserved, mainly because the correct method of application was not understood, and insufficient attention was given to the selection and preparation of the welding material. As a result of the investigations carried out by Mr. E. H. Jones, very satisfactory results have been achieved. The "A.W.P." electrode, provided with an extruded flux coating of variable constituents, employed to weld mild-steel plates and cast iron, may be manipulated by an ordinary craftsman at greater speed than was previously considered possible, and in addition, the resultant welded joints possess maximum tensile strength, whilst the work easily withstands bending, impact, and fatigue strains. This achievement is due to the fact that with these electrodes metal deposited in the weld can be varied to suit the materials to be joined together, and provides a sound jointure without special skill being required on the part of the operator, which has hitherto been the main factor in successful welding practice. Moreover, with composite electrodes, the rare metals composing the alloy to be deposited are kept apart until actual fusion in the arc; this point is of first importance, as it is found that it is only possible by this means to deposit high-speed, nickel, manganese, and other special alloy steels which cannot be otherwise treated. By depositing metal slightly superior in quality to the parent metal, the latter is strengthened by absorbing some of the superiority of the deposited metal. In the past the parent metal adjacent to the weld was often weakened by the reverse action being allowed to take place.

A feature of "A.W.P." electrodes is that in all cases they are given a coating of nickel, which is claimed to give superior results in that it obviates oxidisation. This coating varies from 1 to 10 per cent., according to the composition of the electrode, the average being about 4 per cent. of the total weight of the electrode. A very successful method of electrolytically coating electrodes has been adopted at the company's works, and it is claimed that as much as 4 per cent. of the weight of the article being coated can be deposited per hour. The deposit is of a high quality, and will not crack on repeated bending.

As representing a portion of the work that can be satisfactorily dealt with by this means an entirely new application of the arc process has been opened up in the tool-making industry. The method of depositing a tip of high-speed cutting steel direct from an electrode on to mild-steel shanks has been improved and simplified, and its general adoption in the making and retipping of tools, drills, picks, &c., is only a matter of time. It is probable that in the shipbuilding and repairing industries arc welding will find its biggest individual application. English railway systems have recently begun to realise the value of such a process in their constructional and repair shops, while on tramway and light railway systems arc welding has already obtained a firm footing for the repair of rolling stock and general upkeep of permanent way. In steel tank and barrel manufacture, the process is especially applicable owing to its economy and property of watertightness, while in structural and reinforced concrete work, advantages equal to those realised in shipyards are found in its application.

The efficient repair of cast iron is a matter that looms large before every engineer, and it is impossible to treat it as anything but a separate application. An electrode is now manufactured which, it is claimed, actually produces molten cast iron of the first quality, and the repairs already carried out confirm its future.

The self-contained, portable, or semi-portable as desired, welding plant supplied by the "A.W.P." Co. consists in one case of a special Premier generator direct coupled to a 9-h.p. Gardner internal combustion engine complete with radiator, fan, fuel tank, &c., mounted on a girder bedplate, and all the necessary switchgear mounted on a slate panel as shown in fig. 1. In the other case it consists of a motor and generator direct coupled and mounted on a steel girder bedplate with the necessary switchboards for connection to a supply circuit.

For use on a.c. circuits transformer plant, as shown in fig. 2, has been developed; several of these sets were seen in operation at the time of our visit to the works, as were also adjustable reactance coils for connection to a.c. circuits of from 70 to 110 volts, the current at the arc being varied by altering the plug and socket connections. Where a 60 to 110-volt d.c. supply is available it is only necessary to connect up an adjustable resistance for each operator.

An exhaustive series of tests was recently carried out for Lloyd's Register of Shipping, who have since certified approval of "A.W.P." electrodes for use in ship repair and construction as outlined in Lloyd's Regulations for the application of electric arc welding to ship construction. These

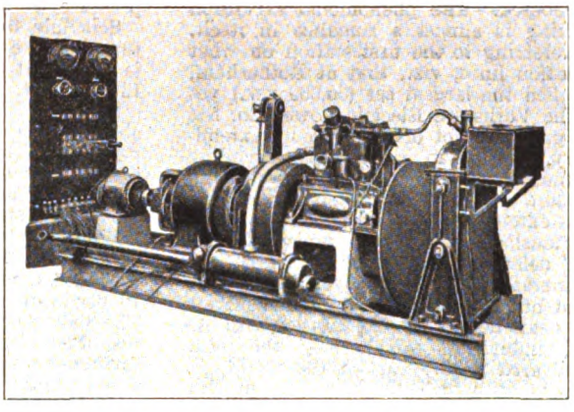

Fig. 1.—Self-contained A.W.P. Welding Plant.

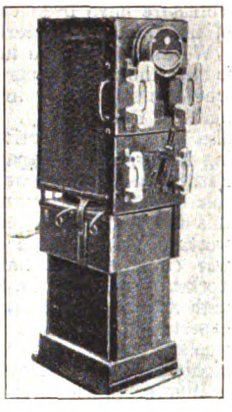

Fig. 2.—a.c. Welding Transformer.

welds were made with alternating current with transformer welding plant of the standard type shown in fig. 2. In the tensile tests the welds were neither hammered nor swaged during or after welding, and the average result of the twelve tensile pieces tested reached the high figure of 27.3 tons per sq. in.

In eight cases out of ten the original plate broke without the weld giving way, and the actual strength of the weld the weld metal withstood an average stress of 28.8 tons per was shown better in the modulus of elasticity tests, where sq. in. before fracturing. A feature of the tensile tests was the high elongation shown in the welded samples; the final extension in 8 in. on eight welded pieces was 18.4 per cent., which compares favourably with 25 to 30 per cent. for mild steel.

Modulus of elasticity tests were carried out on test bars composed entirely of deposited electrode metal. The average result of 12,000 tons per sq. in. can be compared with wrought iron at 12,500 and mild steel at 13,500. The ultimate breaking stress of 29 tons per sq. in. and the elongation of 13 per cent. in 8 in. should be noted. Impact tests showed the ability of welds to withstand severe shock without sign of failure.

Alternating stress tests determined that an unwelded turned steel bar would withstand a large number of alternations (5,000,000 and over) when the stress varied from + 10½ tons per sq. in. to − 10½ tons per sq. in.

The importance of chemical analysis of welds is sometimes overlooked by users of electrodes. The analysis showed that the deposited metal from an "A.W.P." electrode contained .106 per cent. carbon and .48 per cent. manganese, both approximately correct for the formation of mild steel, while the

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embrittling and harmful elements of silicon, phosphorus, and sulphur were kept well below dangerous proportions, and in the case of silicon and phosphorus (both elements which lower the tenacity of steel) very considerably reduced when compared with the original plates. These figures refer to standard electrodes and not to special alloy electrodes, with which practically any desired chemical composition can, it is claimed, be obtained. The series of micrographs made in conjunction with these tests were sufficient to show the good fusion between weld and plate and absence of heat effect upon the plate adjacent to the weld. Two series of these tests were carried out, namely, with A.C. 50 cycles at 80 volts, and with D.C. at 60 volts.

In addition to the above, tensile and bending tests were carried out at the National Physical Laboratory, Teddington, with A.C. 50 cycles, 80 volts, on test pieces prepared according to the British Engineering Standards Association, and welded by the electric arc process with old type and "A.W.P." standard electrodes. Finally, trials have been carried out by the Admiralty at Portsmouth dockyard with D.C. at 60 volts, reversed polarity being employed throughout for all positions of work. The trials were carried out by a dockyard operator with no previous special skill in the manipulation of the firm's electrodes.

In conclusion, we have to thank Mr. J. Caldwell, Mr. H. B. Sayers, and Mr. E. H. Jones for the courteous manner in which we were received at the time of our visit.

CHANGING LIVE LINE INSULATORS.

Sudden insulator failures on a 25-mile, 22,000-volt, overhead transmission line five years old caused a central station in northern Pennsylvania, U.S.A., to adopt a novel method of dealing with the trouble. The line runs through hilly country which is noted for its frequent and violent lightning storms. Steps had to be taken to avert serious trouble without interrupting the service. According to the *Electrical World*, instead of waiting for insulator failures to manifest themselves, a picked line gang was instructed in detecting bad insulators on a live line and in changing them. The men travelled from one end of the line to the other, stopping at each pole. If a buzzing sound was heard the insulator was defective and changed. Before climbing any pole, to be assured of safety it was tested with a telephone receiver to determine the amount of leakage current to earth, and the potential drop was measured every 6 ft. At night the men camped in a tent wherever they happened to be, and regular inspection was thereby assured. Changing insulators was accomplished by means of Cronin tools mounted on poles, as shown in fig. 1. Tool A is used for tying the conductor to the insulator when the latter is equipped with a tie wire made of two pieces of wire, the same size as the line conductor, and attached to the pin insulator before it is mounted on the cross arm. The tie wire E is seen arranged on the insulator so that it will not be a menace, and also F in position to be tied to the conductor. The two hooks on the tying wrench A make

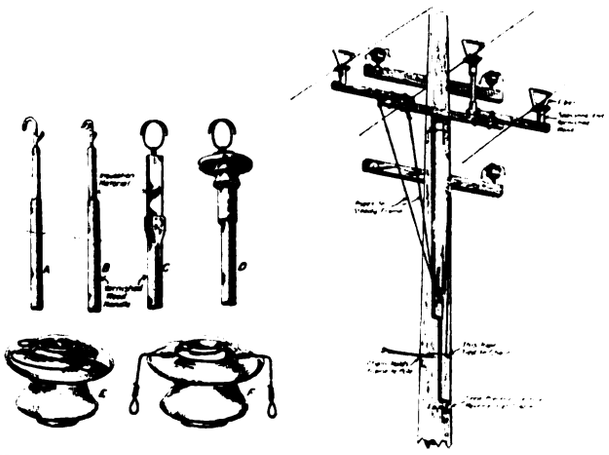

Fig. 1.—Tools Employed in Changing Live Line Insulators.

it easy to tie the conductor firmly to the insulator in a few minutes. When an ordinary tie wire is employed the untying wrench B is used. The tie wire can be gripped in the claw of this tool no matter how tightly it is clinched. After the conductor is set free it can be lifted from the insulator by means of tool C, and held away while the latter is changed. When an insulator is defective and new ones are not available, the cleaning tool D can be fastened to the conductor and clamped to the pole; it consists of an insulator mounted on a pole, and is used as an insulator in an emergency. When cross arms need replacing, or when it is desired to change all the insulators at the same time, the "strong man" shown on the right-hand side of fig. 1 is used. The use of this frame allows the raising of the wires above the top of the pole by means of a rope and pulley. On handling the insulators the tie wires are bent as shown at E to avoid accidental contact with the live conductors. After the insulator is placed on the cross arm the tie wire is bent down ready for tying, as shown at F. Two men work on the pole at once, and one remains on the ground. The process can be accomplished with ease in less than half an hour, and when used to the work the men show no fatigue.

THE PHYSICAL SOCIETY'S EXHIBITION.

(*Concluded from page* 138.)

Messrs. H. Tinsley & Co. had a large and varied collection of apparatus on view. Their thermo-electric potentiometer (the manufacture of which was undertaken specially for the National Physical Laboratory) is the first of its kind made in England. It consists essentially of a divided circuit, the potential being obtained from two points in each arm of the circuit. Fig. 16 shows the theoretical diagram. The potentio-

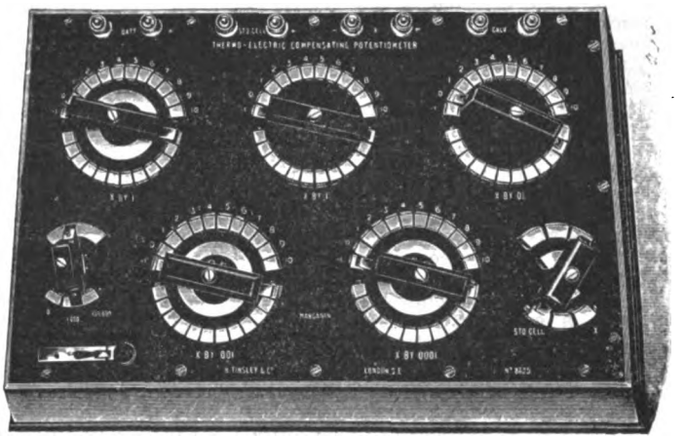

Fig. 15.—Thermo-electric Compensating Potentiometer.

meter current is kept at a standard value in the usual manner by equating the drop across a resistance to a standard cell. The current entering at the point A divides the resistance of the two branches, being so arranged that the current in the right-hand arm is 1/10 that in the left. This proportion is always maintained for any position of the switches by means of the compensating coils which are put in circuit as others are cut out. The top and bottom sets of coils are intercon-

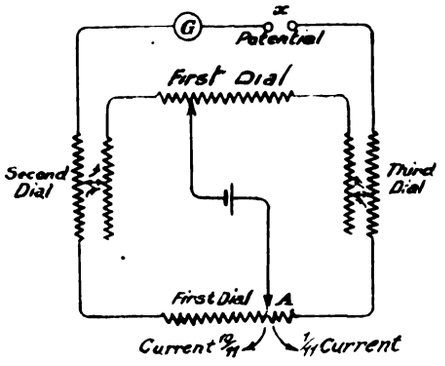

Fig. 16.—Diagram of Connections.

nected so that the top contact moves to the right while the bottom moves to the left. Similarly, the same total resistance is maintained, when either the right or left-hand decades are moved, as will be seen from fig. 16.

Any thermo E.M.F. which may occur due to the motion of the switch is rendered negligible by this arrangement of divided circuit. If an E.M.F. occurs upon the moving of the switch on the first dial, the thermo E.M.F. will become added to the battery E.M.F. of about 2 v., and is therefore negligible. If the thermo E.M.F. occurs on moving the switch of the second or third dial, it will act in a divided circuit, one side of which will be added to, while the other is subtracted from the main E.M.F., the resultant alteration being negligible, never exceeding 1.3 per cent. of the value of the thermo E.M.F., which would not itself exceed one microvolt. Moving the switches when the instrument is set up gives no deflection of the galvanometer such as usually occurs.

A double Kelvin bridge was shown specially constructed to provide a self-contained instrument for low-resistance mea-

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surements. Four standard resistances are contained in the instrument, 1 ohm, 0.1 ohm, and 0.001 ohm. By use of the ratios, measurements can be made to five figures of all values of resistance from 1,000 ohms to 0.001 ohm. Terminals are provided for measuring against independent standards if required.

Another feature of the exhibit was Gall & Tinsley's artificial track-circuit, specially designed for research upon the problems of the track circuit. It brings into the laboratory a two-mile section of line in every condition of construction, maintenance, and weather, and where, moreover, the extremities are within a few inches of each other, allowing the same instruments to be used for measurement at and between opposite ends, and the behaviour of apparatus at each end to be observed simultaneously. It is made suitable for either A.C. or D.C. circuits, the former type serving for both, but the latter of a more simple form and suited only for D.C. The research type is provided with four dials which may be set to represent any condition of ballast resistance and rail impedance between 1 and 100 ohms of the former and 0 and 2 ohms resistance or 0 and 2 ohms reactance of the latter. The dials give the values of rail resistance in ohms, the rail reactance in ohms at some fixed frequency, and the value of the ballast resistance in ohms. The instrument is designed for a normal current at the relay end of 5 amperes, and the reactances are adjusted at this figure. As is the case with the track circuit itself, the reactance of the rails varies with the current, and a correction for various values of current is given with each instrument. The instrument represents the electrical conditions obtaining in any section of the line, having a rail impedance as given by the setting of the dials, between which is a ballast of the resistance given by the dial so named. The convenience of this piece of apparatus for the testing of track—transformers, relays, regulating resistances, &c., under actual conditions—will be appreciated by all who have attempted to carry out such tests upon the permanent way itself, where the conditions are not under control, and have first to be determined before the values of rail-impedance and ballast resistance are known, and further where only one condition of these can be had at once, or worse, a condition so continuously changing over a small range as often to destroy the value of the tests made. On the site tests usually have to be made at night to avoid continual interruption by traffic, and in the worst weather, to get the most unfavourable conditions. Tests of the track-circuit constants can also be made with great facility by using the artificial track circuit in balance against the actual track-circuit and adjusting the dials until the artificial electrically balances the real track-circuit.

The standardisation of low-resistance shunts has been made a speciality by the company. Two sizes of the Drysdale-Tinsley non-inductive type were shown, together with their temperature-resistance curves.

A new pattern of potentiometer that was shown has been developed to give the same range as Tinsley's universal potentiometer, but without using a slide wire. This instrument is provided with three dials, the first reading (when using a 2-volt accumulator) .1 volt per stud, the second .001 volt per stud, and the third .00001 volt per stud. The second dial is the "Vernier" dial, it being shunted across any two studs of the first dial according to the position of that index. A ratio plug allows the potentiometer to be used to read up to 18 volts or down to one microvolt.

Another item was a new variable self and mutual inductor, with a range from 6 to 159 millihenries self-inductance and 0 to 34 millihenries mutual inductance.

Mr. H. W. SULLIVAN had an interesting exhibit of non-reactive resistance boxes, slide wires, &c., standard air-condensers, both fixed and adjustable, galvanometers of laboratory and marine types, and wireless telegraph apparatus.

FIG. 17.—SULLIVAN UNIVERSAL AIR CONDENSER.

Fig. 17 shows an air condenser containing three units, two fixed and one continuously variable, with switches for paralelling them, and a rotating head, giving a range from 0 to 1,000 micro-mfd. continuously, with very fine adjustment. Another condenser is fitted with a specially long scale, extending to 320 deg.

A thermionic valve oscillator for generating high-frequency currents is illustrated in fig. 18; it contains everything except a condenser by means of which the pitch of the note can be adjusted, and the 200-volt battery and filament battery. This set is specially suitable for A.C. bridge testing, as steady frequencies from 300 to several thousand cycles per second can be obtained, with an approximately pure sine wave. A three-valve amplifying receiver was shown in conjunction with the Edison Swan Electric Co., Ltd., in operation. This set, which is illustrated in fig. 19, is suitable for spark

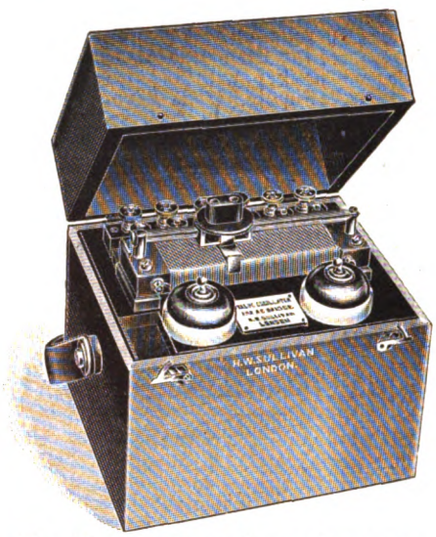

FIG. 18.—THERMIONIC VALVE OSCILLATOR.

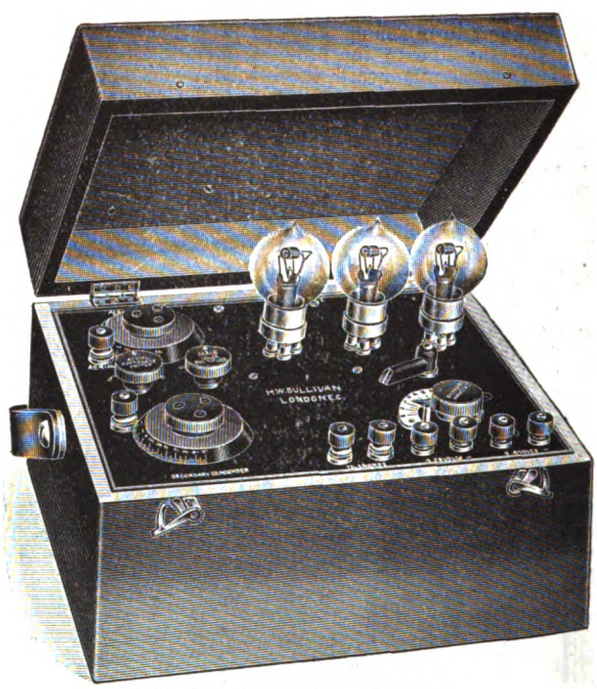

FIG. 19.—AMPLIFYING RECEIVER.

reception, over a range of wave lengths from 200 to 4,000 m., which can be extended by means of inductance. This set is self-contained, only the telephones and batteries being external to it. The valves act as radio-frequency amplifiers as well as detectors, and are reactance-capacity coupled, this being superior to the resistance-capacity method of coupling, particularly on the shorter wave-lengths.

The WESTINGHOUSE COOPER HEWITT CO., LTD., showed a quartz mercury vapour medical lamp for the production of ultra-violet rays, mounted in a spherical housing of burnished aluminium which was specially designed to facilitate the use of the lamp, and to maintain the necessary conditions of operation. Other apparatus was exhibited, for examining X-ray photographs, rifle barrels, &c.

Mr. W. H. HARLING and Messrs. HENRY HUGHES & SON, LTD., showed drawing instruments of new types, generally following the lines of the Continental instruments of pre-war days. The British instruments were unexcelled in quality, but were not suitable for machine production; the new designs, which were got out to meet the needs of the Ministry of Munitions during the war, while retaining many of the high-class features of the British in-

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struments, are of standardised pattern suitable for manufacture with accurate repetition machinery, and can be turned out in great quantities, while they have the advantage that each part is easily replaceable. The machine production of these instruments is a new industry in this country, which if adequately supported will be captured from the Germans.

Messrs. Marconi's Wireless Telegraph Co., Ltd., had an interesting exhibit of measuring instruments—including a new form of hot-wire instrument specially suitable for the measurement of high-frequency currents—a compact direction-finder of the marine pattern, Fleming and Round valves, and an amplifying detector suitable for the reception of continuous-wave or spark signals, with a range of wave-length from 500 to 3,000 m., and for use in connection with the operation of recording devices. The hot-wire ammeter was provided with a method of zero adjustment which did not affect the calibration, and was fitted with a transformer in which the secondary was independent of the primary aerial circuit, so that an injury to the instrument had no effect on the aerial circuit.

NEW ELECTRIC LOCOMOTIVES.

The recent extension of an additional 217 miles on the Chicago, Milwaukee, and St. Paul Railway, that is now electrified from Seattle on East, makes an interesting addition to the electrification of this noteworthy railroad. For the past two years 440 miles of this railway have been electrified over the Rocky Mountain passes, thus the new addition makes available over 650 miles, and by next spring it is estimated that over 800 miles in all will be in operation. According to the *General Electric Review*, as a result of its unqualified success, the same system will now be used to meet the severe grades and snow conditions of the Cascade range. The motive power consists of 42 locomotives for freight and passenger service and four switchers. Of this original equipment,* the freight and passenger locomotives differed only in the gear ratios. The five new locomotives being constructed by the General Electric Co. for operating the heavy main-line transcontinental passenger trains on the section Seattle-Tacoma-Othello are entirely different in design, built distinctively for passenger service, and possess some very interesting mechanical and electrical features. The section is 200 miles long, and includes a stretch of 17 miles of 2.2 per cent. grade and another, 19 miles long, of 1.7 per cent.; it is worked at 3,000 volts D.C., and regenerative braking is employed.

Designed to haul, unassisted, 12-coach passenger trains weighing 960 tons against a 2 per cent. grade at 25 M.P.H., the new locomotives are of the gearless type, with bi-polar motors, the motor armatures being mounted directly on the driving axles. Each locomotive weighs 265 tons, 229 tons being on the drivers. Of the 14 axles, twelve are driving and two are guiding. The weight of the armature and wheels is the only deadweight on the track, and this is approximately 9,500 lb. per axle. The total weight on drivers (458,000 lb.) is 86 per cent. of the weight of the locomotive, and is distributed 38,166 lb. on each axle. The total length inside

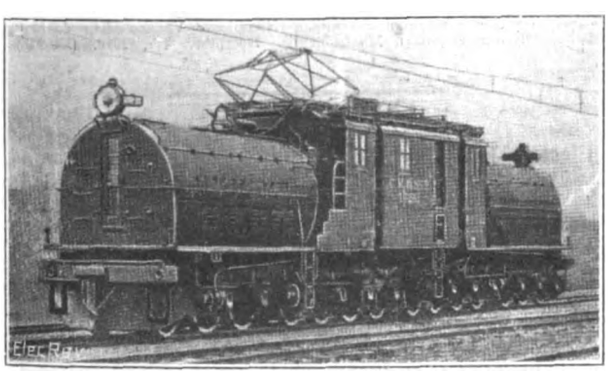

Fig. 1.—A New G.E.C. 3,240-H.P. Electric Passenger Locomotive.

knuckles is 76 ft., and the length over cab, 68 ft. The driving wheels are 44 in. in diameter; the leading and trailing wheels 36 in. in diameter; the total wheel-base is 67 ft. Curved-top cabs at each end of the locomotive contain the 3,000-volt contactors and grid resisters. In one of these cabs there is also located a 3,000-volt D.C. air-compressor and storage battery; in the other a small motor-generator set (for operating the contactors and for train lighting) and the high-speed circuit breaker. Two operating cabs are provided, and situated between them is a cab occupied by an oil-fired steam boiler and accessories for heating passenger trains. A sliding pantograph is mounted on top of each of the two operating cabs. These pantographs have two sliding contacts, giving a total of four points per slider with the double trolley. The second pantograph is held in reserve as a spare.

* Elec. Rev., June 21st, July 12th and 19th, 1918.

Speeds of 65 M.P.H. were attained during the tests of one of these locomotives, fig. 1, on the G.E.C. testing track at Erie. The tests have been described as "the most magnificent exhibition of electricity applied to railroads ever seen." A feature was a tug of war between the electric and two powerful modern steam engines as used on the New York Central Railway for hauling the big limited trains. The three locomotives were securely coupled together, and the danger of pulling out the draw bars was avoided by making them push against each other in different directions. The steam engines got under way and pushed the electric ahead of them along a straight track; then energy was gradually switched on to the electric while the throttles of the steam engines were opened fully. To the surprise of the spectators the steam engines were seen to slowly but surely lose momentum, and finally come to a complete stop, still with their throttles wide open. Next they were forced backwards, and as the electric developed its full power the procession became almost a rout.

Hardly second in interest to the above performance, was the exhibition of the regenerative powers of the electric locomotive. To reproduce the same conditions as those which exist when the engine is coasting with a full load of cars behind it, two steam locomotives were coupled on behind the electric and pushed it along the track at a good speed. The regenerative system was then put in action, and the speed was seen to noticeably decrease, and before the trial ended the two steam engines had as much as they could do to make headway under full steam. At times during this test instruments showed that as much as 2,000 KW. was being returned by the locomotive through the sub-station.

KARL VON SIEMENS ON THE SITUATION.

A very despondent view of the situation in Germany is entertained by Herr Karl F. von Siemens, chairman of the Siemens & Halske Co., Berlin. Addressing the shareholders at the recent annual meeting, he is reported to have stated that the path upon which German economic life is moving is leading to conditions which are becoming worse and worse and more difficult. The turnover of industry in money is in course of constant increase, not owing to greater production, but to the depreciation of the currency. For the present, and as a consequence of the great German famine in goods as well as that of the whole world, it is possible for many industries to cover the increased working expenses, notwithstanding the reduced output. It is, however, noticeable in many branches that there is a limit beyond which it is impossible to think of satisfying the demand, because the working expenses cannot be recouped; and in the case of many transport undertakings, it has already been shown that increases in the fares do not produce any additional receipts on account of the reduction in the traffic. Similarly, manufactures are possibly available, but the consumers who have to pay the purchase prices are too few, and the output must, therefore, undergo a further decline, as the costs of production are still growing. The course of the economic machine should not be allowed to proceed without regulation, but it should be entrusted to the care of experienced men.

The chairman, proceeding to discuss the economic life of the country, stated that it is too frequently asserted that this is dependent upon other countries, and that the Germans will soon come into swing again if they can again obtain the necessary raw materials from abroad. In his opinion this argument may be correct in regard to one or two industries, but it is not the case with many of them, and in these instances the decline is just as great as in those which need foreign materials. The principal thing lacking is coal, not because the Germans have lost too much coal, or have to make deliveries to their late enemies, but because an insufficient quantity of coal is produced as compared with former peace times, and cannot be distributed among consumers. Under these circumstances the recovery of industry in the first place is a question of coal, and iron, and steel, and the Siemens and Halske Co. suffers the most from these causes. A lack of foreign raw materials does not exist for the time being, but there is a great scarcity of semi-finished German and foreign materials. There is very little the company can do to co-operate in remedying the evil as the company belongs to the manufacturing industry which can do nothing with purely raw materials, but must receive them from other industries in a semi-finished condition.

Coming to consider the labour question, the chairman remarked that as contrasted with former periods, the many strikes at present imply a complete loss of the production, as it is impossible to recover the lost output owing to the veto on the working of overtime, and the indisposition to work efficiently. The introduction of politics in the labour relationship has not only brought about a reduction in the efficiency of the workmen and employers, but the capacity of the managers and leading officials has also fallen to a minimum, as their time is constantly occupied with negotiations within and without the works, so that there is no possibility of their activity being concentrated on their particular departments. The sudden introduction of wages agreements which have required years for development in other industries, and which exhibit many defects owing to the shortness of the time and the lack of experience, has put many workmen out of tune and considerably prejudiced the desire to work on the part of those aspiring elements upon whom alone progress rests. The reputation of the German engineering industry, said Herr von Siemens, is based upon the quality of its work, which stands unequalled; and besides the intellectual work, it has been built up chiefly by the superiority of

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the German special workmen. If, however, aptitude and ability no longer find their due reward, every incentive is undermined, and the quality of the work suffers, and Germany will therewith lose an important factor for her reconstruction. The speaker then referred to the coming into operation of the Works Councils Law, which, it is feared, will be used by the dominating radical element for the purpose of producing further disturbance in industry.

Herr von Siemens, in conclusion, confirmed the report that the company has associated itself with the A.E.G. and the Osram works in the amalgamation of the glow-lamp works, believing that this branch will be strengthened by joining the combination. It is hoped by means of an interchange of experience and the systematic division of the production to improve the quality of the lamps and reduce the costs of manufacturing, in order to facilitate the trade contest with foreign competitors.

NEW PATENTS APPLIED FOR 1920.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by MESSRS. SEFTON-JONES, O'DELL AND STEPHENS (successors to W. P. Thompson & Co., of London), Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

1,612. "Electric fire." H. J. DEAN-OSGOOD. January 19th.
1,627. "Circuits of ignition systems of internal-combustion engines." M. S. CONNER and C. C. PUCKETTE. January 19th.
1,645. "Electrically-heated apparatus." R. K. HEARN. January 19th.
1,650. "Eletrically-operated pumps." MERRYWEATHER & SONS and J. H. OSBORNE. January 19th.
1,659. "Electric devices." BRITISH THOMSON-HOUSTON CO. (General Electric Co., U.S.A.). January 19th.
1,668. "Magnetic controlled pendulum." W. A. PACKER. January 19th.
1,670. "Commutators." A. B. BUCKLEY. January 19th.
1,686. "Magnets of rotating wheel type for sparking coils of internal-combustion engines." BOSCH. AKT. GES. R. January 19th. (Germany, November 21st, 1918.)
1,687. "Ignition apparatus for internal-combustion engines." BOSCH AKT. GES. R. January 19th. (Germany, March 15th, 1919.)
1,714. "Magnetos." J. H. TOURNAYRE. January 19th. (France, June 28th, 1919.)
1,750. "Electric welding, brazing and soldering machines, &c." W. J. READETT. January 20th.
1,763. "Protective arrangements for electric distribution systems." A. REYROLLE & Co. (J. C. van Staveren). January 20th.
1,768. "Electrically-propelled vehicle." J. H. HANSEN. January 20th.
1,810. "Rotary electric transforming apparatus." BRITISH THOMSON-HOUSTON CO. (General Electric Co., U.S.A.). January 20th.
1,821. "Electric switches." L. MOSER. January 20th. (France, April 19th, 1919.)
1,830. "Sparking plugs." R. F. HALL. January 20th.
1,840. "Electric induction furnaces." COMPAGNIE FRANCAISE DES METAUX. January 20th. (France, February 7th, 1919.)
1,843. "Battery ignition for internal-combustion engines." BOSCH AKT. GES. R. January 20th. (Germany, November 25th, 1918.)
1,844. "Electric lighting of automobiles." BOSCH AKT. GES. R. January 20th.
1,871. "Wireless telegraphy and telephony." W. H. ECCLES and J. H. VINCENT. January 21st.
1,872. "Device for testing sparking plugs." J. B. TUCKER. January 21st,
1,873. "Electric switches." J. B. TUCKER. January 21st.
1,880. "Electric heater and disinfector for beds." H. C. MEYER. January 21st.
1,887. "Electric burglar alarm." T. FRASER. January 21st.
1,893. "Electric hand lamps." H. J. DALLISA. January 21st.
1,913. "Sparking plugs." J. E. BARROWS. January 21st.
1,959. "Electricity motor meters." J. HARRIS. January 21st.
1,966. "Electric switches." L. MOSER. January 21st.
1,973. "Controllers for electric railways operated by high-voltage direct current." AKT. GES. BROWN, BOVERI ET CIE. January 21st. (Switzerland, January 21st, 1919.)
1,978. "Projector for glow-lamps." BOSCH AKT. GES. R. January 21st. (Germany, May 11th, 1919.)
1,981. "Electrolytic production of magnesium from anhydrous magnesium chloride." E. A. ASHCROFT. January 21st.
1,982. "Spark plugs." J. O. BROCK. January 21st. (United States, March 9th, 1916.)
2,005. "Wireless telegraphy receivers." H. P. REES. January 21st.
2,024. "Sparking plugs." G. H. BARRACLOUGH. January 22nd.
2,029. "Mouthpieces for telephone transmitters." G. A. LINES. January 22nd.
2,031. "Apparatus for grinding electric commutators or distributors." F. BOLTON. January 22nd.
2,054. "Electro-magnetic wave signalling." J. HOLLINGWORTH. January 22nd.
2,061. "Spark plugs." F. HACHMANS. January 22nd.
2,069. "Transformers." G. LIGNORI. January 22nd.
2,084. "Electro-magnetic switches." BRITISH THOMSON-HOUSTON CO. (General Electric Co., U.S.A.). January 22nd.
2,118. "Regulating devices for thermostats." J. F. GEE. January 22nd.
2,130. "Clips for holding tubular electrical conduit." J. DOUGLAS. January 23rd.
2,133. "Automatic telephone systems." AUTOMATIC TELEPHONE MANUFACTURING CO. and J. SAVIN. January 23rd.
2,151. "Electrical machinery." S. TWEEDALE. January 23rd.
2,175. "Ignition of internal-combustion engines." THOMAS TRANSMISSION, LTD., and K. J. THOMSON. January 23rd.
2,186. "Dynamo-electric machines." W. PARKER and SIEMENS BROS. DYNAMO WORKS. January 23rd.
2,204. "Antiseptic telephone mouthpiece." D. LUZENBURG. January 23rd.
2,236. "Electrical resistances, potentiometers, &c." E. W. KITCHIN. January 24th.
2,237. "Transmitters for electrical signalling systems." W. H. CHATTEN. January 24th.
2,302. "Automatic switches for dynamos." H. LUCAS and H. N. URQUHART. January 24th.
2,303. "Electrodes for electric arc welding." BRITISH ARC WELDING CO. and H. OGDEN. January 24th.
2,304. "Electrical transference of designs in textile arts." E. C. R. MARKS (Oesterreichische Siemens-Schuckart Werke and Regal-Patente Ges.). January 24th.
2,327. "Apparatus for electric heating of hot-bulb engines." G. B. PETTER and PETTERS, LTD. January 24th.
2,338. "Electric valves or tubes for wireless telegraphy and telephony." H. M. AIREY, G. B. BRYAN, C. L. FORTESCUE, and A. K. MACRORIE. January 23rd.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1918.

8,529. APPARATUS FOR THE ELECTRICAL SEPARATION OF SUBSTANCES IN SUSPENSION IN GASEOUS MEDIA. Soc. Gallot et Cie. and Soc. Poussin, Rondeaux et Cie. May 22nd, 1917. (116,104.)
10,454. ELECTRODES FOR ELECTRO-OSMOTIC PROCESSES. Elektro-Osmose Akt. Ges. (Graf Schwerin Ges.) October 20th, 1917. (135,816.)
21,458. DYNAMO-ELECTRIC MACHINES. E. J. Harman and E. Le Bas. December 21st, 1918. (137,089.)
21,466. MEASUREMENT OF ALTERNATING ELECTRIC CURRENT POWER. S. Z. de Ferranti, G. Wall, and Ferranti, Ltd. December 21st, 1918. (Cognate application 15,447/19.) (137,090.)
21,667. WIRELESS TELEPHONE TRANSMITTERS. L. B. Turner and R. H. Wagner. December 24th, 1918. (137,098.)
21,698. GENERATION OF ELECTRICITY BY THERMO-ELECTRIC BATTERIES. C. M. Walter. December 30th, 1918. (137,101.)

1919.

140. INTERRUPTORS FOR USE IN ELECTRIC IGNITION SYSTEMS. Dayton Engineering Laboratories Co. January 2nd, 1918. (122,185.)
1,986. SUSPENDING CONDUCTOR WIRES ON ELECTRIC RAILWAYS AND THE LIKE. F. W. Fawdry and P. Dawson. January 27th, 1919. (137,133.)
2,920. CONTROL OF THE IGNITION OF INTERNAL-COMBUSTION ENGINES. Humber, Ltd., and J. A. Cole. February 6th, 1919. (137,142.)
3,137. STARTING AND SYNCHRONISING OF SYNCHRONOUS DYNAMO-ELECTRIC MACHINES. R. E. Grime and Mather & Platt. February 8th, 1919. (137,144.)
3,476. ELECTRO-MAGNETIC RELAYS. British L.M. Ericsson Manufacturing Co., N. Blades and A. E. Sutherland. February 13th, 1919. (137,147.)
3,692. ELECTRO-MAGNETIC STEP-BY-STEP SIGNALLING AND SYNCHRONOUS ROTATION. C. L. Walker. February 14th, 1919. (137,150.)
4,101. METHOD OF LOCKING ELECTRIC LAMPS IN THEIR HOLDERS FOR USE WITH MAJOLICA FITTINGS AND THE LIKE. J. H. Collie. February 19th, 1919. (137,155.)
5,955. SPARKING PLUGS. L. S. Clarke. March 11th, 1919. (137,177.)
7,287. IGNITION DEVICES FOR INTERNAL-COMBUSTION ENGINES. F. C. M. Cesbron. March 22nd, 1918. (124,750.)
8,300. TWO, THREE, OR MULTIPLE PIN PLUGS. Naamlooze Vennootschap Fabriek van Instrumenten en Electrische Apparaten "Inventum." April 4th, 1918. (125,077.)
8,759. WINDING OF INDUCTION COILS. F. Weatherall. April 7th, 1919. (137,199.)
12,319. ELECTRICAL MEASURING INSTRUMENTS. A. W. Lishman. May 16th, 1919. (137,223.)
15,054. SECRET-CONTACT COMBINATION ELECTRIC SWITCHES. E. W. Walsh and C. H. G. Kingsland. June 16th, 1919. (137,237.)
15,758. ELECTRIC COOKING OR HEATING VESSELS AND APPARATUS. C. H. Lauth. December 23rd, 1918. (Divided application on 21,547/18.) (137,240.)
15,759. ELECTRIC COOKING OR HEATING VESSELS. C. A. Lauth. December 23rd, 1918. (Divided application on 21,547/18.) (137,241.)
18,133. ELECTRIC LAUNDRY IRONS. A. E. Fitzgerald. July 21st, 1919. (137,249.)
19,418. SPARK-PLUGS. A. H. Cressy. August 6th, 1919. (137,254.)
19,699. ELECTRO-MAGNETIC STEP-BY-STEP AND LIKE MECHANISM. C. L. Walker. February 14th, 1919. (Divided application on 3,692/19.) (137,255.)
20,580. REMOTE CONTROL ELECTRIC SWITCH. P. Perot. August 21st, 1919. (137,261.)
26,746. ELECTRIC SPARKING PLUGS. Etablissements de Dion-Bouton, Soc. Anon. December 12th, 1918. (136,801.)
30,207. THERMIC TELEPHONE SYSTEMS. Naamlooze Vennootschap de Nederlandsche Thermo-Telephoon Maatschappij. December 4th, 1918. (136,162.)

Electric Fire Engines.—In different parts of the world, notably Germany and the U.S.A., electrically-propelled fire engines have been used to a considerable extent, while in London the L.C.C. Fire Brigade employs a total of 15 such vehicles, states Mr. F. Ayton, chairman of the Electric Vehicle Committee of Great Britain. A repeat order for two turntable ladders mounted on Tilling-Stevens petrol-electric chassis which have been in use for some time in the L.C.C. Fire Brigade, has recently been received by the company. The ladder, which, when fully extended, measures 85 ft., is operated electrically, power being obtained by simply connecting the ladder motor to the chassis generator by means of a switch, the engine being kept running. The ladder can be used either as an escape or as a water tower. The Hanwell Council is considering the purchase of a Tilling Stevens petrol electric fire engine.

Ships' Lights.—The President of the Board of Trade has appointed a committee, under the chairmanship of Mr. Clifford C. Paterson, O.B.E., to consider whether, in order to secure that ships' lights shall comply with the requirements of the International Collision Regulations, it is desirable to lay down standards for the lights, or any parts of them; and, if so, to advise what those standards should be, and what is the best method of securing compliance with them. Mr. J. W. T. Walsh, of the National Physical Laboratory, and Mr. A. S. Hoskin, of the Board of Trade, will act as joint secretaries to the committee. Any communication with regard to the matters to be considered by the committee should be addressed to the secretary, Ships' Lights Committee, Board of Trade, Great George Street, S.W.1.—*The Times.*

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THE

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VOL. LXXXVI. FEBRUARY 13, 1920. No. 2,203.

ELECTRICAL REVIEW.

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THE PRICE OF THE "ELECTRICAL REVIEW."

During the War, almost exceptionally among technical publications and periodicals of the character of the ELECTRICAL REVIEW, we have refrained from increasing the price. Owing, however, to the constant increases in cost of paper, printing, engraving and production charges generally, we have reluctantly decided that the price from the beginning of this year must be raised to 6d. per copy. The change will not apply to unexpired subscriptions.

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THE GERMANS AND INTERNATIONAL AGREEMENTS.

As far as facilities for obtaining information on the subject have been at their disposal, the big German electrical firms have been closely following the developments in the electrical industry in the West during the past few months. Amalgamations of works in England, the establishment of communities of interests between companies in the United States and France, the formation of closer connections between English and French and Belgian firms, and the affiliation of interests between English and Dutch companies—these and other questions have aroused keen interest in leading circles in Germany, whose ruthless methods of warfare caused the termination of the former connection between a prominent American company and one of the big Teutonic works. Not only so, but this particular connection has now been transferred to France, whilst a former Dutch relationship has also been lost by Germany in favour of England.

It almost seems as if the Germans are now asking, "Where do we come in?" Certainly they desire to come in. At the annual meeting of the A.E.G., late in December, Dr. Rathenau informed the shareholders that it was known that efforts were being put forth in the West to form large trusts, although the Germans, for the time being, were not in touch with the Western groups. The chairman added that "an opinion could not be formed as to whether a time would come when they would be able to co-operate with them"—the groups. Apart from somewhat vague reports which have been in circulation for some months past, the statement made by the chairman of the company in question, represents practically all the information conveyed officially from the works in that country concerning their wishes in relation to other countries. They neither reveal their plans for the home market nor disclose what they are seeking to obtain in other countries, although this reticence is perhaps only natural under the circumstances. As a consequence, it is necessary to rely either upon unofficial information or upon deductions from the course of events.

As far as the German inland market is concerned, the fact may be recalled that even in pre-war periods the big German firms occasionally co-operated with each other in the case of transactions involving very considerable sums; whilst in other respects they competed with each other, at all events outwardly, until the publication of the details of the secret price agreement existing between them finally dispelled any illusions which may have prevailed on the question down to that time. Apart from the separation years ago of two heavy electrical engineering works from their original owners and their transfer to an independent company, and the taking up by one company of a large financial interest in another, no actual community of interests by means of an interchange of shares, has yet been established in the German electrical industry. As has been

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shown in other branches in that country, no incentive exists in a period of highly satisfactory trade for an interchange of shares or a consolidation of various financial interests. But the conditions of the world have undergone a change, and necessity may force the hands of those firms who have hitherto desired to retain their independence and compel them to join together for self preservation. In this connection, a German newspaper reveals what is projected. It is stated, for instance, that there is no doubt that a great German electrical trust will be formed, sooner or later, for the purpose of warding off "hostile attacks," and strengthening the economic power of the industry in the home market. The recent consolidation of the glow lamp manufacturing branch is a precursor of coming events, and it would scarcely be surprising if the electrical industry were transformed into a great combination on the lines of the aniline dye trust, which was considerably extended just two months ago.

If, then, it is correct to assume that the big firms intend to amalgamate in some form or other in the near future, the chief object in view will be to obtain sufficient strength to be able to present a united front in the case of competition in the markets of the world, in the event of its becoming impossible to conclude an understanding with groups of makers in other countries. As already shown, Dr. Rathenau was not very explicit at the recent meeting of the A.E.G. But the newspaper previously referred to is quite candid respecting the German intentions. It states that the plans entertained by the leading firms are first to complete the organisation of the home industry, and then to endeavour to form international agreements! If this effort should be successful, the newspaper remarks that an important service will be rendered to the national economy.

It is quite impossible to understand the mentality of the Germans in thinking of the bare possibility of being able to establish working agreements with Allied countries. The mere suggestion is an admission, if not of weakness, at least of apprehensions as to the future of the German electrical industry. Let, then, the apprehensions have full play, for surely no electrical group could possibly work in harmony with those who provoked the great war, deluged the world with blood, and caused the sacrifice of many millions of lives, but who were sufficiently cunning to keep the horrors of warfare outside their own frontiers, at least, in the West. The Germans wish by-gones to be by-gones, but this is totally impossible—the Allies cannot forget the terrible results of the five years of war.

The Electricity Supply Act.

From the King's Speech at the opening of Parliament on Tuesday, we learn that the clauses authorising the formation of District Electricity Boards, and providing for the compulsory purchase of power stations and main transmission lines, which were dropped from the Electricity (Supply) Bill last session, are to be reintroduced, and will doubtless be backed by the full weight of the Government. The House of Commons has already passed these clauses, but the opponents—practically confined to the company interests—may safely be assumed to have improved the opportunity to develop their case against the Government proposals, and we may look for a lively contest in the Commons as well as in the Lords. We should have thought it preferable to appoint the Commissioners, and give them time to study the situation in the light of their existing powers, besides affording an opportunity to supply undertakers to take stock of their position, and to enter into co-operative schemes on the freest possible basis. But even now we have not learnt the names of the new Commissioners, though we have reason to believe that some of them have been appointed.

We are at a loss to understand the reason for the delay. Is it that it is so difficult to find first-class men equipped with "practical, commercial, and scientific knowledge, and wide business experience, including that of electrical supply"? Or is it that such men are reluctant to divest themselves of all shares or other interest in supply undertakings? Or, again, is the Ministry unable to afford the market value of the men who possess the proper qualifications? The Ministerial actions so far have not presented any indication of "railway" speed; indeed, they resemble nothing so much as those of a "Government department."

[Whilst going to press we have acquired some later information on this subject. See our "Notes" pages.]

Returning to the promised Bill, the principal subject of contention will be the "standard price" clause; but whether the companies have much to gain by prolonging the agony is open to question. That they have just cause for complaint is undeniable; as pioneers many of them have borne the burden and heat of the day, without extracting much profit from the business, and they were hoping to reap a well-earned harvest during the last few years of their existence—assuming, of course, as one must, that their ultimate fate would be purchase by local authorities, as contemplated by the earlier Acts. They are undoubtedly entitled to some recompense for their efforts. On the other hand, during the declining years of their concessions, they would have been unable to raise capital, and indisposed to spend it (the latter days of the National Telephone Co. present a close parallel), and the public interests would unquestionably have suffered detriment from this cause, to avoid which, in many cases, the undertakings would probably have been purchased some years before the appointed day, at a higher price than their ultimate value.

The new Bill will render them liable to purchase—and compulsory purchase—at a still earlier date, and, consequently, the price ought in equity to be still higher also. That is what they have a right to expect under the terms settled by Parliament in 1888, and acted upon ever since.

In point of fact, however, they are offered for their power stations and mains the capital expended less depreciation—practically the "then value" that would have obtained if the war had not intervened, but less than half the present value under the actual conditions. No one, however biased, can pretend that this is fair. On the other hand, if they elect to dispose of the whole of their undertakings, including the distribution systems, as they are entitled to do under the Bill, to the District Boards, they will receive the whole of their expended capital without deduction for depreciation. This, while taking no account of goodwill, and to that extent unfair, at any rate constitutes a closer approximation to justice, the return being more than the price that would have been payable if the war had not happened, but less than the present value of the plant. It is up to the representatives of the company interests to endeavour to secure an improvement on these terms, and for that purpose to adopt more efficient tactics than those which permitted the Government to "do them in the eye" last session.

Whether it is worth the while of the companies to try to defer the day of purchase is a debatable question. On Joint Electricity Authorities and District Boards alike, their representatives will almost invariably be heavily outvoted, and it is a regrettable fact that municipal authorities, though less bitter towards companies than formerly, are still unwilling, with some exceptions, to co-operate with them cordially; indeed, in a few areas their attitude is frankly hostile. Under these conditions, the companies may naturally conclude that life is not worth living, and prefer to take what they can get for their undertakings and clear out of the business. In that event we may, in a few years, see the whole of the electricity supply of this country concentrated in the hands of a small number of communal public bodies. The alternative is to remain in the business and place their valuable experience at the service of the joint authorities.

Decentralisation of the I.E.E.

An amusing feature of the dinner of the North-western Centre of the Institution last week was the friendly skirmish between the rival camps of London and Manchester. While the "London Centre" (as Manchester regards it) is in possession of headquarters, the N.W. Centre considers itself every bit as good, and a bit better. "Facts is stubborn things," and the nine points held by London are not easily disposed of; but the North-West clearly means

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to secure a fair share in the government of the Institution, and has already a series of notable successes to its credit. As the President pointed out, the history and traditions of the Institution are rooted in London, but years ago the Northern Society of Electrical Engineers—the only rival society that the Institution has known in this country—was a strong and flourishing body, and although it was united with the larger society, it had—and in the person of the N.W. Centre, it has—traditions of its own; it looks upon London rather as an elder brother than as a parent, and, though it is sincerely loyal to the President and Council, it is determined to uphold its right to a due share of responsibility and trust in connection with the Institution's affairs, especially those which more particularly concern itself. The special points mentioned by Mr. Robertson were the desirability of printing some, at least, of the Students' papers in a Students' *Journal*, the necessity of relaxing the regulations for the admission of candidates in order to prevent the exclusion of worthy men whose war service had interfered with their professional careers, and the claim of the Centre to deal with local applications for membership.

Mr. Wordingham's suggestion that the chairman and vice-chairman of the new Liverpool Sub-centre should be on the Committee of the Centre, just as the chairman and past-chairman of the Centre sit on the Council, calls to mind his remark at a recent meeting that the multiplication of new Centres was impossible, because the chairmen and past-chairmen would swamp the elected members on the Council. This argument seems a rather leaky one. Why should they not? An elected member may be chosen by a comparatively small portion of the electorate, but the chairmen and past-chairmen are chosen as the trusted representatives of the Territorial Centres, and it would be just as reasonable to maintain that the latter should not be outvoted by the former. A much more plausible objection to the development of this system of creating a Council is that the business of the Institution makes heavy demands upon the Members of Council who are in a position to perform the duties, and that it is not feasible for provincial members to put in the necessary time at headquarters.

Enemy Debts. The appointment of a Controller for the collection of pre-war debts between ourselves and Germany, again raises the dissatisfaction on the part of British traders in regard to this matter, and a more serious attempt is now to be made to bring the views of the business community before the authorities. Under the Economic Clauses of the Peace Treaty, which, on the whole, do not appear to have received the consideration at the hands of the general public which they deserve, all debts owing to Germany by us, and all debts owed by Germany to us, are to be paid through the Clearing Houses which, under these clauses, are now established in London and Berlin. To that, of course, there is no objection. The main cause of the grievance which is now being ventilated is the condition that debts on both sides are to bear interest at the rate of 5 per cent. per annum from the commencement of the war. Whatever the considerations were which impelled the Government, through its commercial advisers, to agree to this condition, it is perfectly clear that there will be many hard cases in this country. Take, for instance, the case of a firm owing a considerable sum to Germany, for which a cheque was sent a day or two before the declaration of war, which cheque when presented was, promptly and rightly, refused payment by the bank here. There are many such firms, and their point of view is that it is a great injustice to them to be made to increase their payment to their German creditors by an amount equal to 5 per cent. per annum for five years. In such a case as we have mentioned, this is the position as it is put forward, and there seems sound reason in it. In the first place, the firm was willing and able to pay the net amount of the debt in 1914. Acting prudently, it would seek to invest the money in some easily realisable stock in order to be able to pay it over when the time came. In 1914, the only stock of that character would be the 3½ per cent. War Loan. In any case, it is extremely unlikely that an average of 5 per cent. will have been earned on the money, and the firm has, therefore, not only to suffer the penalty of making up the difference, but also to bear the loss of the depreciation in the capital value of the stock on sale at present prices. There are many such instances: and now that the clearing houses are in existence, and the Controller is demanding the debts which are owed to Germany "forthwith"—and, with a delightful sense of humour, adding that no guarantee can be given when the debts owing from Germany will be paid—British business men concerned are putting their heads together to consider the best means for meeting the situation. It is not suggested that the Peace Treaty can be modified, but the point is seriously being put forward that, in the absence of any discretionary powers on the part of the Controller, the Treasury should be asked to bear the losses which the Government has, it is felt, gratuitously placed upon the shoulders of the trading community. We doubt very much whether any success in that direction will be achieved, and, in the present state of the national finances, we cannot view lightly the prospect of a large sum having to be found for this purpose; nevertheless, the grievance is a real one, unless there is a countervailing advantage on the other side, which we have not yet heard of. From dealings which have taken place between the Controller and British debtors to Germany, there is a belief that he has some discretion to deal with the difficulties which are inevitable, but whether this discretion covers the main cause of complaint is not yet clear. Another grievance is that the clearing-house system, which compels payment in either direction, only applies to Germans resident in Germany There are, however, a large number of pre-war debts owing by Germans resident in other parts of the world which it may be extremely difficult to collect now, and it is felt that some Government action should be taken in this matter.

The D.O.T. In our opinion, the Department of Overseas Trade has an excellent opportunity for gaining the confidence of British manufacturers and traders. Like most of our organisations, it has been passing through a period of transformation and reconstruction during the past year, and there are indications that its new or altered machinery is getting to work satisfactorily. It is for the Treasury to see that so necessary a Department does not suffer for want of means. If it is folly for a private firm to attempt, with insufficient funds, to build up a big export business which shall be permanent and shall afford a profitable outlet for the enormously increased production that will come sooner or later, it is something worse for a national effort intended to facilitate such operations for the good of the whole community to be handicapped by want of the vital wherewithal. However efficient may be the organisations established for foreign trade promotion by manufacturers who operate through trade associations—and they are unquestionably doing good work—there is a place for the Government to fill on behalf of all, both associated and unassociated. We believe that the D.O.T. is now alive to the greatness of its opportunity, and in co-operation with the Trade Press it should, if it pursue an enterprising policy, can work with freedom, can escape the soothing influences of official existence, and continue ever wide-awake, gain the esteem and gratitude of both traders at home and purchasers abroad. One of the Department's present developments is in the hands of its Economic and Editorial Section, which is preparing a series of Manuals, or Handbooks, of Commercial Information relating to each of the principal foreign countries, in which will be published basic information which will be of assistance to merchant-bankers, traders, and others interested in trading operations. Manuals for France and the Argentine are now in an advanced stage of preparation, and some material has been accumulated for similar publications on Brazil, Italy, and Greece. Annual reports will also be issued, taking the place of the Consular reports to which we were accustomed in pre-war days. These will appear more promptly, and, no doubt, will be far more serviceable to the trading community.

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ELECTRIC SUPPLY AT THE LONGBRIDGE WORKS OF THE AUSTIN MOTOR CO., NORTHFIELD, NEAR BIRMINGHAM.

The Austin Motor Co.'s works, being situated outside the distribution area of any large undertaking, have generated their own electric power from the commencement, and the history of the system has been like that of many others, in that many changes have taken place in the process of keeping up to date.

The first system was direct current at 110 volts, with small gas and steam engines as prime movers. The works increased, and the advantages of three-phase alternating-current motors were appreciated, so in 1914 it came about that a new power house was built on a more suitable site to contain a larger plant, comprising six 175-kva. alternators by the Allmänna Svenska Elektriska Co., with exciters direct coupled, driven through flexible couplings by high-speed engines at 375 r.p.m.

The alternators generated three-phase current at 525 volts, 25 cycles. Two were driven by gas engines, the remainder by Belliss & Morcom compound V-type two-crank enclosed steam engines. Exhaust steam was led into a common main connected to a Ledward & Beckett ejector condenser. Rapid increase of load due to the manufacture of muntions of war, in which the firm took so prominent a part, necessitated a corresponding increase in the generating capacity, and two 1,250-kva. 1,500-r.p.m. vertical Curtis turbo-alternators by the B.T.H. Co. were installed in 1915. The sub-base surface condensers of these were supplied with cooling water from a Crichton wooden cooling tower erected on an adjacent site, make-up water being obtained from the brook which flows through the works. Each condenser was served by a motor-driven circulating pump, and a motor-driven Edwards three-throw air pump at 75 r.p.m. The boiler house then contained eight 30 ft. × 9 ft. 6 in. Lancashire boilers, six by Yates and Thom, one by Edwin Danks, and one by John Thompson, all equipped with Units superheaters, two Green economisers, and a natural-draught brick stack of 7 ft. internal diameter, 170 ft. high. Steam was supplied at 160 lb. pressure through a 12-in. main to the engine room. Coal, delivered by rail, was conveyed overhead to the Hodgkinson mechanical stoker hoppers, from storage on the ground level. Standard vertical Weir feed pumps, of 5,000 g.p.h. each, supplied the feed-water through duplicate ranges. At times the demand for power was so great that the whole plant was in commission and carrying overload.

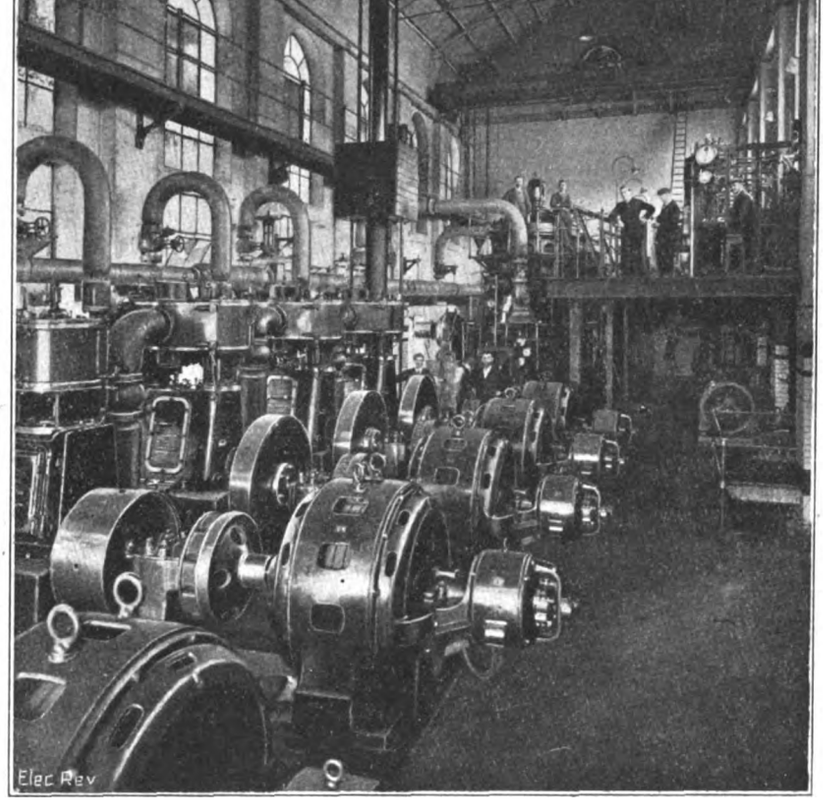

Fig. 1.—South Power House.

During 1916 the company undertook and carried out the erection of two large new works on the opposite side of the railway, one known as the North Works, for the manufacture of 8-in. h.e. shell, from billets to the finished article, and the other, the West Works, for 18-pounder h.e. shell. The North Works, in use by the end of 1916, comprised a lay-out of power house, boiler house, hydraulic press house, with eight large presses, stamps, heat treatment furnaces, air compressor and hydraulic pump house, and a machine shop 900 ft. long × 300 ft. wide. To supply the new works, the most modern power plant was installed, viz.:—Three three-phase, 50-cycle, 550-volt, 1,850-k.v.a., B.T.H. horizontal Curtis six-stage impulse turbo-alternators at 3,000 r.p.m., with exciters direct coupled on the same shaft. Each turbine exhausts into a surface condenser, by Mirrlees, Watson & Co., in the basement. The condensate is extracted by a centrifugal Leblanc air-pump, and air is taken by multijector exhausters, of which there are two to each condenser, so that one can always be stopped to clear the nozzle in case of need, while the other is working. Electric motors of 70 h.p. each drive the circulating pumps for the cooling water obtained from three Crichton cooling towers 70 ft. high with a base area of 77 × 30 ft. Air, after passing through a Heenan and Froude filter, is drawn through the generators and discharged outside the turbine room. A 14-kw. d.c. Belliss-Crompton set is available to supply the emergency lighting at 110 volts. The current generated at 550 volts is supplied to the bus-bars at that pressure, and 24 feeders (20 37/12 and four 19/14), of three single cables each, supply the North and West Works. The main switchboard contains 12 double-feeder panels for 500 amperes each feeder, three generator panels of 3,000 amperes each, one instrument panel for volt-recorder and leakage ammeter, one 3,000-ampere panel to connect up three e.h.t. single-phase transformers now supplying current to the South Works, and three panels for the frequency changer, which converts from 50 cycles to 25 cycles for the South Works. The switchboard, of black enamelled slate mounted on steel-tube framework, extends nearly the whole length of the turbine room on the floor level, and has the standard B.T.H. equipment with oil-immersed switches, hand-operated from the front of the board. Three Tirrill regulators control the three generators.

During 1917 and 1918 the West Works were supplied through two banks of three single-phase Berry oil-cooled transformers of 625 kva. each, by the British Electric Transformer Co., at 6,600 volts; but since the Peace requirements are only a small fraction of the former, the three step-down transformers have been removed to the South Works, enabling a large proportion of the 25-cycle plant to be replaced by the 50-cycle, which is now adopted as the standard. The West Works, now largely saw-mills and car-body shop, with paint-spraying and finishing departments, is supplied direct at 550 volts through two 3-core 0·125-sq. in. and one 3-core 0·3-sq. in. feeders, about

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500 yards long. The boiler house contains 12 Lancashire boilers, 30 ft. × 9 ft. 6 in., by Yates and Thom, with Units superheaters, three Green economisers of 360 tubes each, a natural-draught brick stack of 9-ft. internal diameter and 200 ft. high, and an induced-draught fan driven by a 50-H.P. motor, with separate steel stack. There are four Weir vertical feed-pumps of 5,000 gallons per hour each, with a feed-heater in the pump house and a CO_2 recorder; steam is supplied at 170 lb. per sq. in. pressure through a 12-in. steam main to the turbine room. The steam temperature at the turbine stop-valve averages 550° F., and the vacuum varies from 28·5 to 29·5 in.; coal is delivered by rail, and the trucks are discharged by a tippler feeding the boot of an elevator and conveyor system to the boilers.

Since the Armistice, the company has performed the modern equivalent process of beating the sword into the pruning hook, the North Works now being a complete tractor factory, with its output commenced. The South Works, comprising large machine shops, erecting shop, hardening shop, stamp shop, inspection and experimental departments, &c., are engaged on the output of the 20-H.P. motor-car. In addition to this, aeroplanes, and petrol-electric generating sets, with storage batteries and automatic control requiring no skilled attention, for small installations suitable for supplying villages, institutions, and private houses, are being manufactured. The amount of power required at present is less than half that absorbed during the heavy periods of the War, so that the new power house in the North Works can cope with the whole supply, and the 25-cycle system has been converted to 50 cycles, with the exception of those motors which it is not convenient to replace yet. These are supplied through a frequency changer in the North Power House consisting of three B.T.H. machines, viz, a synchronous 815-KVA. motor, 550-volt, 50-cycle, three-phase, direct coupled to a 650-KVA., 25-cycle, 525-volt, three-phase generator, and a 19-KW., 80-volt, D.C. exciter, all mounted on one bedplate. There are over 500 motors installed, varying in capacity from 200 H.P., driving a hydraulic pump, to ½ H.P., rotating

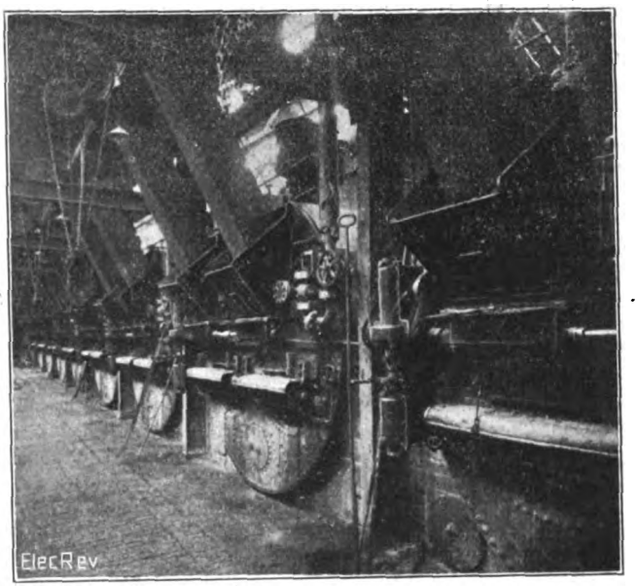

Fig. 4.—North Works Boiler House.

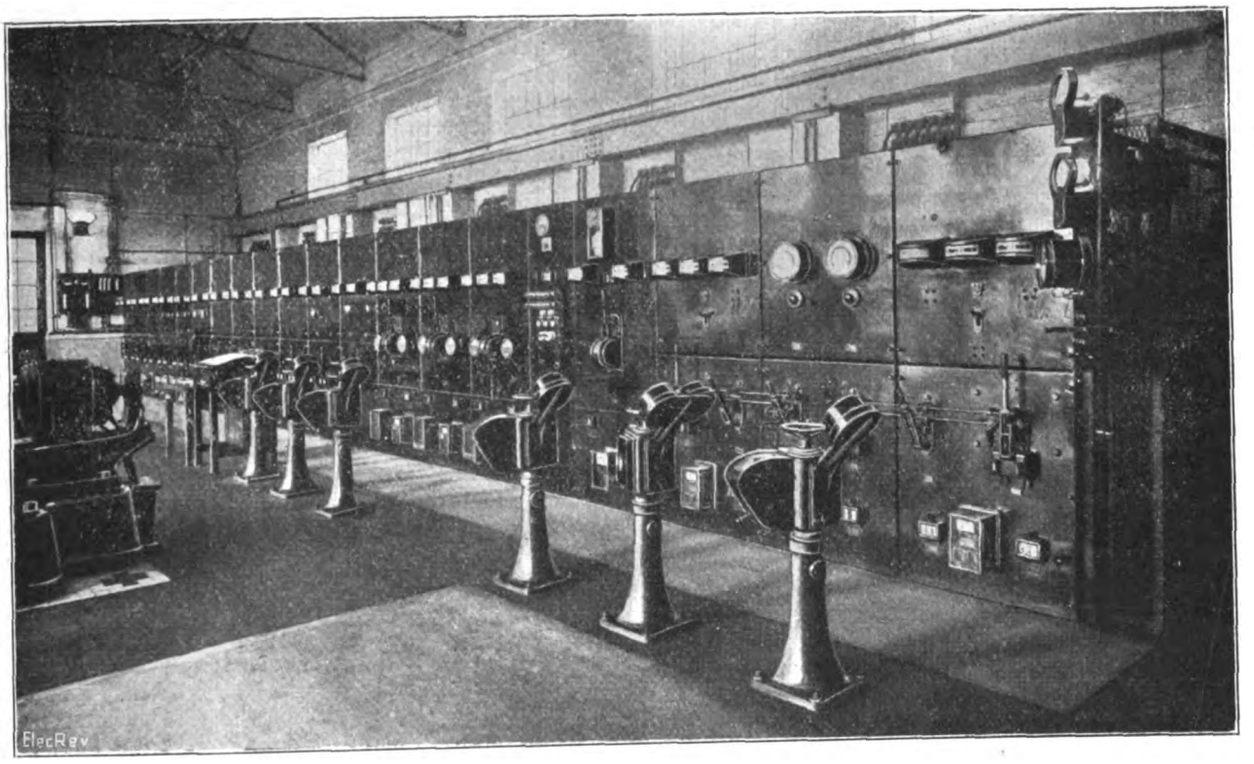

Fig. 2.—Main Switchboard, North Works Power House.

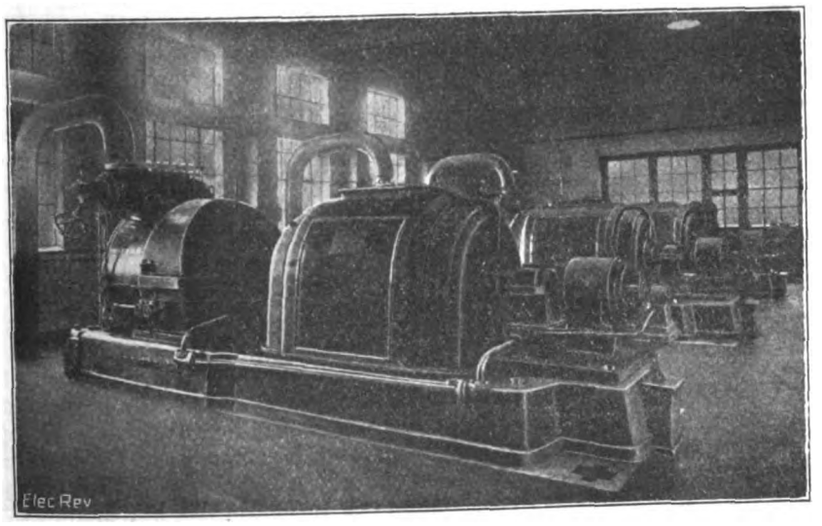

Fig. 3.—Turbo-Alternators in North Works Power House.

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the air filter for the generators in the power house. There are a large number of 100-H.P., and 50-H.P. motors driving line shafting in the machine shops; the motors are of the induction type, mostly squirrel-cage, running at 720 R.P.M., with a few at 1,440 or 960 R.P.M. Speed changes are effected by means of pulley cones at the machines. Crane motors are of the slip-ring type, with grid resistances.

The South Power House now contains the three step-down transformers formerly in the West Works. The transmission from the North Works is at 6,600 volts, by two Pirelli-General Electric 3-core, 0·25-sq. in. paper-insulated, lead-covered, armoured cables, buried direct, except where carried over the railway on the outside of the girder bridge which connects the two works. The new 50-cycle switchboard in the South Works is the standard B.T.H. type, with one 3,000-ampere transformer panel, seven double feeder 300-ampere panels, and one single-feeder panel. The E.H.T. switches at both ends of the transmission are of the removable truck type.

Of great use in the works are 17 Edison accumulator battery trucks, 5 of 50 cwt., 11 of 40 cwt., and one of 30 cwt. capacity. Motor-generator sets are installed for charging these daily. The lighting is at 110 volts. Single-phase circuits are run between each phase of the transformer secondaries and the neutral point. In the South Works there are six, in the North Works four, and

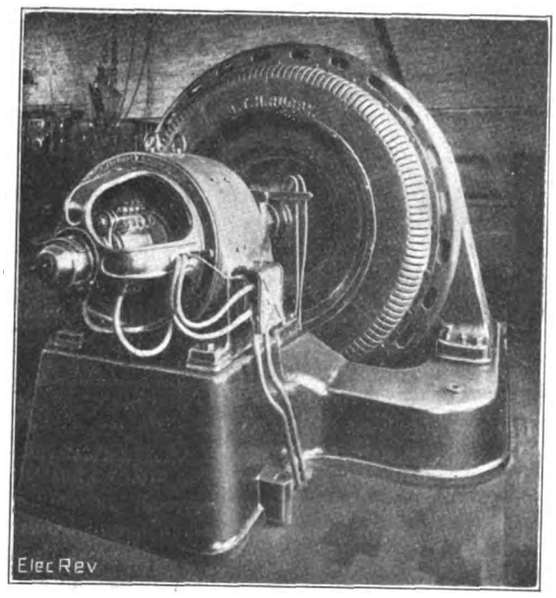

FIG. 5.—FREQUENCY CHANGER.

in the West Works three lighting transformers, oil-cooled, 90-K.V.A. primary delta 550 volts to secondary star 110 volts between phase and neutral, by the British Electric Transformer Co. The lighting is mainly effected by 300-watt and 200-watt lamps at half a watt per candle-power; smaller lighting is done by 20, 30 and 60-watt metal-filament lamps. Electric drills, desk fans, and printing arcs are run from the 110-volt circuits. About 150 clocks on the Synchronome system synchronise the works for time, and an electrically-controlled steam whistle, known as "The Bull," announces the times to start and cease work. Heating throughout the factory is effected by high-pressure steam at 100 lb. per sq. in., partly supplied from the power boilers, through reducing valves, and partly from an auxiliary boiler house containing six Lancashire boilers, two of which are fitted with destructor furnaces for consuming waste timber and other refuse. One Lancashire boiler has been transferred from the South to the West Works to supply the heating steam, and consumes wood refuse from the saw mills.

The works engineer is Mr. T. W. Hartley, and his chief assistant Mr. W. N. Y. King.

The Profiteering Act.—The Electric Lamps Sub-Committee of the Committee on Trusts has held its seventh meeting and considered its draft report.

THE FUEL OF THE FUTURE AND THE GAS COMPANIES.

By B. L. KLEMENS.

On two recent occasions the *Gas Journal* has been deeply stirred by articles under the above heading in the ELECTRICAL REVIEW. On neither occasion has it been able to restrain its anger, and on both it indulges in abuse which has no effect on the case set out, apparently considering it high treason to ask for proof of Sir Dugald Clerk's statements, while to disprove them is an unspeakable crime.

The *Gas Journal*, apparently, can only see the mote in its neighbour's eye, and not the beam in its own, for while complaining that the ELECTRICAL REVIEW occupies three columns in setting forth its points, it uses one and a half columns in attempting to dispose of a case which it describes as not worth disposing of. When the Gas Light & Coke Co. replied to a question concerning the amount of coke obtained by baking one ton of coal, that 8 cwt. are obtained, the *Gas Journal* says the words "for sale" should have been inserted after the word "obtained," because (so the *Journal* says) the gas company gave a net figure. But the statement does not bear examination. The coke sold, according to Sir Dugald Clerk, is equivalent to 41 per cent. of the original heat value of the coal; but the South Metropolitan Gas Co. says that the heat value of the coke is from 10,000 to 11,000 B.TH.U. per lb. (but it would not give any guarantee). The Gas Light & Coke Co., when discussing the efficiency of coke "boilers," gives the heat value as 12,000 B.TH.U., and when it tries to support the 70 per cent. or 80 per cent. advertisement, as 12,350 B.TH.U. per lb. The *Gas Journal* says that it is 12,500 B.TH.U. per lb. It is clearly impossible for all these different values to be equal to 41 per cent. of the coal heat value with the same amount of coke. If 20 lb. of coal yield a net 8 lb. of coke having a heat value of 41 per cent. of the original coal heat value, then, at 13,000 B.TH.U. per lb. for coal, 8 lb. of coke are equivalent to 106,600 B.TH.U. = 13,325 B.TH.U. per lb. That is, the coke has a higher calorific value than the coal, which is absurd. The *Gas Journal* also suggests that the efficiencies used for calculating the mean efficiency of gas for cooking purposes, are not those of the latest type of apparatus. This, however, is not at all probable, for all the efficiencies were those quoted by the Gas Light & Coke Co. except for that of the oven, for which, as its figure was palpably false, Sir Dugald's figures were taken. Can anyone imagine the Gas Light & Coke Co., or any other gas company giving particulars of anything but the most efficient apparatus, when replying to a correspondent who wished to know the amount of gas required to perform certain operations? It was quite clearly stated in my article that the boiler-ring efficiency was assumed at 50 per cent. Instead of producing nearly two columns of rhodomontade on the second occasion, the *Journal* would have been better employed explaining by what scientific means Sir Dugald Clerk makes the watt-hour the equivalent of more than 3.412 B.TH.U. He states that the one-watt lamp requires the use of 54 B.TH.U. at a generating station, per candle-hour, with an efficiency of 8.5 per cent. at the lamp. That is, the watt-hour, according to him, is equivalent to 4.590 B.TH.U., when he seeks to compare quantities of heat used; an error of nearly 35 per cent.

The first actual criticism refers to the efficiency of the gas-making process. The *Journal* denies that Sir Dugald said anything about entirely converting the coal into gas without coke or tar residue, and then proceeds to quote him as saying: "If we consider the whole of the heat used in the process (amounting to 29 per cent.) to be debited against the principal product—coal gas—then to obtain 25 heat units in the form of gas it is necessary to use a total of 25+29=54 heat units of the original coal." The *Gas Journal*

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needs to refresh its memory, or else it has deliberately refrained from quoting the next sentence, which, although Sir Dugald wisely refrained from putting this theory into words, entirely disproves the *Journal's* contention. The sentence in question is: "That is, the thermal efficiency of the gas-making process is 25/54 equals 0.46, or 46 per cent." On the figures originally given in the lecture, coal equivalent to 54 heat units would be converted into gas equivalent to 13.5 heat units, and coke and tar equivalent to 24, but if the *Journal's* assumption is correct, the gas yield is doubled, and coke and tar remain also. As stated in the Review, such figures are fantastic and absurd, because coal cannot be treated on this basis, but even if it were possible, it has nothing to do with the point at issue, which is, that when Sir Dugald gives 3.4 heat units as those usefully employed in the oven for every 100 at the gas works, he is assuming (whether rightly or wrongly is immaterial in this particular case) that 16 heat units are delivered to the oven out of this 100, and the efficiency of the oven was therefore only half that assumed in the first article.

If, for the sake of argument, the Gas Co.'s wholly erroneous statements concerning the coke were accepted at their face value, it would still be necessary to convert a net 34,800,000 B.TH.U. (making full allowance for coke and tar) to do by gas the work that can be done by electricity for a destruction of coal equivalent to 16,400,000 B.TH.U. This, of course, is only a paper comparison, for 58,240,000 B.TH.U. must be converted by the gas companies, and the net figure would only be true if the coke and tar heat values could be used at cent. per cent. efficiency. Even assuming that this impossible supposition were true, our coal supply would be exhausted twice as fast if gas were used as the medium for lighting and heating, instead of electricity.

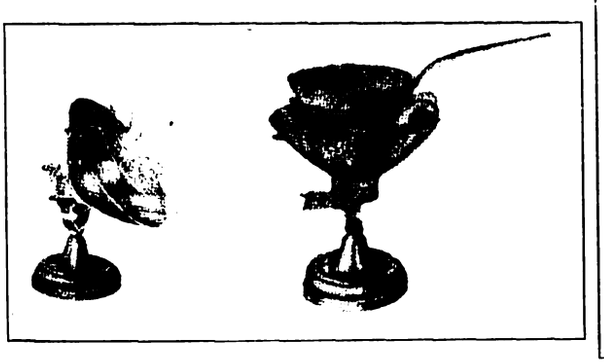
THE IDEAL HOME EXHIBITION.

When, on the afternoon of Wednesday, February 4th, H.R.H. Princess Alice, Countess of Athlone, opened the *Daily Mail* Ideal Home Exhibition at Olympia, there were on view some 250 displays, each devoted to the comfort, convenience, and cheap running of the home. In addition, there are sections dealing with the garden, poultry rearing, labour-saving appliances, music, recreation, and baby-land. In the annexe the Ministry of Health has erected a miniature village of ideal homes for workers, and also a panorama of the city of the future, while the Ministry of Agriculture is responsible for a full-sized allotment which has vegetables growing as in June. The great question of the day, housing, is thoroughly illustrated by many types of structures in a variety of materials; a housing conference, organised by the Royal Institute of British Architects, was begun on the opening day, while kinematograph displays and popular lectures will be given at frequent intervals during the period the exhibition remains open until February 25th. The exhibition and the conferences, organised with the cordial help of the Ministries of Health and Agriculture, the Royal Institute of British Architects, the Architectural and the Garden Cities Associations, and others, should prove of much utility; the public will see what can be done by a wise expenditure of money to overcome difficulties, and the labour-saving section especially should appeal to all.

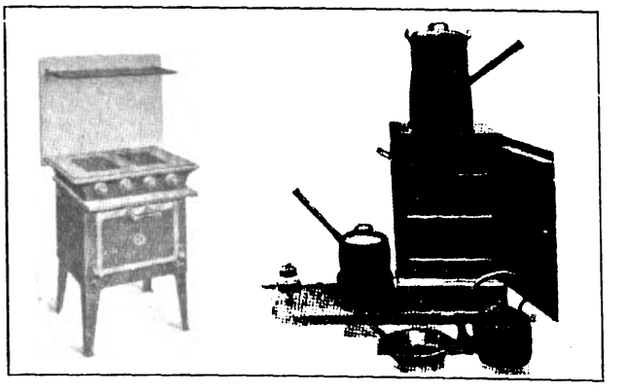
There has never been anything quite like the present exhibition; it is one that nobody can afford to miss seeing. Many things of utility, adornment, comfort, economy, and labour saving that contribute to the conception of the ideal home are on view, and various phases of house construction and equipment can be studied at first hand. It is easy to recognise that the difficulty of maintaining an adequate domestic service lies at the root of the problem of the home lover to-day. Ingenuity is being exercised to reduce manual labour in the home to a minimum, and electricity is being called in to discharge the thousand and one tasks which in the past have made housekeeping a burden. Electricity in the home comes into its own at this exhibition; the ideal home, heated, lighted, cleaned, and kept comfortable by the aid of electricity, which cooks, washes up, and in many other ways acts as handmaiden to the house-wife, is thus realised.

Many of the electrical exhibits are not new, they were on view at other recent exhibitions; nevertheless, a feature of this exhibition is the fine and complete display of modern labour-saving devices, and a striking concentration of electrical household appliances is that given by the "all electric" house which is, in fact, an exhibit in itself well worthy of a special visit. The idea of a stand in this form, not only equipped with electrical devices throughout, but showing each in its proper position and at work, is excellent, and one that must appeal directly to the public.

The *Daily Mail* announces its intention of sending every member of its staff throughout the country to the Exhibition at its own expense. This excellent idea could, with advantage, be emulated by the electricity supply undertakings, as there is plenty to be seen, not only of an educational character, but also calculated to inspire confidence and to suggest the vast influence which electrical methods may have upon the art of home building. We might point out that any difficulty in the payment of expenses might be overcome, under Clause 30 of the Electricity (Supply) Act, by the Electrical Development Association arranging a conference or meeting at the Exhibition. Any electricity undertaking is empowered under this clause to pay the expenses of any delegates or members of its staff nominated to attend such conferences.



Figs. 1 & 2.—Pedestal Heater and Cooker.



Figs. 3 & 4.—Domestic Cookers.

The General Electric Co., Ltd., 67, Queen Victoria Street, London, E.C. 4.—This exhibit takes the form of a two-storey model house, completely equipped with electric lighting, heating, cooking, and other appliances, and is proving a great attraction. On the ground floor of this "all electric" house the kitchen,

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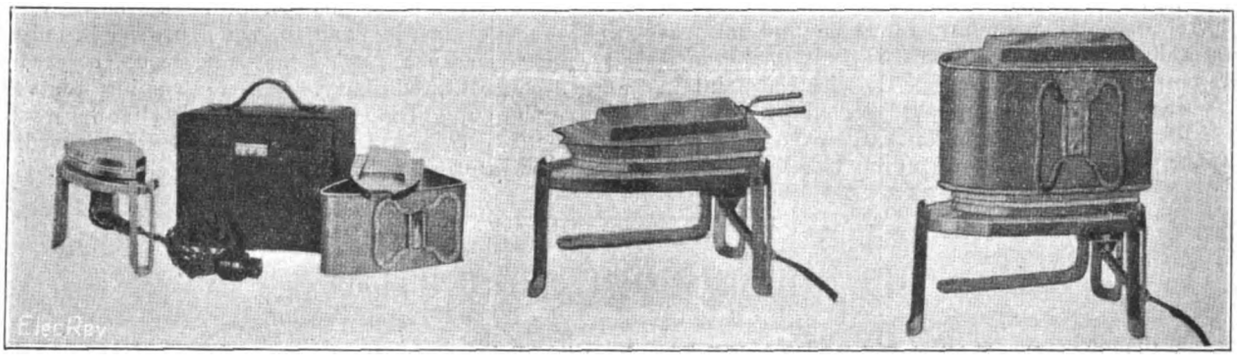
larder, living room, and parlour are situated; these are connected with the wash-house and store by an artistically-constructed pergola. The first floor contains three bedrooms and the bathroom. In all the rooms and on the landings the lighting arrangements are well thought out, fittings suitable for every part of the house being available. Each room has its electric radiator, of a design in keeping with the decorative scheme. Radiators can now be obtained with a switch to enable a graduated heat control to be obtained; some will permit of the boiling of a kettle, and a noteworthy one, the "Magnet" (figs. 1 and 2) pedestal heater, placed in the living room, is instantly adaptable for toasting, boiling, frying, and stewing—a pleasing combination heater and cooker, the utility of which does not spoil its attractive appearance.

reversed iron on its special stand becomes the hot plate on which the other utensils are heated. Fig. 6 shows how by fitting the lid of the boiler it becomes a curling tongs heater, and fig. 7 shows the boiler in position for heating small quantities of water.

A dish-washer, driven and heated by electricity, is a feature that all housewives will covet; and polishing apparatus will save much labour when cleaning silver, cutlery, &c

The wash-house contains an application of electricity that will perhaps save more labour and annoyance than any other—a washing machine, fig. 8, easy to operate and speedy in action. By its use the terrors of "washing day" can be disregarded; and the wringing, by a simple accessory, is done by the machine at the same time. After washing, comes drying—where the electric fan



Figs. 5, 6, and 7.—Electric Iron and Travelling Outfit.

In electric light in the home we have a steady source of illumination that is completely isolated from the surrounding atmosphere, thus avoiding all the fumes that are bound to arise when light is produced by combustion. During the last few years advances have been made in this branch of electrical science, and in innumerable ways electric light has proved a blessing. It is switched on instantaneously from any selected position, and in reply to the objection that has sometimes been raised that electric light cannot be "turned down," a type of switch is now been made that enables a lamp to be lowered as required, instead of being switched off entirely. The quality of the light given by the best makes of lamp is so well known that it seems almost superfluous to emphasise it; it is soft and pleasant to the eyes, especially good when much reading and study has to be done.

Fig. 8.—Electric Washer.

Towards the kitchen, of course, and its operations, the eyes of the housewife will be most frequently directed. Here we find that electricity is the ever-willing servant. The electric cooking range (fig. 3) is an ideal which most women will strive for; it is clean, makes no dust or smoke, and produces no fumes. Smaller pieces of cooking apparatus, fig. 4, grillers and toasters, will prepare a meal in a few minutes; there is no bother of fire-laying, no lengthy wait for the stove, or oven, to "warm up." Accessory appliances, such as warming-plates, hot-plates, food warmers, are shown; these, of course, are just as useful in the living-room as in the kitchen, for a great part of the charm of electricity is the cleanliness which allows of the preparation of a meal in the room where that meal is to be consumed, if it is so desired. The universal voltage electric iron shown in fig. 5 comprises an iron and stand, with curling tongs heater and boiler, all packed in a neat leatherette case. The

may help—and ironing. The electrically-heated "Magnet" iron is a boon; it saves all the delay of waiting for the heating of the ordinary solid iron, for it is ready for use in a few minutes after the switching-on of the current.

Turning to the living room, we find the invaluable toaster, which toasts quickly and deliciously. Electric kettles are available at a moment's notice; these, naturally, are shown in several of the rooms, as are the useful hot-plates, which will either prepare food and boil water, or, in the case of warming-plates, keep them hot until required.

In the parlour, as in the entrance hall, we find a cigar-lighter, which will also light a pipe, where electricity plays the part of the burning match. An electrically-driven sewing machine will delight the heart of the home worker. And when the parlour is only needed for an hour or two, nothing is more easy than to switch on the electric radiator—with no after-results in the way of ashes and dust.

Upstairs, the house is attractively fitted with many appliances which continue to prove the well-nigh universal possibilities of electrical energy. The bedrooms, of course, have their electric fires and pedestal heaters, so that the lighter forms of cooking can be done

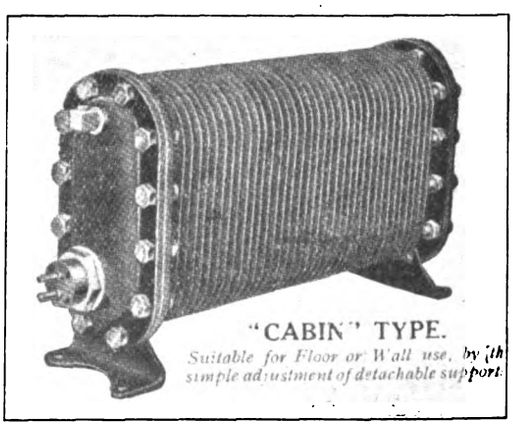


Fig. 9.—Electric Hot Water Radiator.

if desired—extremely handy in the event of illness. A milk warmer explains its own use by its name—the household with a nursery will appreciate this; the toilet-table has its electrically-heated curling-tongs, and the electric shaving-mug is a device that will appeal to the masculine mind—it solves the shaving-water problem completely, bringing precisely the right quantity of water to the correct temperature in two or three minutes. Most of these smaller articles, including the pedestal heater, can be run from the ordinary lighting plug.

For the cleaning of the house an electric vacuum cleaner will do the work of a couple of maids, and by its use the broom and dustpan can be eliminated.

In the bathroom we find an electric towel-rail and gown-rail, capital items for drying and airing towels, linen articles, costumes, &c. Hot water for the bath and lavatory basin is supplied at any hour of the day or night by an electric calorifier, situated in the scullery; it can be placed, however, where it is most convenient, and it is automatic, regulating its own heat.

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Besides the "Magnet" electric fires there is another type of heater, known as the "Magnet" electric hot-water radiator (fig. 9), which does not give a radiant heat as is the case with fires, but effects a uniform heating of the surrounding air by means of the convection currents set up. For this purpose they are economical heaters giving a high efficiency with a low energy consumption, and at the same time the fire risk is practically nil. They are made in two types, the "column" type and the "cabin" type. The former comprises a system of tubular hot water circulators provided with a large number of heat distributing gills or blades. A dual pattern immersion heater is fitted at the bottom, so that a varying heat control can be obtained. The "cabin" type is of similar construction, but is broader but not so tall, a single heat-immersion heater being provided. These radiators need no attention except that it may be necessary once a year to add a little water through the water filler. The construction is particularly robust being entirely of steel and brass.

But it is impossible to mention in detail everything electrical provided by the enterprise of this company in its original exhibit, which must be seen to be fully appreciated. It is a revelation of the manner in which, of recent years, electricity has proved to be an ever-ready servant, making the work that remains a pleasure. The house, we should add, has been specially designed by Mr. Albert J. Thomas, L.R.I.B.A., and constructed by Messrs. Humphries, Ltd., the furnishing is by Messrs. Harrods, Ltd., the sanitary fittings are supplied by Messrs. J. Bolding & Sons, the tiles by Messrs. Geo. Tucket & Co, and Messrs. Roberts, Adlard and Co.

MESSRS. STRODE & CO., LTD., 48, Osnaburgh Street, London, N.W. 1, exhibit country house lighting plant consisting of a horizontal low-speed oil engine burning cheap paraffin, and controlled by a governor which ensures steadiness in running and economy in fuel consumption. Constant attention or regulation is unnecessary; the plant is simple in character and easy to manage. Where space has to be economised, a low-speed dynamo is direct-coupled to the engine, but, where sufficient room is available, a belt-drive can be supplied. All working parts of the dynamo are easy of access for inspection and cleaning, and, at the same time, well protected against accidental contact. The generating plant requires to be run three or four hours per day to charge a battery of

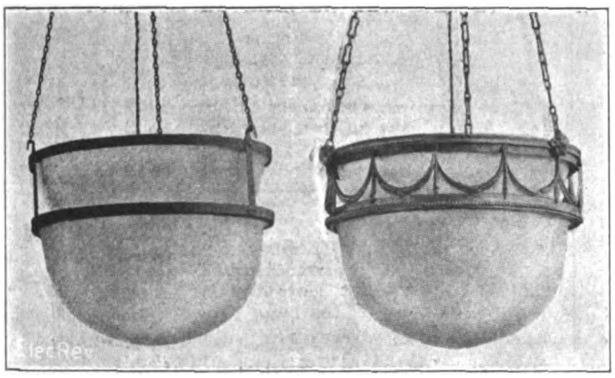

FIG. 10.—IMPROVED INDIRECT LIGHTING FITTINGS.

accumulator cells, and for the remainder of the time energy may be taken from the battery. Separate switches and fuses are provided on the switchboard to control the dynamo, and the house circuit, also for extra circuits where required. A regulating charge and discharge switch is provided for the battery, which enables certain cells to be cut in or out of circuit to obtain the correct voltage. An automatic cut-out protects the battery in the case of the charging current falling below the proper limit. This firm's new "Destro" electric cooking and heating utensils are manufactured exclusively of aluminium, and combine lightness, strength, and cleanliness. Each unit is fitted with a quick-heating element, there are no soldered joints, and the elements are easily replaced. Black ebonised handles are fitted, the construction is strong, with a superior finish. Specimens of electric bells, telephones, flush switches, plugs, and ornamental switch covers, as well as the firm's steel conduit system of wiring are to be seen. Improved indirect lighting fittings, combining the advantages of both indirect and semi-indirect systems, are exhibited, in which indirect illumination is obtained with a special reflector, having two confocal curves on the upper part of the fitting (as shown in fig. 10), the bowl being illuminated at the same time, so that a soft and diffused light is obtained. There is a fine selection of fittings, including alabaster, superlux, and other dash fittings, specially constructed for use with gas-filled lamps. Although not actually exhibited, it may be stated that the firm is bringing out a new form of window reflector light, and also a reflector fitting for studio work, designed on scientific lines.

MESSRS. BERRY'S ELECTRIC, LTD., 86, Newman Street, Oxford Street, London, W. 1.—This "Touch-button" house, with its innumerable electrical devices for dodging drudgery, had a constant stream of visitors and will serve to give some idea of what the real "Touch-button" house will be when it is opened next month at the above address. The name is not altogether a fancy one, for the pressing of a button in the various rooms has a remarkable effect, and the house, comprising artistically decorated rooms, the contents of which are all for sale, contains and is set apart for demonstrations of labour-saving devices. The well-known "Magicoal" electric fires, and "Colec" system of radiant heating, which are the firm's chief specialities, are exhibited to advantage. The actual heat comes from an electric radiator on the hearth, and the coal-fire effect is brought about by reflected light. There are no chimneys in the house, no soot, little dust, and work is reduced considerably. All the rooms are heated by means of a central coal or coke fire to a temperature of 55° F., and the "topping up" is provided by means of electricity. In the kitchen electricity is a regular maid of all work; it appears to play almost a human part all over the house, even to an electric vibrating razor for shaving.

(To be continued.)

FAILURES OF TURBO-GENERATORS, AND SUGGESTIONS FOR IMPROVEMENTS.

AT a meeting of the NORTH-EASTERN CENTRE of the INSTITUTION OF ELECTRICAL ENGINEERS at Newcastle, on January 26th, Mr. J. SHEPHERD read a summary of his paper (which was abstracted in our issues of January 16th and 23rd). In the subsequent discussion Mr. ROSEN said he did not agree that turbo-generators were unreliable, as he knew of a machine that was put in 15 years ago and was still running, and had only had a few overhauls. Many of the faults were due to conditions at the stations, but again, many of the shortcomings were being overcome. He thought that if the alternator rotor were removed, and an examination made of the stator windings, a large number of serious accidents would be obviated. Further, he contended that the tendency of modern construction and improvements was to lessen faults due to stresses at critical speeds. Flexible couplings were quite satisfactory when the working pressure was kept within reasonable limits. The author seemed to think that water-cooling would prove the cure for the difficulties raised, but the speaker thought there was in this a great danger, for leaks could not be entirely prevented.

Mr. JACKSON said the author referred to the turbine as being first installed in 1903, but before that they had it on Tyneside. In that district many experiments had been made with air cooling. Great difficulties had been met with when spray filters had been used, and also with the cloth filter. The cloth filter was satisfactory while in use, but difficult to clean when out of action. Experiments had been made with water cooling, with a great amount of success. If water cooling were used, and the water allowed to fall to too low a temperature, it might cause condensation. Then there were the failures of the tubes due to age and corrosion. Gas was often taken up, and water taken from a condenser was often very corrosive indeed, but chemical mixtures had been introduced which had overcome the difficulty. He protested against the suggestion that flexible couplings were not satisfactory. He had seen solid couplings used that were the cause of serious vibration.

Mr. LUNN said he had experienced difficulty with corrosion arising from the use of condenser water. He asked whether oil could not be used for cooling purposes instead of water. If a leak occurred it would not be so serious as if water had been used, and if some dropped on the windings probably it would not do much harm. If air were passing through and carried in dirt it would soon cause trouble. The oil would have to be cooled, and that might increase the cost. He had not used water spray, but the air filter seemed to keep the air almost clean, and after twelve months there was very little sign of dirt on the windings. He had had one breakdown caused by a bad joint. He thought it was due to faulty soldering. When the joint was repaired and the burnt portion removed, they found all the conductors of one length were broken down. The longer conductors were supported, but it had not been considered necessary to support the shorter ones, and evidently that was a mistake, because the strain had caused the insulation to break on each of these conductors. He thought it was very necessary that dampers should be fitted to the air-ducts, as they would save a great deal of damage.

Mr. BEARD said he did not agree that the old low-speed alternators gave no trouble. He also criticised Mr. Shepherd's statement that "As a rule serious failures with turbo-generators only develop when machines are of large size and form units in a system of some magnitude." The speaker thought that rather the reverse applied, because generally speaking, on large systems the protective arrangements were so much better than on the smaller systems, and a breakdown was less liable to do much damage. With regard to the slip on rotors, he could not recall where side slip had occurred; the conditions were very unsuitable for side slip to take place. Mention had been made of the use of carbon tetrachloride, but he advised great caution in its use. Referring to automatic dampers, he said these were closed by the same relays as cut out the machine in the case of failure.

Mr. TURNER and Mr. PATTERSON also briefly joined in the debate, and Mr. SHEPHERD replied.

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At Birmingham, on January 28th, Mr. J. Shepherd's paper on the above subject was read and discussed before the South-Midland Centre of the I.E.E.

Mr. W. Wilson said that anyone who had had marine experience must have realised that the introduction of electric drive would bring about a number of welcome improvements, while at the same time the corrosive effects of the salt air were only too evident to those who had to maintain electrical apparatus exposed to its influences. Among other advantages, the following were the most evident that would be derived from electrical propulsion of ships: The development of power would be centralised; the removal of the inefficiencies of isolated auxiliaries would result in a saving of coal. The increased ease of manœuvring was particularly felt in naval vessels, where greater safety, as well as convenience, would be afforded by electric transmission, through the increased sub-division and isolation that would be made possible. One of the most evident advantages was the absence of the long intermediate shaft, which was responsible for such a large proportion of the breakdowns at sea. The difficulties in the way were not less serious than the author had stated; the principal difficulty was that of cooling the generators.

Mr. W. N. Cranston explained that if they took 15 deg. C. as the approximate difference in temperature required between the iron surface and the air in the duct, and assumed the corresponding difference in the case of water cooling to be negligible, they could permit an internal temperature rise of 15 deg. C. more. If they took 50 deg. C. as the present temperature rise from all sources they could allow 40 per cent. greater loss, provided all other things remained equal. Unfortunately that was not so, since they relied on the cooling from the air gap surfaces of both stator and rotor as a valuable heat path, the efficiency of which depended entirely upon a rapid change of the air in the gap taking place, and in the author's ideal machine it would disappear. In a machine having a stator loss of 200 kw., about 60 kw. would be dissipated from the gap surface of the stator, and a similar amount from the rotor. In the absence of air ventilation the whole of that heat would have to be conducted across the stampings, at the point of highest loss, and he was afraid this would practically absorb the whole of the 15 deg. C. gained. Whatever might be the future of water cooling as an auxiliary, he thought the main cooling medium would continue to be air. They might use a closed circuit with some form of cooling device, which would give absolute cleanliness, and it would be possible to rob the air of its oxygen before admitting it to the machine, and so eliminate the fire risk. A gas had the great advantage over a liquid that the heat in it could be extracted mechanically even though it might be at a lower temperature than its surroundings. This opened up great possibilities of using the turbo losses to some advantage.

Mr. R. G. Jakeman, in common with several other speakers, thought the author had been rather unfair to the present designs of turbo-alternators. The author appeared to have assumed that all channels would be completely filled with the cooling liquid. It seemed quite likely, however, that the centrifugal force would cause the liquid to be flung outwards, leaving a vacuum at the bottom of the slot, which would reduce the surface of liquid available for cooling.

Mr. F. Forrest said the present method of cooling large turbo-alternators could not be regarded as satisfactory. He believed future development would tend towards some system of liquid cooling. There were grave risks in adopting water cooling for the stator of a high-voltage alternator, and he did not believe that this would ever become standard practice. Forced oil-cooling for both stator and rotor would be a satisfactory solution of the difficulty, although the volume of the cooling ducts for oil as compared with those necessary for water cooling would be about two and a quarter times as large.

Swedish Engineers and Higher Piece Rates.—The *Economic Review*, quoting the *Social-Demokraten* for January 14th, says that in support of their claims for higher piece rates as compensation for the shorter working day, the Swedish workers in the engineering industry urge that labour efficiency has risen considerably during recent years; and that greater output cannot be achieved, which is the solution offered by the employers. To substantiate this claim, the Metalworkers' Union has now carried out an investigation, covering 13 large firms in the engineering industry, six in Stockholm and seven in the provinces. It reports that during the years 1914-19 a reduction of 23.9 per cent. in the hours of work has taken place, which affords a measure of the increase in efficiency. The pay per hour has risen on an average 107.5 per cent. during this period. Of this figure, 32.7 per cent. was derived from increases in piece rates, the remaining 74.8 per cent. by increased output. The employers have therefore easily been able to meet the compensation paid for the higher cost of living, and a more sympathetic treatment of the present compensation demands with regard to the 8-hour day might have been expected.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

A Vacuum Shrouded Immersion Heater.

In our issue of June 14th, 1918, we gave details of a method of heating water or other liquids by means of a heating element immersed in a vacuum flask. The inventor, Mr. L. O. Meyer, has further improved this device by adding a small resistance which reduces the current to a strength just

Fig. 1.—Vacuum Shrouded Immersion Heater.

sufficient to maintain the contents of the flask at boiling point. The inventor states that ¾ pint of water can be kept at 212 deg. F. by a heater taking 4.5 watts from a 4-volt accumulator.

A New Wind Turbine.

Mr. Clarkson, of the Air Power Co., Prestwich, Manchester, has recently developed a new wind turbine, fig. 2. This machine may be constructed in various sizes and types in accordance with the force available in different districts. The diameter of the turbine ranges from 6 to 20 ft., and it is fitted with either single or multiple rotors. A starting and stopping gear is provided, and roller bearings support the

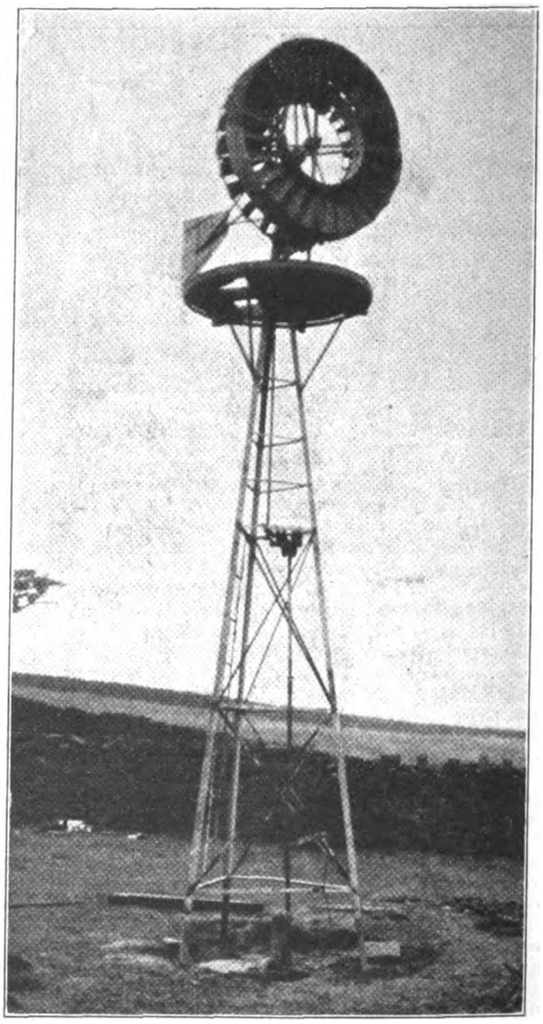

Fig. 2.—The Clarkson Wind Turbine.

rotor. Automatic gear to regulate the force of the wind is also included, and the whole is mounted on a steel tower. In view of the cost and difficulty of obtaining fuel at the present time, any scheme to dispense with it probably constitutes a good financial proposition. Wind-electric plants are already in use in Denmark and elsewhere.

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THE GYROSTATIC COMPASS.

By SIDNEY G. BROWN, F.R.S., M.I.E.E.

(*Abstract of paper read before the* Royal Institution of Great Britain, *January 30th*, 1920.)

A gyrostat consists of an accurately balanced spinning wheel, mounted with as little friction as possible, and in such a way that the axis of the wheel may point in any direction in space. Mere translation in space has no action on the instrument; carrying it about, for instance, does not alter the direction of the axis. On the other hand, the gyrostat is acted upon by any force that tends to tilt the axis, or to give the axis a new direction in space.

The wheel is spinning round its axis. Call the direction of this OA. If we impress a force upon the wheel, tending to tilt or rotate it round another axis OB, then the rule is that the spinning wheel will " precess " or move in such a direction

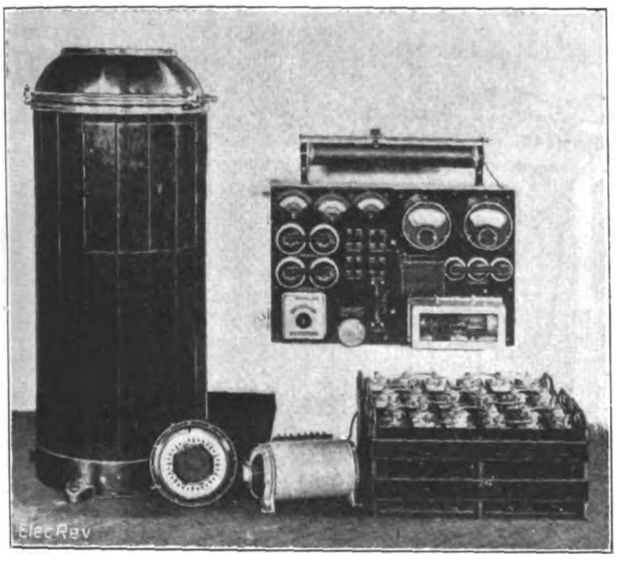

Fig. 1.—Complete Equipment of Brown Gyro-Compass.

as to try to make the two axes OA and OB coincide, and the direction of spin of the wheel to coincide with the new direction of rotation that we are trying to produce by the applied force.

The gyrostat under impressed forces tends to move so as to make the whole angular momentum a maximum. Suppose, therefore, a gyrostat has its axis OA fixed parallel to the earth's surface, but free to turn in " azimuth," as it is called, upon a frictionless vertical spindle, the earth will act upon such an instrument, and it will be a gyro-compass. The earth as it rotates is continually tilting the axis of the wheel in space; the wheel will, therefore, turn so as to set its axis of rotation as nearly as possible parallel to the axis of the earth. It is only when the two axes coincide that the wheel is free of any further tilting action—that is, when it is pointing true north; deviate the axis, however little, from this position of rest, and the action of the earth comes in again to precess the wheel back again to the north.

The use of a gyro-compass on land is very limited, and its great value at the present time is on board ship. Now a rolling and pitching ship is about the worst place to put a gyrostat to act as a compass, because the ship's movements all tend to tilt the axis. The problem, therefore, is to make the compass insensible to the movements of the ship, and respond only to the slow angular rotation of the earth.

To indicate the severity of the ship's movements I may recall a recent trip of this gyro-compass on board a fast destroyer. During a severe gale the ship was recorded to roll over 50 deg. of total angle; yet the gyro-compass maintained its accuracy and allowed the ship to be safely steered into harbour, to which she had to run for safety. In all this whirlwind of movement the gyro-compass heard and only responded to the still small voice of the earth's rotation.

For use on board ship the compass must be mounted on a pendulum in gimbal rings, and its period of oscillation is lengthened to something like 85 minutes, which is usual in practice, so that the rolls, which are of the order of 7 to 15 seconds' period, shall have but small effect on the compass.

In this case the rotation of the earth does not act directly upon the gyro wheel, but by means of the force of gravity through the pendulous weight. Unfortunately this form of mounting introduces troubles of its own.

Suppose the spindle is pointing west, and is horizontal, then the earth as it rotates will leave the wheel pointing in this one direction in space, but the weight will try and follow the earth's rotation, and will start precessing the gyro towards the north. The rate at which the wheel comes to the north depends upon the weight attached to the casing. All the time the wheel is coming to the north the earth is adding to the rate of the precession, and the spindle is as a consequence tilted, and is deflecting the weight, at the north position. Under these conditions the effect of the weight is to continue the precession, and the gyro wheel will swing through the north position, and will continue to move until the effect of the earth arrests and reverses the motion. The compass will therefore continue to swing through the north position with constant amplitude backwards and forwards, undamped. To render the compass of use, some method of damping the swing must be introduced, so that the compass may finally settle on the north. Friction between the vertical spindle and its support is inadmissible, because the movements of the ship would react through the friction and cause errors in the reading. Anschutz, in his early form of compass, by use of an air blast gets rid of this connection with the ship. The air blast was arranged to oppose the movement in " azimuth " when the wheel tilted, and thus he obtained an effective method of damping. The strength of the air blast, which varies proportionally to the tilt, should be nothing when the compass is at rest on the north—that is, when the tilt is nothing—and this would be true with the compass on the equator. In other latitudes, however, the compass rests at the north with a tilt still remaining. It does not come back to the horizontal position because the axis of the wheel is trying to set itself parallel to that of the earth. This leaves a residual air blast continuously acting, producing a permanent twist in " azimuth " and a constant error. It is therefore preferable to damp the swings of the compass by acting upon the tilt rather than its movement in " azimuth," because in this case there will be no latitude error. The tilt is a maximum at the middle of each swing—that is, when it is moving through the north position—and it is the return of the weight to its truly vertical position that is responsible for the continuation of the oscillation. We therefore require some method of neutralising the action of the weight, not before, but after the compass has reached the north. This I accomplish in the " Brown " gyro-compass by automatically moving a liquid from one bottle to another, and in such a direction as to counterbalance the weight, precessing the gyro wheel; and I delay its action by means of a valve or constriction in the tube joining the two bottles.

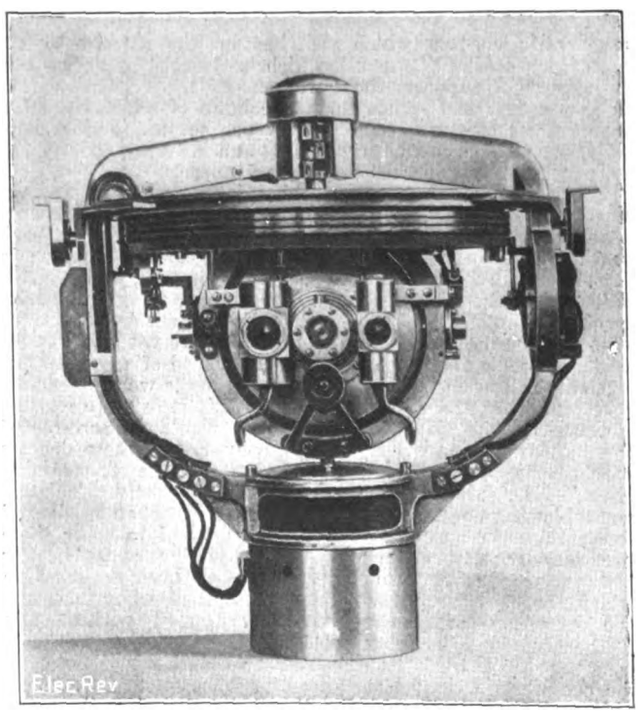

Fig. 2.—Gyro-Compass Removed from Binnacle.

The force with which the compass seeks the north is proportional to the product of the rotation (one revolution in 24 hours) and the spin of the wheel. In the " Brown " gyro-compass the wheel, which is 4 in. in diameter and 4¼ lb. in weight, runs at 15,000 revolutions per minute. The maximum directive force of the earth on this wheel, that is when the spindle is pointing east to west, is only the weight of 30 grains with a leverage of 1 in. This small force is continually

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diminishing in value as the axis approaches the north direction, and vanishes absolutely in that position. If the compass be deflected, say 1 deg., from the north, then the force of restoration is only ½ grain at a leverage of 1 in. It will therefore be seen how important it is to eliminate as completely as possible any friction on the vertical axis that would tend to oppose the directive action of the earth.

There are three forms of gyro-compass now in use, the Anschutz (German), the Sperry (American),* and the "Brown" (British).

In the "Anschutz," the vertical axis is supported by a bath of mercury; in the "Sperry" by a suspended wire, the twist, if any, being taken out by a follow-up motor, through

This would be true if the compass were undamped; but all gyro-compasses are damped, and the ballistic deflection must, therefore, include a term due to the damping.

This damping term up to the present has been neglected, but in practice it is found that when a ship is steaming and turning to alter its course, the compass does not come dead-beat to its new position, but has an oscillation started which is common to all existing gyro-compasses. On a merchant ship the damping error is of little moment; but on a war vessel which is manœuvring it may be serious, as it may swing the compass off its correct reading by several degrees. I have made certain modifications in my compass to remove the damping error.

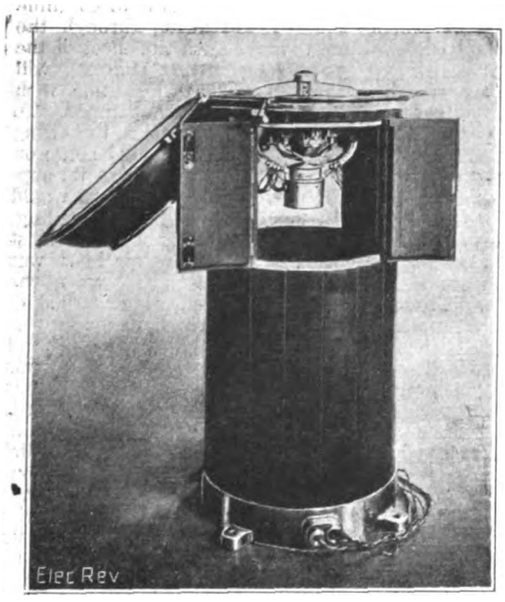

FIG. 3.—BINNACLE AND GYRO-COMPASS.

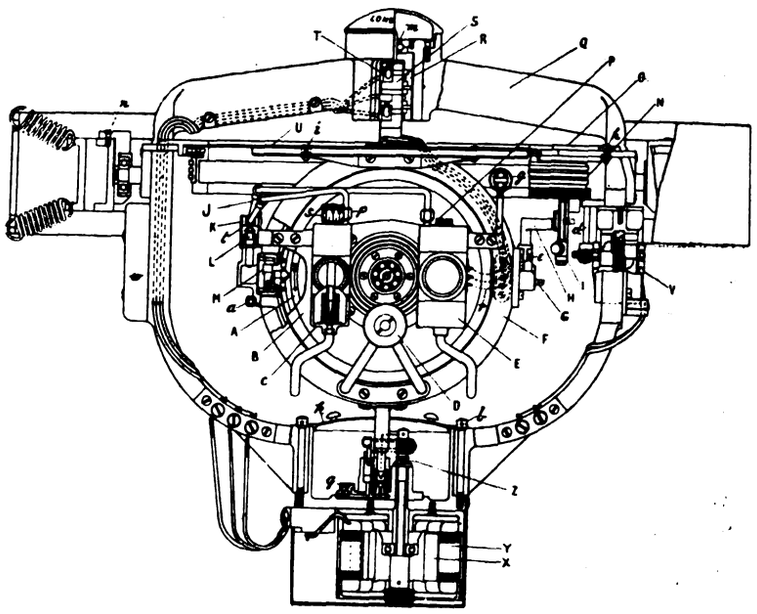

FIG. 4.—DETAILS OF BROWN GYRO-COMPASS.

A, gyro-wheel; B, casing, carried on knife edges; C, damping bottle; D, quadrantal weight; E, control bottle; F, supporting ring; G, adjusting screw for E-W balance; H, air blast for repeater control; I, air contact-maker; J, air pipes; K, air box; L, air jet; M, knife-edge; N, follow-up ring; O, ring on which lubber-line is marked; P, screw stoppers; Q, main pendulum on ball bearings; R, mercury contact rings; S, slip rings; T, mercury cups; U, compass card; V, step-by-step motor for turning follow-up ring N; X, rotor of pump motor; Y, stator; Z, ball-bearing thrust block; *a*, adjusting screw for air jet; *b*, screws; *d*, intermediate spindle; *e*, adjustment for repeater air blast; *g*, spirit level; *h*, *i*, screws for adjustments; *k*, cover; *m*, ball-bearing guide for vertical axis; *n*, screws; *p*, pipe sockets; *q*, suction valve for oil pump; *r*, flexible leads to gyro stator; *s*, divided screw head of damping valve; *t*, cover of air box; *v*, oil cup for gyro wheel; *w*, counterweight.

an electric contact which switches on the current to the motor; and in the "Brown," which is operated by an hydraulic system of support, the lower end of the vertical spindle acts as a ram and stands upon a column of oil. The oil is under great pressure, some 500 lb. per sq. in., and is kept pumping up and down, thus raising and lowering the vertical axis continually some 180 times every minute.

The continual movement of the spindle results in a practically frictionless vertical support, so that the total moving part, some 7¼ lb. in weight, can be carried round in "azimuth" by the smallest force, due to the earth's rotation; in fact, so small is the friction that the compass, if deflected, will always come back again to its true north position, certainly within 1/10th of a degree. I think I am safe in saying that it is the most perfect frictionless support yet given to the vertical spindle of any gyro-compass or indeed of any machine.

A ship sailing to the north at, say, 20 knots would complete a revolution of the globe in 45 days. If there were a gyro-compass on the ship, the instrument would be sensible of the angular movement, and would point one or more degrees west of the actual pole; this is termed the "north steaming error." The extent of the error can be accurately calculated, and tables have been prepared so that this error can be allowed for. Automatic means have also been devised to make these necessary corrections in the reading of the compass. For instance, a special form of repeater has been designed in which the card can be set eccentric, so that, when once set, the correction will be automatically applied without any further reference to the tables.

As the ship changes its speed the acceleration will act upon the pendulous weight and cause an oscillation to be started. This oscillation is termed the "ballistic deflection."

The permanent north steaming error and the transitory error, due to the ballistic deflection, are in the same direction, and mathematicians have calculated that with an undamped gyro-compass, if the time of its oscillation is set to 85 minutes in any particular latitude, the ballistic deflection can be made exactly the same as the deflection due to the north steaming error; this being so, the compass should move into its new resting place without further oscillation.

The last, but by no means the least, of the errors that may arise if the instrument is not properly designed, was not known when the gyro-compass was first brought out, and it proved a most difficult fault to correct; its elimination has had more to do with the design of the later forms of gyro-compasses than any other factor. If a gyro wheel is precessed towards and kept pointing to the north by an ordinary pendulum weight it will work well on board ship, provided that the ship is steaming on a fairly smooth sea; but if the direction of the compass points anywhere in the quadrants—that is, N.W. or N.E., S.W. or S.E.—and the ship rolls, the wheel will try to set itself so as to bring the rim of the spinning wheel in line with the roll, and in a long, continued and heavy roll the compass may show an error of 20 or more degrees, a most serious fault, and one that would render the instrument quite useless in a heavy sea. This error is called the "quadrantal error." If the compass points direct N.S.E. or W. the error is nothing, but it would be a maximum in any of the directions before mentioned.

Anschutz gets rid of the error by multiplying the number of his gyro wheels, and by constructing the instrument as symmetrical as possible. In the year 1914 the Sperry Co. claimed to have effected a cure for the error by attaching the pendulous weight, not directly to the gyro casing, but through a pin arranged to move in a slot in the casing.

In the "Brown" compass the quadrantal error is eliminated by making the weight operate completely out of phase with the roll—that is, at 90 deg. displacement.

The "Brown" gyro-compass is shown diagrammatically in fig. 4. A is the gyro wheel in its casing B. This case is carried on knife edges M in the vertical ring F, and is thus free to tilt under the action of the rotation of the earth. The vertical ring turns in azimuth on a frictionless mounting, consisting of an oil pump at the bottom of a ball-bearing *m* at the top. XY is the three-phase motor that drives the oil pump.

The gyro wheel is the rotor of a three-phase motor, and current is led into the moving system through the three sets of iron contact rings R and S. These rings do not touch, but the outer set are hollow, and mercury fills the space between them, so that there is little friction.

The vertical ring is dynamically balanced by two projecting weights D. Q is the pendulous mounting, supported by gimbal rings and by the outer row of springs to take up shock.

* The Anschutz compass was fully described in the ELECTRICAL REVIEW for December 1st, 1911, and the Sperry in the issue for June 6th, 1913.

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The gyro wheel runs at 15,000 revolutions per minute, and thus acts as a powerful blower, giving an air-pressure equal to some 3 in. of water. Fixed to the vertical ring, but connected through the hollow bearing *m* to the inside of the case, is the air jet L. This jet blows into the two halves of the air box K, and thence through the pipes J. The air-pressure is thus transmitted to the oil in the two sets of bottles C and D.

H is another air jet similarly mounted and employed to act upon a pair of contact-making vanes I. The contacts,

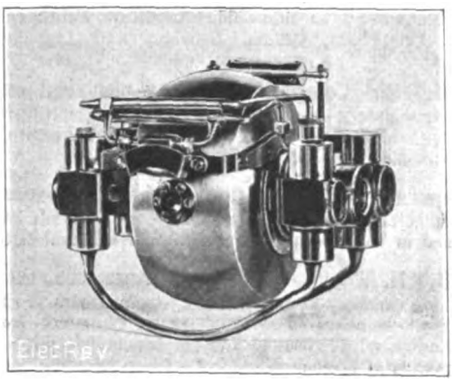

FIG. 5.—GYRO WHEEL IN CASE.

through the agency of the controller which is fixed on the switchboard, work the repeaters and the step-by-step motor V. This motor forces round the follow-up ring N to keep the contact-making vanes I always opposite the air jet, and in doing this all the repeaters on the ship follow suit.

U is the compass card fixed to the upper portion of the vertical ring, and O is the lubber line support. By removing the four screws marked *n* the gyro-compass can be completely removed from the gimbal rings. The instrument thus removed is shown in fig. 2.

When the case B is horizontal, the bottles E are half full of oil, and the air jet L is blowing equally into the two halves of the air box K; but when the case tilts, the air pressure blows into one side of the box more than the other, and in such a direction as to force the oil from the lower bottle into the one raised. There is, therefore, a considerable righting troque indicated by the weight of the oil trying to restore the case to the horizontal.

When the pendulum swings under the action of the rolls of the ship the air jet L moves from one side to the other side of the air box in tune with the roll, blowing the oil periodically from one bottle to the other. At the middle of the swing of the pendulum the air jet is at the middle of the air box, and there is no difference of air pressure, and therefore no movement of the oil; and when the swing is at the end of its path and not moving, the air jet is at one side of the air box and producing the maximum movement in the oil. It will therefore be seen that the movement of the pendulum and the movement of the oil are out of phase with each other. It is for this reason, given good dynamic balance, that there is no quadrantal error whatsoever with this method of control.

Fixed to the same air box K are the two damping bottles C, but the air here acts in the opposite direction. In one of these damping bottles is an adjustable needle valve; this valve has a constricted passage, and thus the flow of oil from one bottle to the other is suitably retarded.

As regards the accuracy of the compass, one on board a flagship in the North Sea during the war was observed with particular care, especially during very heavy weather, and it was reported that it was never more than 1¼ deg. from the true north position during the whole of the tests.

Trials on a commercial ship have demonstrated the fact that the employment of a gyro-compass resulted in the ship steaming every day over 3 per cent. greater mileage; in other words, one day's steaming in thirty would be saved, resulting in a proportionate saving in coal and all other expenses.

BUSINESS NOTES.

Lead.—Messrs. James Forster & Co. report under date February 7th:—

During the last two market days there has been a good demand at steadily advancing prices, and at the end of yesterday's session values showed a rise of fully 25s. per ton on the week. The closing prices are £48 15s. February, £48 17s. 6d. March, £49 April, £49 5s. May, and £49 10s. June, with buyers over. The week's turnover is well above 5,000 tons.

Controlled lead has not been available during the current week, and the authorities are still reluctant sellers, their price being nominally £49 net ex warehouse.

A fair quantity of Australian lead has arrived recently, but, owing to the delay in obtaining berths, steamers are extremely slow in discharging, and this is causing considerable inconvenience in some directions. A small quantity of Spanish lead is arriving shortly, but very little permanent relief is to be expected from this quarter.

We can see no prospect of any early change in the intrinsic position, and consequently we can only look for a continuance of firm markets tending towards higher values.

Messrs. G. Cawson & Co. report:—

These are the highest prices recorded in the history of the trade, and it is remarkable to see what a strong combination can do in controlling a market when it is backed by ample financial resources. The position with regard to supplies remains unchanged—there is still ample stock of available lead, and with the quantities now coming forward, consumers may rest satisfied that there will be always plenty of lead to meet their requirements. Consumers have again taken small parcels. There has also been a little inquiry and business done for export. Germany, however, is reported to have resold lead here, which they had bought for consumption. The position generally is so confused and so much mixed up with the fluctuations of exchange, that it is impossible to prognosticate anything definite as to the future. So long as speculators continue to control the market, as they are now doing, the price must be maintained. It looks as if the consumer may have to wait a long time for cheap lead.

Applications for British Trade Marks.—Appended is a summary of the recent applications for British trade marks in respect of goods connected with the electrical industries:—

Agpom. No. 396,624. Class 13. Electric incandescent lamps. Aladdin Renewed Electric Lamp Corporation, 82, Victoria Street, London, S.W., October 30th, 1919.

Jiffysweep. No. 387,572. Class 6. Electric and hand-driven vacuum cleaners. Electrical Appliances Co., Ltd., 8, Fisher Street, Southampton Row, London, W.C., January 14th, 1919.

Bizzysweep. No. 387,573. Class 6. Electric and hand-driven vacuum cleaners. Electrical Appliances Co., Ltd., 8, Fisher Street, Southampton Row, London, W.C., January 14th, 1919.

Jiffyklean. No. 387,574. Class 6. Electric and hand-driven vacuum cleaners. Electric Appliances Co., Ltd., 8, Fisher Street, Southampton Row, London, W.C., January 14th, 1919.

Bizzyklean. No. 387,575. Class 6. Electric and hand-driven vacuum cleaners. Electrical Appliances Co., Ltd., 8, Fisher Street, Southampton Row, London, W.C., January 14th, 1919.

Sentinel. No. 395,441. Class 8. Electrical cutouts for indicating failure in the oil feed of internal-combustion engines. Hendrick W. Moerman, 43-6, Southampton Buildings, Chancery Lane, London, W.C., September 22nd, 1919.

Philec. No. 395,698. Class 8. Electric batteries. Philadelphia Storage Battery Co., Ontario Street, Philadelphia, U.S.A., October 2nd, 1919.

R.M. (letters embodied in design). No. 395,963. Class 8. Instruments used in radio telegraphy and telephony, and parts of same. R.M. Radio, Ltd., 5, Chancery Lane, London, W.C., October 10th, 1919.

Atmos. No. 390,855. Class 13. Sparking plugs. Arthur Cox, "Harlech," Warwick Road, Olton, Birmingham, May 5th, 1919.

Oojah. No. 397,063. Class 13. Sparking plug testers. Changeable Sign Co., Ltd., Chippenham Works, Shirland Road, London, W., November 10th, 1919.

Utility "Autopax" electric cooker (lettering combined with design). No. 395,381. Class 18. Electric cookers. Automatic Telephone Manufacturing Co., Ltd., Milton Road, Edge Lane, Liverpool, September 19th, 1919.

Olmadun. No. 397,581. Class 6. Electrical and other appliances for operating proscenium curtains. Oliver & Dunbabin, 9, Fenchurch Buildings, London, E.C., November 25th, 1919.

Metrovick. No. 396,424. All goods in Class 6. No. 396,425. All goods in Class 8. No. 396,426. All goods in Class 13. Metropolitan-Vickers Electrical Co., Ltd., 2, Norfolk Street, Strand, London, W.C., October 23rd, 1919.

Series of ten designs comprising initial letters V.M. No. 396,903. Class 8. Metropolitan-Vickers Electrical Co., Ltd., 2, Norfolk Street, Strand, London, W.C., November 9th, 1919.

Machinery and Electrical Trade of Hongkong.—In a recent report on the trade of Hong Kong the U.S. Consul remarks that with the war in Europe drawing all possible strength from the factories of the United States and Europe, and with uncertain finance and scarcity of raw materials in sight, it was but natural that imports of machinery of all sorts were comparatively small. What trade there was came mostly from the United States, but the chief other feature of the year was increasing competition from Japan and from China itself in many lines of standard machinery. High costs prevented any advancement of new enterprises, while all other demands were held down to a minimum for the same reason.

In the Consul's opinion, the laid-down cost of most standard machinery, including locomotives and cars, machine tools, boiler-shop supplies, and equipment, blacksmith-shop equipment, and all similar goods, will average about 200 per cent. of pre-war prices even allowing for favourable exchange, while the increase in cost in Hong Kong of electrical goods and equipment will be 100 to 200 per cent. Power-house equipment has increased 150 per cent. on an average. War restrictions on the export of machinery also served to reduce trade, for uncertain deliveries made it impossible to develop any other than the most pressing enterprises.

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In electrical supplies and equipment actual imports were small. The chief Hong Kong power concern ordered several machines in the United States for its new plant, some of which arrived before the end of the year; and the chief Canton power concern ordered a complete new plant in the United States, though none of the equipment was actually delivered during the year. Arrangements have been made for the reorganisation and re-equipment of other power concerns though orders have not yet been placed. In electrical supplies, Japanese competition has especially been felt. The Japanese factories have been turning out cheap fittings, lamps, fans, wires, cables, conduits, small motors, and all similar goods at prices which cannot be touched by American and European manufacturers for standard goods. These goods are cheap and flimsy, but for the time being at least they answer the needs of the ordinary Chinese user and have, and will continue to have, a large share of the trade in this line. Electric lamps and a considerable line of fittings and supplies also are being made in China itself. Competition in such lines in the immediate future between American and European standard goods and these cheap local supplies will be very keen, and it is probable that only by long and somewhat costly experience will the Chinese consumer learn that standard goods are economical in the long run.

Liverpool Electrical Lockout.—In Liverpool a more serious view is being taken of the effect of the present trouble between the National Federated Electrical Association and the Electrical Trades Union on the question of the recognition of the new code of working rules, which had been approved by the District Joint Industrial Council, but had not been ratified by the National Joint Industrial Council, and could not therefore be put into operation. A large number of firms not in the Association immediately accepted the new terms, as well as a few of them in the Association after a lock-out was declared. The E.T.U. had in operation a rule limiting overtime, and by lifting the ban for one month, appear to be endeavouring to use the employers who have submitted to the rules, against those who have not. There is plenty of work at Liverpool at the present time, as well as a demand for electricians, and what the outcome of the present dispute will be so far as concerns the Joint Industrial Council, which was set up to eliminate labour troubles, can only be conjectured, but there is a very pronounced feeling of its failure to meet circumstances. The root of the trouble is that the E.T.U. claims that the new rules do not require ratification by the National Joint Industrial Council, whilst the Association contends that the rules agreed upon with the E.T.U. were merely recommendations to the National Joint Industrial Council. Our local correspondent remarks that it appears that at the outset it should have been made clear what are the respective functions of the National and the District Councils.

Manufacture of Telephone Material in Czecho-Slovakia.—Two engineers named Capek and Umbach, with experience obtained in Europe and the United States in the manufacture of telephone apparatus, are planning to start a factory in Prague for the production of such goods, including telegraph as well as telephone instruments, railway signalling apparatus, and telephone equipment generally. The Ministry of Posts and Telegraphs is said to be interesting itself in the venture, as also is the Zivnostenska Bank, Prague.

Electric Fires in Demand.—The Arora Co., of Loughborough, informs us that, owing to the enormously increasing business in electric fires, its sales have again doubled this year (had it not been for the 18 weeks moulders' strike, they would have been trebled), and it is continually appointing new agents in the various territories. The present British agents of this company are at London, Manchester, Liverpool, Bradford, Newcastle, Birmingham, and Glasgow.

Understamped Letters.—The Department of Overseas Trade continues to receive complaints from British Consular representatives abroad regarding the insufficient stamping of letters from Home firms. A case is mentioned in the *Board of Trade Journal* of a Consular official in France who had to pay 3·50 fr. on an advertising almanack. Presumably many other recipients had a like experience. Is such remissness likely to promote friendly business relations? If correctly stamped and wrapped, the postage on the almanack in question would have been 3d.! In regard to letters, the use of special coloured envelopes has much to commend it as a means of preventing errors when the posting clerk is rushing things off to catch the mail. Is not hurry at post-time preventible in a well-organised office?

Dissolutions and Liquidations.—F. A. JENNINGS, LTD.—Upon the petition of Messrs. Bruntons, of Musselburgh, the voluntary winding-up of this company has been ordered to be continued under the supervision of the Court. Joint liquidator appointed: Mr. E. H. Hawkins, 4, Charterhouse Square, E.C.

THACKER, BELL & Co., LTD., 44-46, Leadenhall Street, London, E.C. 3.—This company is winding up voluntarily, with Mr. C. Hirst, as liquidator. Meeting of creditors, February 19th, at the Institute of Chartered Accountants, Moorgate Place, E.C.

RHYMNEY VALLEY AND GENERAL ELECTRIC SUPPLY Co., LTD.—Meeting called for March 6th, at 4, Cathedral Road, Cardiff, to hear an account of the winding up from the liquidator, Mr. C. Carpenter.

PREECE, CARDEW, SNELL & RIDER, consulting engineers, 8, Queen Anne's Gate, S.W.—Messrs. A. H. Preece, Sir J. F. C. Snell, J. H. Rider, and J. H. Woodward, have dissolved partnership. Debts will be attended to by Messrs. A. H. Preece, J. H. Rider, and J. H. Woodward, who will continue the business at the same address, under the title of Preece, Cardew & Rider.

LEE, BUFTON & ELLIOTT, electrical engineers, 10, Porter Street, Sheffield.—Messrs. W. Marples, H. Bufton, and W. Elliott, have dissolved partnership. Messrs. H. Bufton and W. Marples will attend to debts, and continue the business under the style of Lee & Bufton.

THE ELECTRICAL Co., LTD., 6, Old Jewry, E.C.—Last day for proofs for dividend to non-enemy creditors, February 21st. Mr. H. de V. Brougham, Official Receiver and Liquidator, Carey Street, W.C.

New Belgian Company.—A new electrical engineering company has lately been formed in Brussels (30-32, Rue de Treurenberg), with a capital of 500,000 fr., and the title La Société Manufacture d'Appareillage Electrique Nioca.

New Swedish Wireless Company.—The Svenska Radio Aktiebolag is the name of a new company which has recently been formed in Stockholm in connection with wireless telegraphy.

New B.T.H. Works.—*The Times* states that the Government cartridge factory at Blackheath, Staffordshire, erected during the war, has been acquired by the BRITISH THOMSON-HOUSTON Co., LTD., of Rugby, who expect to find employment in a short time for some thousands of hands.

Catalogues and Lists.—ASSOCIATED FIRE ALARMS, LTD., Jewin House, Redcross Street, E.C. 1.—Two booklets, "Automatic Fire Detection," and "Our Record," describing various systems of alarms.

THE OVERSEAS ENGINEERING Co., LTD., 75, Curtain Road, E.C. 2. List No. 36 (second edition), dealing with "National" motors and dynamos. Net c.i.f. prices are given.

HAYWOOD FOUNDRIES, LTD., 30-32, Seaton Street, Euston Road, N.W. 1.—Catalogue dealing with castings in non-ferrous metals, illustrated by micro-photographs of materials. Comparative tests of Haywood's high-tensile bronze and mild steel are given.

BUILDING PRODUCTS, LTD., Columbia House, 44-46, King's Road, Sloane Square, S.W. 3. Eight-page booklet, dealing with "Rigifix" bolt-hanger sockets and slotted inserts for use in reinforced concrete factory building. Illustrations of installations are given.

New French Electrical Companies.—The Société Hydraulique Tunisienne has been formed at Paris for the construction of electric plant of all kinds for the generation and distribution of electric energy. Its capital is 500,000 fr.

La Société d'Entreprises de Reseaux Electriques is the name of a new company which has lately been formed in Paris (33, Avenue des Champs Elysees), with a capital of 1,000,000 fr.

With a capital of 1,000,000 fr., the "Aladdin," Société Anonyme, has been established at Paris for the manufacture, purchase, and sale of all kinds of electric material, and especially glow and other lamps.

The Société Marocaine de Distribution d'eau, de Gaz, et d'Electricité has decided to raise its capital from 5,000,000 to 10,000,000 fr.

Under the style of Docks Electriques Français, Bosio, Durand et Cie, has been formed at Marseilles, with a capital of 500,000 fr., to carry out electric installations.

There has been formed at Bordeaux the Comptoir Electrique de France, Etablissements Besse, Darsses, et Busson Réunis, with a capital of 300,000 fr., for trade in electrical apparatus and general electric supplies.

With a capital of 340,000 fr., the Etablissements Nay, of Paris, have been constituted a company for the carrying out of electric installations.

The Société des Moteurs et Appareils Electriques Lilliput has been established at Paris, with a capital of 500,000 fr., for the manufacture of the motors and apparatus bearing the name of Lilliput.

The Société Industrielle d'Electricité has been established at Paris for the manufacture and sale of all kinds of electrical requirements. The capital is 750,000 fr.

Eve, Noizet et Cie have been formed into a company, with headquarters at Paris, for the manufacture, purchase, and sale of all kinds of electric motors. The capital of the new concern is 200,000 fr.

There has been formed at Grenoble, under the style of La Dauphinoise Electrique, a company whose object is the making, repair, and sale of electrical material. The capital is 300,000 fr.

With the designation of Société d'Entreprise d'Electricité has been constituted at Paris a company, with 25,000 fr. capital, for the carrying out of electrical installations.

For the acquisition and working of an electric apparatus business, MM. H. Boucket and E. Aubignat have formed themselves into a company at Paris, with a capital of 50,000 fr.

There is a question of forming a company at Rennes for the supply of electricity to the district centres of the Province of Brittany. The title of the proposed company is to be l'Electricité en Brétagne.

Marine Motor Exhibition at Olympia.—A Motor Boat and Marine and Stationary Engine Exhibition will be held at Olympia from March 12th to 20th. A number of electrical and allied manufacturers are exhibiting, and it is stated that nearly all the space has been let.

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Book Notices.—A *Handbook* of the Library of Commerce attached to the Bristol Municipal Public Libraries has been issued. It not only contains lists of all trade and technical books, directories and journals that are on file, but also particulars of the principal subjects covered in these publications, the references being kept up-to-date in the form of a card index at the library. There are one or two slips, such as the reference to *The Times* Engineering Supplement being "weekly" whereas it is monthly, but the publication is likely to be very convenient for visitors' use. The city librarian will welcome additional commercial literature, including trade catalogues.

"Volumetric Tests on Scientific Glassware, Class A Tests, and Class B Tests," 35 pp. Volumetric glassware has been tested on a small scale at the National Physical Laboratory for the past 15 years. With the growth of the industry in this country, it was felt that the scope of the work should be widened, and consequently, a new building has just been completed at the Laboratory specially equipped for dealing with this class of work on a large scale. In addition to the tests of scientific accuracy, provision has been made for testing apparatus intended to possess only commercial or Class B accuracy. A full account of the tolerances allowed, methods of test, details of construction, test fees, &c., is given in the new edition of the Laboratory Test Pamphlet, copies of which may be obtained, free of charge, from the Director, The National Physical Laboratory, Teddington, Middlesex.

"Welfare Work," Vol. I, No. 1. The *Journal* of the Welfare Workers' Institute, 16 pp., price 2d. (monthly).—Devoted to articles on the various aspects of "welfare" work in industry by well-known authorities, and to reports of the activities of the Institute and its members.

"New Forms of Instruments for showing the presence and amount of Combustible Gas in the Air." By E. R. Weaver and E. E. Weibel. 44 pp. Scientific Paper, No. 334, of the U.S. Bureau of Standards. Washington: Government Printing Office. 15 cents. —This paper describes three types of instrument for gas detection, all depending upon the combustion of the gas in the surrounding atmosphere by an electrically-heated wire. This surface combustion takes place at a temperature much lower than the normal ignition temperature in air. The instruments dealt with are the "compensated bridge indicator," the "glowing wire indicator," and the "bimetallic detector." The publication is illustrated by diagrams and curves recording the instruments' performances.

"Constants of Radiation of a Uniformly-Heated Enclosure." By W. W. Coblentz. 7 pp. Scientific Paper, No. 357, of the U.S. Bureau of Standards. Washington: Government Printing Office. 5 cents.—Giving the results of experiments and investigations to ascertain the coefficient of total radiation of a so-called "black body" with corrections for reflection losses.

Institution of Civil Engineers.—"Abstracts of Papers in Scientific Transactions and Periodicals" (new series). January, 1920, No. 2. London: The Institution.

"The Telegraphists' Guide." By Bell & Wilson. Pp. xiv + 258, figs. 178. London: S. Rentell & Co, Ltd. Price 5s. net. In this, the eighth edition, the chapters have been re-arranged and the subject matter brought up-to-date. A new chapter on central battery working has been added, and the sections dealing with concentration switches, and the "Megger" and "Bridge-Megger," have been expanded.

"Telephonic Transmission." By J. G. Hill. Pp. xiv + 398, figs. 185. London: Longmans, Green & Co. Price 21s. net.

"Vickers' News." Vol. I, No. 9, 16 pp. London: Vickers, Ltd. Includes articles on surface hardening and porcelain fittings production.

"*Journal* of the Institution of Electrical Engineers." Vol. LVIII, No. 287. January, 1920. London: E. and F. N. Spon, Ltd. Price 10s. 6d. This issue contains the following papers:—"The Design of Multiple-Stage Amplifiers using Three-Electrode Thermionic Valves," by Prof. C. L. Fortescue; "Carbon Arcs for Searchlights," by Messrs. C. C. Paterson, J. W. T. Walsh, A. K. Taylor, and W. Barnett; "The Short Tungsten Filament as a source of Light and Electrons," by Mr. G. Stead; and an address to the Students' Section by Mr. A. P. Trotter.

"The British Dominions Year Book for 1920" has been issued (1s.) by the Eagle, Star and British Dominions Insurance Co., Ltd. It contains many interesting articles on industrial, financial, trade, housing, shipping, transportation, female labour, science and the war, and other questions; also a good deal of matter relating to post-war events, war honours, &c.

"*Journal* of the British Science Guild," No. 10, January, 1920, 49 pp., price 6d. (7½d. including postage).—Among the subjects dealt with are the "Need for Rewarding Medical Discovery," and "Science and Labour." Copies of the *Journal* may be obtained from the Secretary, 6, John Street, Adelphi, W.C. 2.

"Thermal Expansion of Insulating Materials," Scientific Paper No. 352 of the U.S.A. Bureau of Standards. 31 pp., price 10 cents. Washington: Government Printing Office.—This publication gives data relating to the thermal expansion of the more important insulating materials such as porcelain, fibre, hard rubber, bakelite, &c.

Bankruptcy Proceedings.—WALTER HENRY MELLON, electrical engineer, late trading as H. B. Wallis & Co., 37, Elliott Road, Chiswick, Middlesex, late 43, Turnham Green Terrace, Chiswick.—The Receiving Order in this matter was made on debtor's petition. It appeared from the statement of affairs submitted that the liabilities amount to £384, and assets £155, thus leaving a deficiency amounting to £228. Debtor commenced business on his own account four years ago at a small workshop at Chardin Road, Chiswick, with a capital of £50 to £60, and in June, 1917, in partnership with another, he opened a shop at 49, Turnham Green Terrace, under the name of H. B. Wallis & Co., his contribution being about £50 worth of stock, and the partners £50 and a few fittings. The business was carried on successfully, and in September, 1918, another shop was opened at 43, Turnham Green Terrace, and in February, 1919, the partner took over the premises at 49, Turnham Green Terrace, and the partnership business was continued at No. 43. In August, 1919, the partnership was dissolved, the debtor paying his partner £60 for his interest, and he carried on the business until December 12th, 1919, when he sold the goodwill, fittings and fixtures for £100, which was mostly paid to creditors. These payments are being further inquired into. Debtor states that he did not become aware of his position until December 12th, 1919, when the business was sold. Debtor alleges as causes of failure mismanagement of business during his illness. At the first meeting of creditors held last week, the matter was left in the hands of the Official Receiver.

W. H. HOWARD (Holborn Electrical Co.), electrical engineer, 5, Featherstone Buildings, Holborn, and Finsbury Park, N.—Application for debtor's discharge will be heard February 27th, at Carey Street, W.C.

Trade Announcements.—The electrical repair shop of MESSRS. ROBINSON & HANDS ELECTRICAL CO., LTD., is at Aston, not Ashton, as stated here last week.

MESSRS. BARNETT & SOANS, of Kettering, have opened a further branch at 8, Sheep Street, Wellingborough, under the management of Mr. L. E. Troath, late of the Wellingborough Electric Supply Co. Manufacturers' and agents' lists are wanted there.

THE ELECTRICAL CONTRACTING AND MOTOR CO., of which Mr. G. Mercer is manager, has opened new works and showroom premises at Pontefract Road, Castleford.

MESSRS. SLACK & CLARKE, electrical engineers, of Rotherham, having dissolved partnership, the business will be continued under the management of Mr. J. Slack.

Mr. A. R. Walmsley, who purchased from the trustee the business of Mr. George Hill, electrical, mechanical, and tramway engineer, of Trafford Electric Works, Manchester, and formed the business into a private limited company (GEO. HILL & CO., LTD.) in 1910, has transferred his controlling interest to Mr. J. H. Edwards.

Mr. G. B. Broughton, of the General Electric Co., Birmingham, has been appointed manager of the Midland branch of the ELECTRICAL APPARATUS CO., LTD., of London, S.W. 8, in place of the late Mr. A. G. Way. The address of the branch office is:—Carlton House, High Street, Birmingham. Telephone No.: "Central 7478." Telegraphic address: "Elapratus, Birmingham."

As we go to press we learn that the businesses of the ELECTRICAL APPARATUS CO., LTD., and MESSRS. BRAY, MARKHAM & REISS, LTD., have been amalgamated. We shall give further particulars next week.

MESSRS. E. & C. GATES, since demobilisation, have recommenced business at 56, London Street, Norwich, where they are engaged upon all classes of electrical installation work and advertising signs. They have issued an eight-page illustrated publication on country-house lighting.

Payment By Results.—*The Times* states that 600,000 members of the engineering Trade Unions are to ballot on the question of payment by results. The ballot will be taken at an early date. Conferences recently held at York between engineering employers and workers failed to arrive at any agreement on this question.

The *Daily Telegraph* stated, on Wednesday, that an important industrial agreement between the Engineering and National Employers' Federations and the many Trade Unions included in the National Federation of General Workers had resulted from the recent private conferences at York, and was to be submitted to the constituent bodies for acceptance. The proposals relate to a 47-hours' week, and are standard, and not minimum. The question of a two-shift day or three-shift system is left over for another conference. Employers are to be permitted to introduce systems of payment by result, a much-vexed question, on specified conditions. Piece-work prices and bonus or basis times are to be such as will enable workmen of average ability to earn at least 33⅓ per cent. over the present time rates, excluding war bonuses. No Union workman is to be required to work more than 32 hours' overtime in any four weeks after full shop hours have been worked, allowance being made for time lost through recognised causes. A special conference is to be held to discuss the schemes of payment by results, such to include those who contribute to production without being direct producers. The consolidation of war wages is also for future consideration.

Social.—The 14th annual concert of the Bradford tramway employés took place on February 3rd at St. George's Hall. The Tramway Department Military Band was in attendance.

Catalogues Wanted.—MR. J. C. ELVY, of Loughboro', Westland Road, Watford, would be glad to receive catalogues of all electrical appliances used in film production studios, hotels, &c.

Foreign Trade.—JANUARY FIGURES.—The following are the values given of electrical goods and machinery in the official returns of imports and exports for January:—

	January, 1920.	*Inc. or dec.*
IMPORTS.	£	£
Electrical goods, &c.	77,869	+ 1,640
Machinery	1,513,676	+ 218,860
EXPORTS.		
Electrical goods, &c.	690,394	+ 404,049
Machinery	3,733,365	+2,072,458

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LIGHTING AND POWER NOTES.

Aberdare. — Year's Working. — The statement of accounts for the year ended March 31st, 1919, gives the total income of the Electricity Department as £8,521, and the total expenditure and allowances as £5,337, leaving a gross profit of £3,184. The net result after deduction of loan interest, &c., was a credit balance of £108.

Barrow.—Water Power.—The Corporation has been asked to appoint a Committee to discuss with a representative of Messrs. Vickers, Ltd., the question of hydro-electric developments in the Duddon Valley.

Belgrade.—Strike.—As a protest against threats made by the Minister of the Interior to intern the leaders of the Communist party, a general one-day strike was declared on February 5th. The city was in darkness, and the tramways suspended by the closing of the power stations.

Blackburn.—Electricity Supply.—Applications from the Rishton and Great Harwood Urban District Councils for supplies of electricity, and also from Preston for a temporary supply, on the completion of the new generating station, have been accepted by the Corporation, subject to satisfactory financial arrangements being made with the Commissioners.

Bolton.—New Plant.—The Minister of Health has sanctioned the borrowing of £44,495 for the provision of four boilers, with accessories, for the Back-o'-th'-Bank generating station.

Bradford.—Plant Extension.—The Corporation is applying for authority to purchase a 5,000-kw. set with steam plant in accordance with the advice of the consulting engineer.

Cannock.—Consultant.—The Urban District Council has decided to engage the services of Mr. Ellis as electrical expert, at a fee of 100 guineas and expenses, to advise the Council on matters relating to the supply of electricity in the area.

Chester.—Joint Board.—A meeting is being held at Chester, this week, when representatives of various districts will discuss the question of formulating a joint-supply scheme for the counties of Cheshire and Flintshire. Queensferry has been suggested as a probable supply centre.

Continental.—Holland.—The consumption of electric power in Amsterdam has increased at such a rate during the last three months that the municipality proposes to extend and enlarge the power stations in 1920. A credit of Fl. 1,900,000 has been applied for.—*Economic Review.*

Spain.—A concession has recently been granted for the establishment of a plant to utilise the water power of the River Douro, near Zamora, for the generation of electrical energy for lighting and power purposes.

Dewsbury.—Extensions.—The Electricity Committee recommends application for power to borrow £8,500 for the purchase of equipment in connection with securing a bulk supply of electricity from the Yorkshire Electric Power Co., and £13,620 for feeder and cable extensions.

Doncaster.—New Plant.—The Town Council has decided to apply for power to install two 3,000-kw. generating sets at the works, which will cost about £120,000.

House Wiring.—The Town Council has applied to the Housing Commissioner for permission to refund £420 on wiring 42 new dwellings for electric lighting.

Dundee.—Electrical Cottage.—To show the advantages of using electricity in a dwelling-house for all purposes—lighting, cooking and motive power—a cottage is to be erected by the Housing and Town Planning Committee.

Farnham.—Price Increase.—The Electric Light Co. has increased its charge for power to 6d. per unit. The pre-war price was 2d.

Fiji.—Suva Supply Scheme.—According to the *Board of Trade Journal*, the Municipal Council of Suva has been authorised to proceed with an electricity supply scheme extending to a distance of three miles beyond the town's boundaries. All the material for the construction of this project is to be admitted to the colony duty free.

Gillingham (Kent).—New Plant.—The Town Council has decided to install at the electricity works two additional Diesel engines, at an estimated cost of between £30,000 and £40,000.

Halifax.—Extensions.—The Town Council proposes to undertake electricity extensions to cost about £170,000. The Electricity Committee, along with the Gas Committee, has appointed a deputation—including one or two persons outside of the Council with special knowledge—to visit towns to obtain information on the best method of utilising gas in connection with the gas and electricity departments.

Hastings. — Proposed Extensions. — The borough electrical engineer has submitted a scheme for a new generating station, which has secured the approval of Sir John Snell. The report prepared was adopted by the Council.

Liverpool.—Extensions.—Building operations on the extension of the Lister Drive power station are to be extended for a further period of 12 months. It is intended to install several new cooling towers. Tenders have been accepted for two batteries of a total capacity of 465,000 gallons per hour, and six steel cooling towers of a total capacity of 750,000 gallons per hour.

Year's Working.—The total revenue from the electricity supply undertaking for the year ended December 31st, 1919, was £629,539, and the total expenditure £416,773, leaving a gross balance of £212,766 allocated as follows:—To interest, £70,452; sinking fund, £60,477; renewals fund, £31,837; and contributed to general rate, £50,000.

London. — Hackney. — The Electricity Committee recommends the expenditure of £66,150 for generating plant and accessories and £105,000 for steam-raising plant and the necessary buildings.

Stepney.—The borough engineer recommends the installation of two 1,500-kw. rotary converters, which, with the necessary foundations, switchgear, &c., will cost approximately £28,600.

Lydd (Kent).—Military Plant.—The Town Council has approached the War Office with a view to acquiring the electric light plant at the Balloon School and utilising it for supplying electricity to the town.

Nelson.—Extensions.—Tenders, amounting to £82,869, have been accepted by the Town Council for extensions of plant at the electricity works. It is stated that the continued running of the station has been endangered by fuel shortage, and at one time only three days' stock remained.

Oldham.—House Lighting.—The Corporation has decided to install electric lighting in the dwellings being constructed under the municipal housing scheme.

Peterborough.—Loan.—The Council is applying for sanction to borrow £4,000 for house services and meters, instead of £2,000, as originally estimated, owing to the increased applications for the supply of electricity.

Sheffield.—Fire.—Serious damage was caused by an outbreak of fire at the Sheaf Street power station, on February 5th. Fortunately, the fire occurred in the morning, but, nevertheless, many business houses were unable to secure a supply for illumination, which was badly needed on account of the foggy weather.

Stockton.—Mains Extensions.—To extend the area of supply to outlying districts, the electrical engineer recommends the laying of E.H.T. mains and L.T. distributors. The scheme involves the erection of a sub-station. The Electricity Commissioners are to be consulted in the matter.

Stoke-on-Trent.—New Station.—The electrical and consulting engineers have advised the Council that a new generating station, to have an ultimate capacity of 30,000 kw., is urgently required. A special meeting of the Council is being called to consider the proposals.

St. Annes.—Extensions.—In order to cope with the increase in consumers, the electrical engineer proposes mains and feeder-cable extensions costing £10,074. The Council is applying for a loan of this amount.

Watford.—Loans.—The Urban District Council has applied for loans amounting to £45,300 for sub-stations, equipment, mains, public lighting, house services, transformers, meters, and feeder panels.

TRAMWAY AND RAILWAY NOTES.

Aberdare.—Year's Working.—The report for the year ended March 31st, 1919, shows that the total income from the tramways and 'buses was £26,758, and expenditure £18,081—a gross profit of £8,677. A net profit of £3,855 was transferred to the appropriation account.

Blackpool.—Expenditure.—January's account approved by the Corporation totals £555,539. Nearly one-half is accounted for by the purchase of the Blackpool and Fleetwood tramroad undertaking, the following items appearing:—Blackpool and Fleetwood Tramroad Co., Ltd., £246,794 5s. 9d; John Cameron, £10,000; Blackpool and Fleetwood Tramroad Co., Ltd. (directors), £4,000.

Bradford.—New Car.—The city tramway manager has introduced a new type of car, with a closed upper deck, for addition to the local trackless car service. The existing vehicles are single deck, accommodating 29 passengers. The new type, for the building of which the Ministry of Transport has given sanction, will carry 51 persons. Only one car is to be built at first, as an experiment, and the construction will be carried out at the Thornbury Works of the Tramways Department. Sanction has also been received to increase the weight of the present railless cars from 5 tons loaded to 5 tons unloaded, so that cars can be built on a more substantial basis, and, therefore, have a longer life.

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Ashton-under-Lyne.— Fare Increase.—Penny fares have been abolished on the Corporation tramways, and a minimum fare of 1½d. has been instituted on all the principal routes.

Continental.—Spain.—Severe street fighting is reported from Santanda (Spain) between the tramway employés on strike and gendarmes. The authorities endeavoured to maintain the tramway services with the aid of volunteers and gendarmerie to clear the routes, but found it necessary to fire on the strikers. The latter fired back, and in the passage of arms four tramwaymen were injured.

Doncaster.—Car Depôt.—It is reported that the lowest tender for a proposed new tramway shed was £7,983, and the borrowing powers extended only to £5,500. The Council authorised the Electricity and Tramways Committee to accept the tender, and further application is to be made for power to borrow the excess.

Dover.—Fare Increase.—The Corporation is applying for authority to increase the tramway fares by 50 per cent. The present rate is 1d. per mile.

Additional Cars.—The Town Council has received sanction to a loan of £6,000 for the purchase of three new tramcars.

Dublin.—Tramways Profits.—It is announced that the total profit made by the Dublin United Tramways for the year ended December 31st, 1919, was £148,271. A motion put forward, at a meeting of the Corporation last week, to postpone the question of municipalisation for a year, was defeated.

Huddersfield.—Opposition to Bills.—The Corporations of Huddersfield and Halifax are "up against" each other with regard to their respective Parliamentary Bills. Halifax is going to oppose the Huddersfield proposal to undertake tramway and motor-'bus extensions which affect the interests of Halifax in some of the townships between the two places; and Huddersfield is to oppose the Halifax proposal to extend tramways to Elland *via* Elland Wood Bottom.

India.—Railway Electrification.—At the meeting of the Imperial Legislative Council, held on September 23rd, 1919, the following resolution, which was moved by the President of the Bengal Chamber, was adopted:—"This Council recommends to the Governor-General in Council the immediate consideration of the electrification of the suburban railways within 25 miles of Calcutta, and of the improvement generally of local passenger transport and terminal facilities."—*Board of Trade Journal.*

Lancashire and Yorkshire Railway.—In the estimate of further expenditure on capital account, the item "electric power stations, &c.," figures at £120,500 for the year ending December, 1920, and £80,200 subsequently. The total train-miles run electrically during 1919 were 1,968,058.

Leeds.—Overcrowding.—The medical officer of the West Riding County Council has asked the Corporation to take steps to remedy the present overcrowding of the cars, as he considers it extremely detrimental to the public health.

London.—Underground Railways.—In an interview with a Press representative on Saturday, an official of the Underground Railways gave the following interesting figures illustrative of increased working expenses:—

		1914.	1920.
Coal ...	...per ton	14s. 11¾d.	42s. 5d.
Steel rails	... „	£7	£20 7s. 6d.
Mild steel	... „	£7 2s. 6d.	£25
Bar iron...	... „	£7 15s.	£28
Lubricating oil	...per gal.	1s. 5d.	3s. 7d.
Paints ...	...per cwt.	23s. 5d.	50s. 9d.
Cost of an omnibus	...	£550	£1,200
„ „ eight-car train		£17,900	£58,720
„ „ a tramcar	...	£900	£2,500

—*Financial Times.*

Electric Van.—The first of the 2-ton electric parcel delivery vans was put in commission last week by the Metropolitan Railway Co. It is fitted with "Ironclad" accumulators with a capacity of 226 ampere-hours. Its average speed is 10 m.p.h., and it can run a distance of from 35 to 40 miles on one charge.

Maximum Speed.—The London United Tramways Co. is asking the Board of Trade to sanction a maximum speed limit of 16 miles an hour. The Hammersmith Council urges that the limit should be 12 miles an hour.—*The Times.*

Accident.—On February 5th eight passengers were injured in a collision between a tramcar and motor-omnibus at Vauxhall Cross. The 'bus endeavoured to cross the lines in front of the car, but failed to pass in time.

Manchester.—Extensions.—It is anticipated that approximately £160,000 will be expended during the financial year 1920-21, upon additional cars and accommodation.

Portsmouth.—Fare Increase.—The tramway fares were raised 50 per cent., as from February 5th.

Rochdale.—New Track.—The Tramways Committee is seeking the consent of the Ministry of Transport to the laying of a double line of track along Bridge Street, from Bury Road corner, to the electricity works, in place of the existing single line.

TELEGRAPH AND TELEPHONE NOTES.

Automatic Telephones.—The Bolton Town Council has appointed a deputation to interview the Postmaster-General, in the hope of securing a reversal of the decision of the authorities to install a new manual telephone equipment rather than an automatic exchange there next year. The automatic system has been refused on the ground that the cost is prohibitive.

Costa Rica.—On December 31st, 1918, there were 122 telegraph offices, 1,514 telephones, and 2,291 miles of telephone wire in operation. Excluding cable and wireless messages, 416,831 telegrams were sent during the year 1917-18, the revenue received being 223,045 colons. The nominal value of the colon is just under 2s.

Germany.—It is stated by the German Minister of Posts and Telegraphs that the working of the postal and telegraph services during 1920 is expected to result in a deficit of 1,250,000,000 marks, and a still further increase in the charges for these services is indispensable.

Pacific Cables.—The report of the Pacific Cable Board for the financial year ended March 31st, 1919, with statement of accounts, shows that the net traffic receipts were £554,511, which exceed those of 1917-18 by £152,537. The increase was the result of war conditions. The expenditure exceeded that of the preceding year by £23,848. During the year over 8,300,000 paying words of international traffic other than local traffic in Australasia and the Pacific were handled. This was over 800,000 words in excess of the total during the previous year, but 439,000 less than the total for 1916-17. Free messages to, from, and in relation to wounded members of the Expeditionary Forces totalled 200,000 words, against 600,000 in the preceding year. In addition to international traffic, 1,830,000 paying words were carried during the year between Australia and New Zealand and between Australasia and the Pacific Islands. Throughout the year there was great congestion, primarily due to the large amount of Government traffic. At times it became a matter of great difficulty to control the acceptance of traffic, and Government Departments and the Press were appealed to with the object of reducing their cabling in the interests of the public. The Board is indebted to the Press for forbearance during these times of pressure.

The cable section between Norfolk Island and Southport became faulty on August 19th, 1918, and repair by the *Iris* was completed on September 5th, 1918. A total interruption of the cable did not take place until the ship cut in, but the fault rendered duplex working impracticable. The breakdown of this cable did not have any serious effect upon traffic as it was possible to circulate *via* Auckland and Sydney all messages which would ordinarily have gone over the Southport cable. During the repair operations the Norfolk Island-Auckland cable was accidentally cut. This led to the discovery of a section in an unsatisfactory condition which would not have been detected but for the accident. The weak spot was cut out and the cable was restored within a few hours. The other cables were maintained without interruption and in excellent condition. The depôts, instruments, and plant generally, have continued in good order.

The *Iris* continues in first-class condition, and in addition to the operations at Norfolk Island, carried out two repairs (April, 1918, and November, 1918) to the Cook Straits cables on behalf of the New Zealand Post and Telegraph Department, and repaired one of the cables between Sydney and Wellington for the Eastern Extension Telegraph Co., in October, 1918.

The landline between Montreal and Bamfield, which the Board leases from the Canadian Pacific Railway Co., worked well during the year under review and suffered few serious interruptions. A further line, between Halifax (Nova Scotia), and Montreal has been leased from the Canadian Pacific Railway for a period of 10 years with liberty to terminate the lease at an earlier date on payment of specified penalties. The Halifax connection is worked by the Board's staff and maintained in good order by the Canadian Pacific Railway Co. The Board has direct connection with the terminus at Halifax of the Imperial Atlantic Cable which is also operated by the Board's staff, the English end being operated by the British Post Office. The landline in Australia, between Sydney and Melbourne, which is operated by the Board's staff, gave very satisfactory service throughout the year.

Radio Research Board.—A Radio Research Board has been established by the Department of Scientific and Industrial Research to co-ordinate and develop researches into wireless telegraphy and telephony at present being undertaken by Government Departments, with the following membership:—Admiral of the Fleet, Sir Henry B. Jackson, F.R.S., chairman; Commander J. S. Salmond, R.N., Lieut.-Col. A. G. T. Cusins, Wing-Commander A. D. Warrington Morris, Mr. E. H. Shaughnessy, and Prof. J. E. Petavel, F.R.S., representing the Admiralty, War Office, Air Ministry, Post Office, and Department of Scientific and Industrial Research respectively; and Prof. Sir Ernest Rutherford, F.R.S.

The Hague.—A new telephone exchange on the semi-automatic system has just been opened at Scheveningen, after over five years' delay. It had been intended to complete the exchange in 1914, when the plant and equipment—supplied by the Western Electric Co.—were lying at Antwerp, but these were seized by the Germans on the occupation of this port and scattered broadcast.

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South Africa.—The number of telegraph offices increased during 1918 from 1,703 to 1,738, and the number of messages from 6,174,888 to 6,619,635.

The Telegraph Service.—It is estimated that at the Central Telegraph Office alone the daily number of telegrams dealt with usually ranges between 120,000 and 165,000, the highest total being 355,353 on the occasion of the railway strike, on September 29th, 1919. The total number of telegrams handled is close upon 90 millions. The number of telegraph offices in the United Kingdom in now approximately 14,000, and the record number of words transmitted in one day is 1,885,400 words, on December 5th, 1910.

United States.—A severe snowstorm, accompanied by a north-east gale, did much damage, last week, in the entire eastern part of the States, and both telegraphic and telephonic communication was interrupted.

Wireless Telephony.—It is reported in the daily Press that experiments in wireless telephony across the Atlantic between Britain and the U.S.A. are now being carried out.

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the ELECTRICAL REVIEW *in which the "Official Notice" appeared.)*

OPEN.

Aberdare.—Urban District Council. Electricity and Tramways Department. Stores for 12 months, including cables, meters, joint boxes, electric lamps, &c. (February 6th.)

Aldershot.—February 17th. Urban District Council. Electricity Department. Geared turbine and generator, condensing plant, pumps, water-tube boiler and superheater, cables, &c. (January 23rd.)

Australia.—MELBOURNE.—March 30th. City Council. 12,000 metal filament incandescent lamps. (February 6th.)

April 12th. City Council. Two 2,000-KW. rotary converters; H.T. switchgear, 6,600 V.; D.C. switchgear, 600 V. (January 30th.)

Bedford.—February 21st. Electricity Department. E.H.T. cable and transformers, E.H.T. switchgear. (February 6th.)

Belfast.—February 14th. Tramways Committee. Tramway stores, including electrical accessories, cable, lamps, carbon brushes, trolley wire, &c. (January 23rd.)

Belgium.—February 27th. Municipal authorities of Villers-le-Peuplier (Province of Liege) are inviting tenders for the concession for the supply of electrical energy for lighting and power purposes in the district.

February 16th. La Société Nationale des Chemins de Fer Vicinaux, Brussels (48, Rue Montoyer). Supply of 15,000 kg. of copper wire, 4 m/m. dia., in connection with the telephone installation.

Bedwas (Mon.).—March 4th. Bedwas Navigation Colliery Co., Ltd. Six months' supply of stores, including electrical goods, &c. (February 6th.)

Bristol.—February 23rd. Electricity Department. One 2,000-KW., single-phase, 2,200-V. turbo-generator, complete with condenser and auxiliaries. (February 6th.)

Chester-le-Street (Co. Durham).—March 3rd. Urban District Council. Underground mains and all equipment for lighting district by electricity. F. J. Gray, Clerk, Council Offices.

Easington.—Rural District Council. Extension of Easington parish electric lighting. Specification, &c., from Mr. E. N. Simpson, Brampton House, Easington, Co. Durham.

Farnworth.—February 25th. Urban District Council. One 750-KW. rotary converter, transformer, switchgear and instruments, cables, &c. (See this issue.)

Hammersmith.—March 3rd. Electricity Committee. Stores for 12 months, including electric light sundries, insulated wire, meters, jointing compound, &c. (See this issue.)

Kings Lynn.—February 20th. Electricity Department. One Lancashire boiler, superheater, piping, &c. (January 30th.)

Lincoln.—March 2nd. Electricity Department. One automatic battery, for St. Swithin's Power Station. (February 6th.)

London.—H.M. Office of Works. February 13th. Supply of electric cable and wire during period ending December 31st, 1920. (February 6th.)

CAMBERWELL.—St. Giles' Board of Guardians. Three 5-H.P. and 15-H.P. A.C. motors, and one fan. (February 6th.)

Madagascar.—TAMATAVE.—March 1st. Paris, Ministère des Colonies (Service Administratif Colonial). Construction of water and electric supply services in the City of Tamatave, including development of the Volobefalls, and supply of electric machinery. &c.

Manchester.—February 17th. Tramways Committee. (*a*) Steel girder tramway rails; (*b*) tramcar trucks; (*c*) controllers for tramcars. Mr. J. M. McElroy, General Manager.

February 21st. Corporation Waterworks Committee. Water turbine, dynamo and switchboard, &c.; storage battery, reversible booster, motor generator, switchboard, D.C. motors, starting panels, &c.; L.T. paper-insulated lead-covered cables. (February 6th.)

February 25th. Electricity Committee. Three three-wire balancers, and the necessary switchgear, for Dickinson Street generating station. Mr. F. G. Hughes, secretary, Electricity Department.

New Zealand.—DUNEDIN.—April 26th. The Imperial Trade Correspondent at Dunedin has forwarded a copy of the specifications and plans in connection with a call for tenders by the Dunedin City Council for (*a*) electric car bodies; (*b*) car trucks; and (*c*) car equipment. These documents may be consulted by British firms interested, at the Department of Overseas Trade (Development and Intelligence), 35, Old Queen Street, S.W.1 (Room 49). Copies of the specifications and plans can be obtained from the Town Clerk, Dunedin, on payment of a fee of £1 (returnable as usual).

Plymouth.—February 16th. Corporation Transport Department. 20 motor chassis, 20 enclosed omnibus bodies, 11 double-deck tramcars, 100 tons steel rails, six tons fish plates, one motor generator set, one 5 cwt. power hammer. (February 6th.)

Salford.—February 23rd. Electricity Department. Two water-tube boilers, with stokers, mechanical-draught plant, &c. (See this issue.)

Spain.—The municipal authorities of Cambados have lately invited tenders for the concession for the electric lighting of the town.

Uruguay.—February 27th. General Administration of the Electric Power Station of the State. 97,500 electric metal-filament lamps. The Management, Calle Julio Herreva y Obes, 1,458, Montivideo.—*Board of Trade Journal.*

CLOSED.

Bolton.—The Electricity Committee has accepted the following tenders:—

Condensing plant for a 12,000-KW. generating unit at Back-o'-th'-Bank.—Hick, Hargreaves & Co., Ltd.

Four sets of economisers at Back-o'-th'-Bank.—E. Green & Son, Ltd.

Burnley.—Town Council. Accepted:—

Five electrical equipments for tramcars, £4,016.—British Thomson-Houston Co., Ltd.

Five single-deck bodies for tramcars, £6,750.—English Electric Co., Ltd.

Cavan.—Electric Light & Power Co., Ltd. Accepted:—

Suction gas engines and plant.—Campbell Gas Engine Co.

Generators and booster.—Electric Construction Co.

Battery.—D.P. Battery Co.

Switchboard.—Hurst Electric Plant, Ltd.

Doncaster.—Town Council:—

Raising the level of part of the Bentley tram track, £2,790.—Edwards and Co.

Hammersmith.—Borough Council. Electricity Committee. Recommended. Refractory bricks and blocks, ground fireclay, &c.:—

Sections A and B, £652.—Hill, Westlake & Co.

Section C, £213.—Metallurgical Plant Construction Co., Ltd.

Section D, £114.—J. H. Sankey & Son.

Mains extension; supply of 250 yd., each '1 sq. in., '2 sq. in., '3 sq. in., and 500 yd. '15 sq. in.:—

	£	Delivery.
Union Cable Co., Ltd. (recom.)	**1,800**	**6/7 weeks**
B. I. & Helsby Cables, Ltd.	1,880	10 ,,
Western Electric Co., Ltd.	1,849	8 ,,
Callender's Cable & Construction Co., Ltd.	1,869	12 ,,
Siemens Bros. & Co., Ltd.	1,896	8 ,,
W. T. Glover & Co., Ltd.	1,898	12/14 ,,
Enfield Ediswan Cables	1,905	8 ,,
Johnson & Phillips, Ltd.	1,912	12 ,,
Pirelli Cable Co., Ltd.	1,986	12/14 ,,
Macintosh Cable Co., Ltd.	2,027	10/14 ,,

1,000-yd., each 3-in. single and 3-in. two-way cable ducts:—

Sutton & Co.	£410
Doulton & Co., Ltd.	412
T. Wragg & Son (recom.)	**420***
Albion Clay Co.	420
General Electric Co., Ltd.	504
Sankey & Co.	594

(*Two-way, 3½ in., same price as 3 in., including delivery on site.)

Tenders received for the work of linking-up the stations of Fulham and Hammersmith:—

	Scheme A. £	Scheme B. £	Scheme C. £
Pirelli-General Cable Works, Ltd.	18,280	18,400	19,150
Western Electric Co., Ltd.	16,100	16,159	16,864
B. I. & Helsby Cables, Ltd.	16,125	16,045	16,445
Callender's Cable & Constrn. Co., Ltd.	17,931	18,844	18,443
W. T. Henley's Tel. Works Co., Ltd. (recom.)	**15,658**	**15,695**	**15,905**
Siemens Bros., Ltd.	16,402	16,527	16,755
Union Cable Co., Ltd.	16,864	16,970	17,070
Johnson & Phillips, Ltd.	16,210	16,226	16,493
Macintosh Cable Co., Ltd.	15,791	16,110	16,561
W. T. Glover, Ltd.	16,686	16,716	—

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London.—STEPNEY.—Electricity Supply Committee. Feeder cable (Limehouse generating station and Whitechapel sub-station) :—

Henley's Teleg. Works Co., Ltd. (recom.)	**£7,319***
B. I. & Helsby Cables, Ltd.	7,488*
W. T. Glover & Co., Ltd.	8,032*

*Subject to market fluctuations and based on copper at £123 and lead at £48 10s., but cannot guarantee delivery under penalty.

ST. MARYLEBONE.—Electric Supply Committee. Recommended. Water-cooling tower, capacity 412,000 gallons per hour :—

Film Cooling Tower, Ltd.	£4,490
Clyne Engineering Co., Ltd. (recom.)	**9,575**
Davenport Engineering Co., Ltd.	14,882

Rotary strainer for canal water, £945.—London Elec. Supply Corptn., Ltd.

Three-motor overhead travelling crane (60 ton) :—

Babcock & Wilcox, Ltd.	£5,725
Higginbottom & Mannock, Ltd.	4,970
H. Morris, Ltd. (recom.)	**4,815**

Torquay.—Town Council :—

Two 2-ton electrically-driven lorries.—Edison Accumulator Co., Ltd., £1,372 each.

FORTHCOMING EVENTS.

Salford Technical and Engineering Association.—Saturday, February 14th. At the Royal Technical Institute. At 7 p.m. Paper on "Liquid Air," by Mr. J. L. Duckworth.

Association of Engineers-in-Charge.—Saturday, February 14th. At St. Bride's Institute, E.C. At 7.30 p.m. Social and dance.

Royal Institution of Great Britain.—Saturday, February 14th. At Albemarle Street, W. At 3 p.m. Lecture on "The Astronomical Evidence Bearing on Einstein's Theory of Gravitation," by Sir F. Dyson, F.R.S.

Tuesday, February 17th. At 3 p.m. Lecture on "Magnetic Susceptibility," by Prof. E. Wilson.

Friday, February 20th. At 9 p.m. Lecture on "British Crop Production," by Dr. E. J. Russell, F.R.S.

Batti Wallahs' Society.—Monday, February 16th. At the Holborn Restaurant. At 1 p.m. Lecture on "Electricity in Warfare," by Major T. Rich, R.E.

Institution of Electrical Engineers.—Monday, February 16th. Informal meeting. At the Institute of Patent Agents, Staple Inn Buildings. At 7 p.m. Lecture on "Automatic Telephony for Private Branch Exchanges," by Mr. A. B. Eason.

(Wireless Sectional Meeting).—Wednesday, February 18th. At the Institution of Civil Engineers, Gt. George Street, S.W. Paper on "Wireless Telephony on Aeroplanes," by Major C. E. Prince.

(Students' Meeting).—Friday, February 20th. At Faraday House. At 7 p.m. Discussion on "State Ownership *versus* Private Enterprise," to be opened by Mr. A. Serner.

Saturday, February 14th. At 2 p.m. Visit to Chingford Pumping Station of Metropolitan Water Board.

Association of Engineering and Shipbuilding Draughtsmen.—Lectures will be given at Liverpool on February 17th and 18th; Manchester, February 19th; and at Glasgow, Barrow-in-Furness and Sheffield, on February 20th.

Belfast Association of Engineers.—Thursday, February 19th. At the Municipal Technical Institute. At 7.45 p.m. Paper on "The Ultimate Constitution of Matter," by Mr. W. C. Ward.

Electrical Power Engineers' Association (Manchester District Section).—Thursday, February 19th. At the Milton Hall, Deansgate. At 7 p.m. Address by the ex-President.

Junior Institution of Engineers.—Friday, February 20th. At the Royal Society of Arts, John Street, Adelphi, W.C. At 7.30 p.m. Paper on "Obscure Points in the Theory of the Internal combustion Engine," by Prof. F. W. Burstall.

Institution of Mechanical Engineers—Friday, February 20th. At the Institution, Storey's Gate, S.W. At 6 p.m. Annual general meeting and resumed discussion on Mr. E. M. Bergstrom's paper on "Recent Advances in Utilisation of Water Power."

"Daily Mail" Ideal Home Exhibition at Olympia.—Open until February 25th.

Royal Society of Arts.—Wednesday, February 18th. At John Street, Adelphi, W.C. At 4.30 p.m. Paper on "English Canals and Inland Waterways," by Mr. S. Preston.

Chemical Society.—Thursday, February 19th. At Burlington House, Piccadilly, W. At 8 p.m. Ordinary scientific meeting.

NOTES.

Fatality.—At an inquest at Redcar, on February 4th, on S. G. Mackenzie, cabin boy and electric pump attendant, of Middlesbrough, who was killed at the Warrenby Ironworks, it was stated that the lad was found lying on a live wire. An electrician, named Elisha Price, stated that he did some repairs to the apparatus driving the electric pump. He connected up the switch box. When he left it, the pump was working all right, and, as far as he was aware, everything was covered up in the proper manner. Questioned, witness stated he did not know there was an earth wire attached to the switch box for safety. It was part of his duty to see that such wires were connected, but these were generally fitted when the plant was installed, and he took it for granted it would be so in this case. W. R. Davidson, chief electrician, said that he found, after the accident, that the switch was not earthed. The apparatus had been worked from another switch, and the one connected by Price was not intended to be used. In returning a verdict of "Accidental death through being electrocuted," the Coroner said there was evidence of a certain amount of neglect on the part of Price, who ought to have made a closer inspection of the apparatus, and also on the part of the foreman, who ought to have earthed the switch when the apparatus was installed. It was stated this was the first accident of the kind the firm had had during its 25 years' experience of electrical plant

Educational.—The Council of Liverpool University has appointed Mr. G. E. Scholes, M.Sc., M.B.E., to the recently established Chair of Engineering—Thermodynamics of Heat Engines.

ENGINEERING APPEAL FUND.—OVER £20,000 ALREADY RAISED.—In response to the appeal recently issued for the sum of £100,000 for the reconstruction and re-equipment of the Engineering Buildings at University College, London, the following sums have already been received :—£250, Siemens Bros. & Co., Ltd.; £105, Redpath, Brown and Co., Ltd.; £100 each, Lazard Bros. & Co., Ltd., C. H. Merz, Esq., Sturtevant Engineering Co., Ltd., and Wallsend Slipway and Engineering Co., Ltd.; £52 10s., Bullevant & Co., Ltd. These sums, together with smaller amounts, bring the total of the fund to £21,545, apart from the additional £10,000 promised by Lord Cowdray, provided the total subscriptions reach £70,000. Further subscriptions to the fund may be sent either to Prince Arthur of Connaught at 42, Upper Grosvenor Street, W., or to Sir Ernest Moir, Bart., at University College, London.

Federation of Staff Workers.—On Saturday last, the inaugural meeting of the "National Federation of Professional, Technical, Administrative, and Supervisory Workers" was held in London. Mr. G. D. H. Cole, of the Labour Research Department, who presided, stated that the scheme had no connection with the Labour Party or the Trade Union Congress, and that membership would not necessarily involve membership of the Congress. A resolution was passed *nem. con.* approving of the formation of the Federation, and a Provisional Council was elected, consisting of delegates from the Associations represented at the meeting, to hold office until a further conference is held to inaugurate the Federation. Each Society is to pay an entrance fee of £30. The objects of the Federation were explained in our last issue.

Mr. Norman Wyld, general secretary of the Society of Technical Engineers, made statements to the Press and wrote a letter to *The Times* with regard to the position of his Society. A representative of that Society moved an amendment to the effect that "a Federation be formed of professional associations, independent of employers' unions on the one hand and manual workers' unions on the other, and free to negotiate with both in the best interests of the professional worker." Several other Societies' representatives supported the motion, but it was not carried. The purpose of the motion was to make it clear that membership of the Federation would not involve close alliance with the manual workers, and the fact that it was rejected made it evident, in his opinion and that of his friends, that the meeting desired to associate itself with either the employers or the manual workers. They had no desire to oppose the formation of the Federation, and, therefore, did not vote against the resolution, but they were proceeding with the formation of "a federation of four federations of professional workers." In his letter to *The Times*, Mr. Wyld explained that the latter movement had made great progress, and that a constitution for the confederation was being drafted. Pending the formation of the confederation, his Society had decided to avoid alliance with either the workers or the employers.

Non-Ferrous Materials.—The following particulars are published of the stocks (exclusive of old metal and scrap) in this country of soft pig lead and refined spelter in the possession of the Minister of Munitions on February 1st, 1920 :—

Soft pig lead	47,348 tons
Refined spelter	8,697 ,,

N.B.—It must be noted that a proportion of the above stocks is already sold to the trade for forward delivery.

Since the stocks of virgin non-ferrous metals unsold under the control of the Government have now reached such proportions that they cease to be an important factor in the general stocks of such metals held in the United Kingdom (with the possible exception of lead and refined spelter), it is proposed to discontinue publication of these notices in the near future.

Flue Gas in Oil Combustion.—An error in interpreting the CO_2 content in flue gas, when burning oil, is likely to arise among engineers who have been familiar with coal burning. This comes from the fact that perfect combustion of coal would give a higher CO_2 reading than perfect combustion of oil. Comparing particular samples, oil could not possibly give a higher CO_2 reading than 15·6 per cent., while the coal, theoretically, might give 18·8 per cent. The explanation of this lies in the greater amount of hydrogen in the oil. The hydrogen requires oxygen for its combustion, and this in turn brings in nitrogen, which appears in the flue gas. The hydrogen does not produce CO_2, and the water-vapour that it does produce does not appear in the flue-gas analysis. The result is that the higher the hydrogen content in the fuel the lower is the theoretical CO_2 percentage in the flue gas.—*Power*.

The Channel Tunnel.—The Channel Tunnel Parliamentary Committee, in a *résume* of the recent history of the project, states that it is uncertain when the Cabinet will arrive at a decision, but it is clear that the Bill for the construction of the tunnel cannot be passed in the forthcoming session unless it receives the wholehearted support of the Government. Failing that condition, the commencement of this work must be delayed for another year.

Welded Ships.—An electrically-welded vessel was launched on February 5th, at Birkenhead, from the Cammell Laird yard. The ship is a coasting vessel 150 ft. long, and designed to carry nearly 500 tons of cargo. The experiment has been followed with great interest; this is the second electrically-welded vessel to be completed in this country. The Quasi-Arc system was used.

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Summer-Time.—The Belgian Minister of the Interior has fixed the night of March 14-15th for the commencement of summer-time. The clocks will be put forward an hour. The French Senate has adopted a Bill introducing summer-time from Saturday evening, February 14th. The lack of co-ordination is very regrettable; it is sure to result in much confusion in international relations.

The Electricity Commissioners.—The following paragraph appeared in *Electrical Industries* of February 11th :—

"Sir John Snell, Mr. Harry Booth (of the Board of Trade), and Mr. Archibald Page, M.I.E.E., general manager of the Clyde Valley Electrical Power Co., have been appointed Electricity Commissioners. The two remaining appointments have not yet been announced, but we understand that the posts will be filled by a leading municipal engineer and by an official with wide experience of administrative work on a London municipal authority."

On inquiry of the Ministry of Transport, we have not been able to obtain either confirmation or denial of the statement. Our Glasgow correspondent sends us the announcement of the appointment of Mr. Page, and of his successor at the Clyde Valley Power Co. (see "Personal" column).

The Electrical Wholesalers' Federation.—This Federation held its annual meeting at the Hotel Russell, London, on Wednesday.

Our Lead Supplies.—Just as we go to press, we have received the following letter :—

"The Board of Trade returns for January, issued this week, afford ample confirmation of the article on the above subject in your last week's issue.

"The figures given for 1919 show 189,114 tons for absorption in the United Kingdom for the year, or an average of 15,759 tons per month.

"The imports for January amounted to 5,888 tons, the exports to 4,679 tons, the balance left being only 1,209 tons.

"May we put it more forcibly by giving the figures for the last three months :—

	Nov.	Dec.	Jan.		
"Imports ...	2,679	12,496	5,888	=	21,063
"Exports ...	5,874	6,393	4,679	=	16,946
"Left for United Kingdom absorption ...					4,117

"We have then the astounding position that for the three months which, on the average of last year, should show 47,277 tons for home consumption, we have actually received 4,117 tons.

"These figures should dispose of such reports as those asserting that there is no danger of short supplies.

"The Government stock is now practically sold out, and the deliveries from this source alone have hidden the real position which is now being disclosed.

"The Writer of the Article."

"February 11th, 1920.

Appointments Vacant.—Telegraph inspectors (£200 + £65), for the Posts and Telegraphs Department in German East Africa; assistant engineer (£350), for the Hackney Borough Council Electricity Supply Department; foremen and instructors in armature winding, meter repair, contracting (lighting dynamo and motors) and fitting for the Government Instructional Factory, Hackney Wick; whole-time teacher in electrical engineering and physics (£225 to £315), for the London County Council School of Engineering and Navigation, Poplar; shift engineer (£264), for the Accrington Corporation Electrical Engineering Department; head of the Heat Treatment Laboratory, for the Loughborough Technical College; overhead linesman, for the Rawtenstall Corporation Tramways; two meter testers (£208), for the Bradford City Electricity Supply; charge engineer (£270), for the Bootle Corporation Electricity Works; junior staff engineers and control-room attendants, for the Rotherham Borough Council Electricity Supply Department; engineer chief assistant, for Edmundson's Electricity Works, Inverness; meter tester and installation engineer (£260), for the Walsall Corporation Electricity Supply Department; draughtsman (£300), chief clerk (£250), for the Doncaster Borough Council Electricity Department. See our advertisement pages to-day.

Danish Patent Law.—In the *Illustrated Official Journal* (*Patents*) of February 4th attention is called to the provisions of the Danish Law, amending the Law of Patents, which was passed on December 22nd, 1919. This law empowers the Minister of Commerce, upon terms to be fixed by him, to restore patents which have been cancelled since August 1st, 1914, by reason of non-payment of fees, or for non-working; to extend the term of a patent by a period not exceeding five years when the patentee has been prevented by the war from exercising his rights; and to reconsider any application the consideration of which was suspended between August 1st, 1914, and the end of 1919, owing to official communications remaining unanswered. The benefits of this law may, subject to reciprocity, be extended by Royal Decree to subjects of other countries. A copy of a translation of the law may be inspected in the Patent Office Library.

Restoration of Lens Mines.—Only a part of Lens mines has been cleared so far, and, allowing for regular work, it will take the whole of 1920 to clear them entirely. Twelve pits are already cleared at the surface, four are in course of clearance, five are still in a state of chaos. A scheme for electric pumping has been established, the power to be provided by the Société Electrique des Houillères du Pas-de-Calais, which, while waiting for the erection of the proposed 24,000-kw. power station at Hénin-Liétard, will obtain current from the Compagnie de Béthune. German gangs will be entrusted with the repropping of the pits, all the necessary cement being furnished by Germany. As the pumping may take two or three years, the output cannot be resumed, even feebly, before 1923 or 1924. The railway lines cannot be made good before 1921. It must not be reckoned that Lens will be restored before 1928 or 1929.—*Economic Review.*

The U.S. S. "Tennessee."—When the U.S. battleship *Tennessee* was launched at the Brooklyn Navy Yard one of the most formidable machines of its kind in existence was set in motion. Her overall length is 624 ft.; beam 97 ft.; draught 31 ft.; and full load displacement 33,000 tons. She will mount twelve 14-in. guns of 50 calibre, 22 5-in. guns of 51 calibre; two 3-in. anti-aircraft guns; four saluting pieces; and two 21-in. submerged torpedo tubes. Her complement will be 1,119 officers and men. She will be propelled by electricity, supplied by two turbine-driven generators, and each of her four propellers will be driven by its own motor. Her maximum power will be 33,500 H.P., and her maximum speed over 21 knots per hour. The turbines are of the Westinghouse single-cylinder, semi-double flow, impulse-reaction type. The H.P. steam first passes through a two-row impulse wheel in each turbine, and then through a section blading. It then divides into two equal parts and each part passes through a L.P. reaction section into the condensers. The speed of the turbines can be varied through a range of from 1,500 to 2,270 R.P.M., by means of manually-controlled hydraulically-operated governors. The speed of the turbines, as determined by the setting of the governor, remains practically constant, regardless of the load, and hence the propellers do not race when they leave the water in rough weather. Automatic stops are also provided, which cut off the steam in case the speed of the turbines exceeds a safe value. The generators direct connected to the turbines, are two-pole Westinghouse machines, and supply the motors with 3-phase, 3,400-volt A.C. at frequencies ranging from 25 to 38 cycles, depending on the turbine speed. They are excited from the D.C. power supply of the ship, and each can develop 15,000 K.V.A. at the maximum speed of the turbine. The generator coils are very carefully insulated so as to prevent injury from high temperature, moisture, and accumulations of salt. They are kept cool by air which is forced through the ventilating ducts by fans mounted on the rotor shafts. The four motors are of the Westinghouse induction type, direct-connected to the propellers, and each can develop a maximum of 8,375 H.P. continuously. To provide a sufficiently wide speed range, each has two windings, one of 24 poles and the other of 36 poles. The 24-pole winding is connected to slip-rings on the rotor shaft, while the 36-pole winding has short-circuiting connections and is equivalent to a squirrel-cage arrangement. Both windings are used for running, but only the 24-pole for starting and reversing, resistance being inserted in series with it during these operations. The insulation of the motor is similar to that of the generators, and ventilation is provided by means of two motor-driven fans mounted on the top of each motor. The 36-pole winding is equivalent to a gear of an 18 to 1 ratio between the turbines and the propeller, while the 24-pole winding is equivalent to a gear of a 12 to 1 ratio. From 9 to 15 knots, the motors are operated on the 36-pole windings, and all four are driven by one turbo-generator. From 17 to 21 knots, the motors are operated on the 24-pole windings by means of one turbo-generator. From 17 to 21 knots, the motors are operated on the 24-pole windings, by means of both turbo-generators. To reverse, two phases at each motor are transposed without changing the direction of rotation of the turbo-generators. The use of one turbo-generator for the lower speeds assists in maintaining good operating economy by keeping the load on the unit close to its rated capacity except at the very slowest speeds. The steam consumption per shaft H.P.-hour, including that required for excitation, condenser operation, and motor ventilation, is as follows :—

Speed in knots.	Motor-poles.	No. turbo units.	Lb. of steam.
9	36	1	16
15	36	1	12
15	24	1	13
17	24	1	13
17	24	2	12.4
19¼	24	2	11.7
21	24	2	11.9

All the switching apparatus for controlling and distributing the power is located in a control room. The rheostats used for starting and reversing the propeller motors are of the automatic liquid type. In order to ensure the best possible type of construction, a committee of the American Institute of Electrical Engineers assisted the Navy Department in preparing the specifications for the cables. The main circulating pumps are of the centrifugal type operated by 235-H.P. motors. Their speed can be varied so that power consumption can be reduced with the speed of the ship. Le Blanc air ejectors, which are novel on this class of ship, maintain a high vacuum in the condensers. The condensate is handled by motor-driven vertical centrifugal pumps. Thus all the main engine room auxiliaries are rotary and are motor-driven.—*Electrical News.*

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Mechanical Stokers.—Erith's Engineering Co., Ltd., is furnishing to the orders of Edinburgh Corporation Erith-Riley stokers, which are much larger than any stokers hitherto made in any country; each stoker being no less than 33 ft. wide, and it is also furnishing identical stokers to Shanghai electricity works, each stoker being assembled from standardised uniform self-cleaning retort-units, set side by side in a straight-walled furnace, under water-tube boilers normally evaporating 80,000 lb. high-pressure superheated steam hourly. The coal is fed, the fires are sliced, and the incombustible ash is continuously discharged without manual labour. The labour-saving, as contrasted with a battery of twelve Lancashire boilers, which needs eight firemen per shift for the identical steaming duty, is self-evident, and the fully automatic Erith-Riley stoker with the modern water-tube boiler gives a thermal efficiency representing a substantial fuel saving, as well as the capacity to use low-grade small fuels to the best advantage. The latest Erith-Riley stokers for Hull Corporation electricity works are exactly similar; but instead of being applied to one 80,000 lb. boiler each, they are applied to a pair of 40,000 lb. boilers, divided only by a partition wall, but allowing only half the capacity to be shut down at a time, while giving identical results, just as is the case with the stokers of similar capacity at the Bow power plant of the Charing Cross Electric Supply Co., London, where the large boilers are set in pairs, but back to back. The stokers as above are each six times as large as the first ones built in 1914.

Single-shaft Curtis Turbines.—The present limits of speed and power of single-shaft Curtis steam turbines are discussed in three papers published in the *Proceedings* of the A.I.E.E. for November. Mr. Eskil Berg's paper starts by showing that the limit of a single-unit turbo generator does not lie in the generator but is confined to the steam turbine, and that the last wheel of the turbine is the limiting feature. The author, therefore, takes the last wheel of an 1,800-R.P.M. turbine, giving dimensions, stresses, kind of material used, &c., and then designs two turbines, one having 24 stages and the other 13 stages, both machines using this last wheel, and shows that a turbine can be built having its most economical point at 21,000 KW., under steam conditions given in the paper. Under this condition the last stage absorbs 11.5 per cent. of the total adiabatic available energy, and the wheel efficiency is 66.25 per cent. As the load increases, the work done in this stage also increases, so that at 36,000 KW. the energy is practically doubled, but with a sacrifice in efficiency of about 18 per cent., which naturally lowers the efficiency of the turbine as a whole. A 5,000-KW., five-stage, 3,600-R.P.M. turbine load curve is also given and discussed, and the author claims that if the

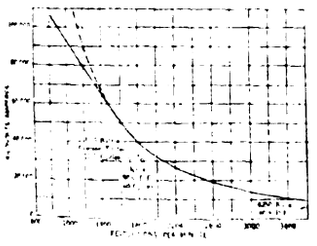

FIG. 1.

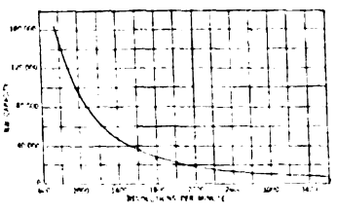

FIG. 2.

MAXIMUM CAPACITY AT VARIOUS SPEEDS OF SINGLE-SHAFT TURBINES.

construction could be made similar to the large turbine, keeping the same stresses and number of stages, a turbine of this capacity could be built as efficient as the larger machine at 20,000 KW.

Mr. F. D. Newbury explains that output is determined broadly by rotor or stator dimensions. With speeds of 1,200 R.P.M. and lower, the stator is the limiting member, while with higher speeds, the rotor is the limiting member. The most effective rotor diameter is not necessarily the largest diameter. To obtain maximum output at a given speed the rotor proportions must be chosen to properly balance mechanical stresses, rotor ampere turns and flux. American design practise has established 400 ft. per sec. as an upper limit of rotor peripheral speed. The maximum length of core is determined by such factors as ventilation, bearing temperatures, critical speed and limits to weight imposed by forging and transportation facilities. The author shows (fig. 1) present limits to K.V.A. rating at speeds from 3,600 to 900 R.P.M. These limiting values are given as indicating present boundaries to knowledge and experience, rather than as real physical or other limits that cannot be exceeded. Mechanical forces due to short-circuit current, and damage caused by armature winding failures, are no greater in the very large generators indicated by fig. 1 than in present day 20,000 and 30,000 K.V.A. units. No opinion is expressed as to the wisdom of installing very large single-shaft units. If operating engineers desire units of 50,000 to 100,000 KW., there is no question but that such generators can be conservatively designed and constructed.

Mr. J. F. Johnson's paper is restricted to a discussion of some factors which influence limits as applying particularly to turbines of the reaction type. With the employment of high vacua the limit of power will be determined largely by the area obtainable through the last stage. Limiting factors include:—1. Chosen maximum values of steam speed through the blades in order to keep the leaving losses within permissible limits. For highest efficiency the steam speed should be about 25 per cent. greater than the blade speed, but in the last stages it is sometimes made 100 per cent. greater as a compromise between efficiency and cost. Similarly the outlet angle of the blades is increased from 20 deg. to 35 deg. 2. Physical characteristics of materials employed and chosen limits to which these may be safely stressed. By varying the form of rotor construction stresses in it may usually be kept within necessary limits up to the point at which limiting stresses in the blades or blade fastenings are reached. For any given rotative speed and blade angle the steam capacity is directly proportional to the stress at the base of the blades regardless of the diameter and blade height. 3. Capacity limits of manufacturing facilities, increased bracing and clearances necessary to ensure requisite rigidity and reliability, and capacity loss due to outages for inspection and repair. Fig. 2 shows maximum capacity at various speeds which are physically possible without exceeding present limits of stresses. It is valuable chiefly as showing the physical relation between speed and capacity with given limiting stress values.

American Electrical Company insures all its Employés.—The General Electric Co. (U.S.A.) has announced a group life insurance plan for all of its employés, including those on G.E. plants and district offices throughout the States. Every employé who has been with the company one year or more will have a substantial amount of life insurance without cost to himself. This applies to everyone in the employ of the company, regardless of age, sex or physical condition. This insurance plan will in a measure relieve the minds of employés as to the danger of financial distress in their families in case of death. Officials of the company have long recognised the value of continuous service, and it is hoped that the plan will encourage permanency of employment. The amount of this insurance is $500 for one year's service, $750 for two years' service, $1,000 for three years' service, $1,250 for four years' service, and $1,500 for five years' service; this is the maximum policy. The life insurance company with whom the policies have been placed requires no physical examination of the employé as a condition of such insurance, which is provided at the company's expense and became effective on January 1st, 1920. The insurance runs for a period of one year, but it is hoped that experience will justify its continuance thereafter. Upon the lives of employés who die leaving no dependents, the amount of insurance is $150, to cover funeral expenses. The insurance ceases as to any employé with the termination of his employment, but the insuring company agrees that insurance on a standard policy form at regular rates may be secured without physical examination upon application to it by the person whose employment is terminated. The General Electric has 23,000 employés in the Schenectady works, where more than 10,000 employés have worked for the company five years or more and a great majority of the remaining 13,000 have served over three years. There are quite a few employés in that and in other plants, however, who have not completed a year's service. These will automatically come within the scope of the plan as soon as they have been with the company a year.—*Electrical Review*, Chicago.

Hydro-electric Power Possibilities.—In an address given by Sir Adam Beck, chairman of the Ontario Hydro-Electric Commission, before the Inland Waterways Convention, recently held at Windsor, Ont., the immense possibilities in the use of water power were emphasised. The speaker took, one by one, various points upon the St. Lawrence and the Great Lakes, giving in each case the possible H.P. development attending the deepening of the river, &c., at those places. The immediate objective was to develop two and a half million H.P., but the total available power for development in Ontario was five millions. Sir Adam Beck calculated that this would mean an annual saving of 100,000,000 tons of coal.

When hydroelectric power was first introduced it was thought that it would be difficult to market 10,000 H.P., but so great has been the development that in nine years the figure has reached 365,000, and the speaker predicted that it would not be long before the whole of the 2,500,000 H.P. of the proposed development would be in use. The estimated cost of the whole of the scheme would be about $100,000,000. The building of the Morrisburg dam would make possible the control of the levels of Lake Ontario with a regulation of from two to four feet. The depth of Montreal Harbour would also be increased by this dam, and its accommodation therefore extended to larger vessels. The levels of Lake Erie would be increased by remedial works from two to three feet, and 50,000 second-feet would be gained without impairing the scenic beauty of Niagara Falls. On the American side 20,000 second-feet would be gained. It had been stated by the scheme's opponents that the war industries which were provided with hydro-power to the deprivation of other industries, would be unused in peace, but facts had proved otherwise, and those industries were now employing just as much power in the manufacture of the commodities of peace.

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Concealed Lighting in a Church.—The appropriate lighting of churches is a difficult matter. Conditions and requirements are so various that it is impossible to evolve any generally applicable rules. The degree of illumination, the employment of visible or concealed units, and, if visible, the design of fitting to be used all depend upon three factors, viz., the interior architecture of the church, the kind of service carried on, and the personal preferences of the responsible authorities. In the interior of the Church of the Sacred Heart, Donnybrook (illustrated), the British Thomson-Houston Co., which was responsible for the manufacture of the appliances used and for the general scheme of the installation, has very successfully aimed at the daylight effect. The main illumination proceeds from units fixed 26 ft. from

Concealed Lighting in a Church.

the ground on the east side of the wooden bracket posts supporting the timbered ceiling. Each unit consists of a three-section battery of Mirolux trough reflectors, containing three 100-watt Mazdalite tubular lamps. In the north and south aisles similar units are fixed on the north and south sides respectively of the spandrels of the main arches. All units point towards the east end of the church, so that the lamps are normally invisible to the congregation. As may be seen from the photograph, which was taken at night by the light of the Mazdalite lamps installed, the illumination is brilliant, and, owing to reflection from the light coloured stone work, is very well distributed.

Sydney Engineer on Electrical Manufacturing in Australia.—The Sydney City Electrical Engineer, reporting to the Electric Lighting Committee on a letter received from Standard Waygood Hercules, Ltd., offering to manufacture electrical plant for the Council on similar lines to those under which G. Weymouth Pty., Ltd., manufacture generating plant and transformers for the Navy Department, based on shop cost, plus 15 per cent. profit, stated that he saw no reason why the Council should not order from this firm in the manner suggested, save in the case of larger or different machinery than anything the company had previously built, or if the Council was dependent on getting apparatus into use on a particular date. In short, he would be strongly in favour of encouraging the making of electrical plant of all kinds in Australia, but would not be prepared to go to the length of risking the Council's ability to meet its obligations to the public by putting plant on order from an Australian company, which in the making of the plant would be experimenting.—*Tenders.*

INSTITUTION NOTES.

Institution of Civil Engineers of Ireland.—At a meeting of the Institution held in Dublin on February 2nd, a paper on "Irish Water Powers and their Places in an Industrial Scheme" was read by Mr. G. Marshall Harriss, M.Inst.C.E.(I.). Mr. Harriss said that Ireland's water power was only limited by the amount of capital they could afford to spend on it. There were throughout the country numerous small water powers that some 80 years ago were in full operation, but to-day for every plant in operation, they would find 50 in ruins. The varying flow of the rivers was a serious drawback, but its significance tended to decrease if they considered a number of powers electrically joined up. The board of the Dublin and Lucan Electric Railway had been considering the possibilities of water power to supplement its steam station, and it had been suggested that the power of the Liffey at the Salmon Leap should be utilised. The total cost of the necessary works was estimated in February, 1919, to be £38,500, or £26 per KW. installed. If the net power proposed was used, the annual output of the station would be 8,385,000 units. The operation costs and capital charges might be taken at £4,600, a total works cost of ·138d. per unit generated. The coal required for generating 8 million units at 3 lb. coal per unit came to 10,700 tons. The Dublin and Lucan Electric Railway required about ·25 million units; its coal consumption for 1917 was 1,650 tons, and the cost of production was 3·941d. per unit.

Institution of Electrical Engineers.—Mr. Percy Good has been appointed by the Council to be one of the representatives of the Institution on the British National Committee of the International Illumination Commission.

The annual dinner of the North-Western Centre took place at the Grand Hotel, Manchester, on February 6th, Mr. C. J. A. Robertson, chairman of the Centre, presiding. Among the guests were the President, Mr. Roger T. Smith; the Lord Mayor of Manchester (Alderman Fox); the chairman of the Salford Electricity Committee (Councillor Billington); Sir T. Robinson, M.P.; Mr. E. F. Stockton, President of the Manchester Chamber of Commerce; and Mr. C. H. Wordingham.

After the toasts of the King, the Imperial Forces, and the Corporations of Manchester and Salford had been duly honoured, the Chairman presented to Mr. Julius Frith a 4-in. Drummond lathe, and a silver tray (intended for Mrs. Frith), in recognition of his services as hon. secretary during the seven years preceding the present session.

In acknowledging the gift, Mr. Frith said those seven years had been marked by many stirring events, and he hoped to see further developments of the scientific side of Manchester's life and industry. He advocated the establishment of a library which would enable busy men to read the technical Press throughout the world, and keep in touch with all that happened in connection with the subjects they were particularly interested in. Much time would be saved by the employment of a staff of readers whose task it would be to sift the material.

The toast of "The Institution" was proposed by Mr. J. Phillips Bedson, and replied to by Mr. R. T. Smith, who heartily congratulated the North-Western Centre upon the self-sacrifice shown in the establishment of the Sub-Centres at Liverpool and Preston. Decentralisation had been going on for many years, and no one had done more than Mr. Wordingham to bring home the importance of it, and to make the Institution feel that it had got a new life and a new interest. At the same time, the traditions of the Institution were, and must always be, centred in London as the capital of the Empire, of which they were all citizens. Those traditions were an inheritance which should not be lightly parted with. What was obsolete and bad could be discarded, but no change should be made simply for the sake of change.

Mr. C. H. Wordingham, in proposing the toast of "The North-Western Centre," said he did not think it would suffer in any way from the formation of the Sub-Centre. The Institution would certainly benefit. He suggested that the chairman and vice-chairman of the Sub-Centre should be upon the Committee of the Centre, thus linking up in the same way as the Centre was linked up with London by the presence of the chairman and vice-chairman on the Council.

The Chairman, in replying, said the Centres were absolutely loyal to headquarters, but they did not always see eye to eye with it, and there was a feeling that they had not always been dealt with as considerately as they ought to have been. In Manchester there was a very strong Students' Section, which should receive greater recognition; many of the papers submitted by the Students were so meritorious that they ought not to be allowed to fall into oblivion. He suggested the publication of a Students' *Journal*. He further appealed for those men whose training had been interrupted by the war. He agreed that the doors of the Institution should be closed against unqualified men, but in these cases the door might be opened a little wider. He also thought the Membership Committee should take the Local Centres more into its confidence with regard to applications for membership.

The toast of "The Guests" was proposed by Alderman W. Walker, and responded to by Sir T. Robinson, M.P.

An excellent musical and humorous entertainment was provided, and the proceedings were thoroughly enjoyable.

I.E.E. Welsh Conference.—The engineer reported at the Swansea Electricity Committee last week that the Institution of Electrical Engineers would come to Wales in July. It was proposed to make Cardiff a centre, with visits to Bristol, Hereford and Swansea. The other towns were giving civic receptions. Mr. Colwill hoped the Committee would support such a reception. There would be some of the most eminent engineers visiting the town, and if anything would give an impetus to the electrical undertaking and foster industry, this would. It was decided to give a hearty welcome to the visitors, and ask the Mayor to entertain them. The Mayor (who has been a member for 37 years) said the visit would be a red-letter day for Swansea.

A.O.E.C.—The annual meeting of the Association of Officers and Staff Members of Electricity (Power and Supply) Companies of Great Britain will take place at Caxton Hall, Westminster (Room No. 1), at 8 p.m., February 17th. The report of the executive committee states that Sir Alex. B. W. Kennedy, F.R.S., has consented to act as President.

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OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

From 79 original applications for the position of shift engineer at the Swansea Corporation power station, Mr. J. SMITH, a former charge engineer in the Swansea Tramways power station, and senior assistant of the tramways, and now holding a commission in the R.E., was appointed shift engineer, at a salary of £305.

Torquay T.C. has promoted Mr. DENT to the position of station superintendent, at £250 a year; and appointed Mr. MEDWAY as a charge engineer.

The salary of Mr. B. HARTLEY, clerk at the Batley electricity works, has been increased to £175 per annum.

Mr. A. LEWIS, of Preston, has been appointed superintendent at the Doncaster Corporation electricity works, at a salary of £250 per annum.

As we recently announced, the chair of electrical engineering at the University of Birmingham, vacant by the resignation of Prof. Kapp, has been filled by the appointment of Dr. WILLIAM CRAMP, of Manchester. In his report to the Council of the University, the Principal, Sir Oliver Lodge, who has just retired, refers to Prof. Kapp's connection with the University, remarking that he brought a European reputation, as the first professor of engineering. Sir Oliver proceeds: "Electrical engineering, as a university subject, has of late years not been so much in demand as it was in the infancy of the dynamo—in the design and evolution of which Gisbert Kapp took so active a part; but there are signs that in the near future electrical engineering will become of first-rate importance again, not only in connection with large works like the electrical operation of railways, but in the direction of new devices and the utilisation, for practical ends, of many of the discoveries which are being made in pure physics. Some of these have already been of emphatic use during the war."

The *Sheffield Independent* states that Mr. S. S. PARKER has accepted a position on the board of Messrs. John Nicholson and Sons (Sheffield), Ltd., Mowbray Steel Works, and in consequence has resigned his position with Messrs. Vickers, Ltd. Mr. Parker has completed 15 years' service with Messrs. Vickers, Ltd., and for 12 years has had charge of the tool-steel department, together with the crucible and electric furnaces. It is added that Mr. Parker superintended the first commercially-worked electric furnace in this country.

Mr. R. N. TWEEDY having been demobilised, is practising as a consulting engineer at 16, Ely Place, Dublin. He desires to receive catalogues, &c., from firms making electrical machinery, accessories, and fittings; also from firms specialising in fuel economising apparatus, as he will be advising particularly on works economy.

Maidenhead T.C. has appointed Mr. J. DOWSETT, works foreman, as assistant electrical engineer, and Mr. W. STERVELL, mains superintendent, as station superintendent, at £5 per week each.

Mr. J. H. BOWDEN presided at a recent gathering of the Poplar borough electricity department to do honour to ex-Coun. Barge (who was formerly chairman of the Electricity Committee) and Mrs. Barge. Mrs. Bowden, Mrs. Tait, and Coun. Sumner (the present chairman of the Electricity Committee) were among those present. Mr. Bowden said that the suggestion for the gathering came from the men. Mr. Barge had been a good friend to the staff and other employés. The chairman presented Mr. Barge with a set of silver-mounted brushes and mirror, and Mrs. Barge with a gold brooch set with sapphire and pearls. Mr. Barge, in responding, spoke in very high terms of Mr. Bowden as chief of the department. Mr. Fisher having spoken on behalf of the workmen, Councillor Sumner proposed "Success to the Undertaking." The health of the chairman was drunk, and Mr. Bowden, in responding, referred to the honours won by men of the department who joined the Forces.

Mr. C. G. ABBEY, who joined Messrs. Fraser & Borthwick last year, has returned to his former employers, Messrs. Kelsall & Parsons, Glasgow, representives for Scotland of the Lancashire Dynamo & Motor Co., Ltd., and other well-known companies.

Mr. W. BELLAD-ELLIS, the town electrical engineer at Queenstown, Cape Province, has resigned his position. He has had considerable experience in electrical installations with Diesel engines, and will devote his attention to the promotion and development of various similar schemes which he has in hand.

The Middlesbrough Committee has recommended that the salary of the electrical engineer, Mr. R. H. SCOTSON, be increased from £550 to £700 per annum.

The Cape Town Electricity Committee recommended the appointment of Mr. ERNEST STUBBS to the position of temporary assistant engineer at the power station at £720 per annum, with £50 towards passage money. The committee also recommended the appointment of Mr. ARTHUR EDGE as station engineer at £600 per annum and £25 towards passage money.

Mr. E. T. GOSLIN, who has been chief electrical engineer of the Glasgow Corporation Tramways for nearly 20 years, has been appointed general manager of the Clyde Valley Electric Power Co., in succession to Mr. Page, who has been appointed one of the Electricity Commissioners in London.

Mr. J. H. COLLIE has resigned his position of chief electrical engineer with Messrs. Cammell, Laird & Co., Birkenhead, and has started business with Mr. F. B. Cox under the name of Messrs. Collie & Cox, consulting and electrical engineers, at 65, Fleet Street, Liverpool, where they will act as sole district representatives for four well-known electrical firms.

NEW COMPANIES REGISTERED.

Taxi-Calls, Ltd. (163,558).—Private company. Registered January 31st. Capital, £1,000 in £1 shares. To carry on the business of electrical and mechanical engineers, manufacturers of and dealers in electrical and mechanical devices, &c. The subscribers (each with one share) are: C. H. Moore, 5, Craven Mansions, Lancaster Gate, W.2, retired solicitor; N. C. Dibben, B.A., Cantab., Temple Grafton, near Alcester, Warwick. The subscribers are to appoint the first directors. Solicitor: G. A. Herbert, 10, Old Square, Lincoln's Inn, W.C. Registered office: 123, Pall Mall, S.W.1.

John Ogilvy & Co., Ltd. (10,921).—Private company. Registered in Edinburgh January 26th. Capital, £20,000 in £1 shares (10,000 preferred and 10,000 deferred). To acquire and take over the business of an electrical contractor lately carried on by J. D. B. Ogilvy at Inshiwan, Forfarshire, and to carry on the business of electrical engineers and contractors, consulting engineers, &c. The subscribers (each with one share) are: J. D. B. Ogilvy, Inshiwan, Forfar, engineer; B. C. Clayton, Wylands, Ross, Herefordshire, engineer. The first directors are: W. Anderson and J. D. B. Ogilvy. Registered office: 48, Queen Street, Edinburgh.

Hodgson & Partners, Ltd. (163,670).—Private company. Registered February 4th. Capital, £5,000 in £1 shares. To carry on the business of founders, electricians, builders, decorators, and any business in which electricity may be used, and to acquire the business carried on by F. Hodgson at 12, Heath Street, Hampstead. The first directors are: F. Hodgson, 26, Kemplay Road, Hampstead; A. E. Wellman, 77, Devonshire Road, Aldermans Hill, Palmers Green, N.W.13; H. J. Kirby, 51, Larkhill Rise, Clapham, S.W.; H. T. Smith, 78, Thorold Road, Ilford. Solicitor: H. Harrowell, 89, Chancery Lane, W.C. Registered office: 12, Heath Street, Hampstead, N.W.

Keltie's Garage, Ltd. (163,673).—Private company. Registered February 4th. Capital, £10,000 in £1 shares (2,000 preference). To carry on the business of electrical engineers and contractors, garage proprietors, &c., and to enter into an agreement with Capt. H. R. V. Haggett and P. S. Clifton. The subscribers are: Capt. H. E. V. Haggett, 71a, Warwick Road, Earl's Court, S.W. (500 preference and 500 ordinary shares); Capt. A. Y. R. Napier, 19, Piccadilly, W. (1,000 preference). The first directors are: Capt. H. E. V. Haggett, Capt. A. J. T. Haggett and R. S. Clifton. Solicitor: P. B. Shepheard, 23, Young Street, Kennington.

Chase Electrical Manufacturing Co., Ltd. (163,778).—Private company. Registered February 6th. Capital, £6,000 in £1 shares. To carry on the business of manufacturers of and dealers in electrical appliances, apparatus and fittings, &c. The subscribers (each with one share) are: F. Chase, 195, Archway Road, Highgate, N., engineer; G. H. Freeman, 23, Bedford Row, W.C., solicitor. F. Chase is the first director. Registered office: 195, Archway Road, Highgate, N.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Nairobi Electric Power & Lighting Co., Ltd.—Satisfaction to the extent of £1,000, registered January 10th, 1920, of charges registered September, 1913, and July, 1915.

New Shipston Lighting Co., Ltd.—Debenture for £1,150, registered January 8th, 1920, charged on the company's undertaking and property, present and future, including uncalled capital. Holder: J. R. King, J.P., Honnington Hall, Shipston-on-Stour.

Kidderminster & District Electric Lighting & Traction Co., Ltd.—Satisfaction registered December 31st, 1919, of £42,500, being total issue under charge registered April 10th, 1905.

Oriental Telephone and Electric Co., Ltd.—Satisfaction registered December 16th, 1919, to the extent of £4,100 of charges registered July, 1905, and June, 1907.

Rhondda Tramways Co., Ltd.—Satisfaction registered December 24th, 1919, to the extent of £4,900, of charges registered April 3rd, 1911, November 19th, 1912, and March 19th, 1915.

City of Oxford Electric Tramways, Ltd.—Satisfaction registered December 24th, 1919, to the extent of £1,400, of charge for £46,000 registered February 25th, 1914.

Ingleton Electric Lighting & Power Co., Ltd.—Particulars filed January 1st, 1920, of £1,750 debentures, charged on the company's undertaking and property, present and future, including uncalled capital, amount of present issue being £1,250.

W. A. & R. J. Jacobs, Ltd.—Debenture to secure £3,000, registered December 24th, 1919, charged on land and building, at Edgware Road and Hendon, and the company's undertaking and property, present and future, including uncalled capital, except leases of 94 and 96, Leonard Street, and 53 and 55, Great Eastern Street, London. Holders: L.C.W. & Parr's Bank.

Lancashire Electrical Engineering Co., Ltd.—Mortgage on land and shop, 213, Old Street, Ashton-under-Lyne, Volt Works, &c., registered December 24th, 1919, to secure £600. Holder: W. Bardsley, 13, Canal Street, Hyde.

Lithanode, Ltd. (formerly Longstreths, Ltd.).—Debentures for £3,000, registered January 2nd, 1920, charged on the company's undertaking and property, present and future, including uncalled capital.

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CITY NOTES.

British Columbia Electric Railway Co. Ltd.

Mr. G. P. Norton presided at the annual meeting on February 3rd. He read a statement prepared by the chairman, Mr. R. M. Horne Payne, in which the latter referred to the fact that they met under much more pleasant circumstances than at any meeting since 1913. Not only were they able to recommend modest dividends, but the outlook for the future was encouraging. Trade and industry in British Columbia had prospered satisfactorily since the end of the war, and were now based on stable and permanent conditions. So long as the company received fair treatment they had nothing to fear for the future. The ordinary net revenue was better than in the previous year by £20,993, and there was also an additional £138,419 arising from causes mentioned in the report. It was impossible to say for how long the revenue might be augmented as the result of the rate of exchange for remitting money from Vancouver to London. The bonus of 3 per cent. on the deferred ordinary stock must be looked upon as an entirely exceptional distribution, and not regarded as likely to recur in future years. On the other hand, the improvement in local conditions was such as to justify the belief that the time had returned when they might hope to be able to make an annual distribution of dividend on the deferred ordinary stock. Their hopes in this respect were encouraged by the increase in earnings during the first six months of the current year, which, as compared with the previous year, showed an increase of $382,590. Although increases at this rate might not, and probably would not, be maintained, and a large increase in the wages bill had to be faced, the improvement was encouraging, and they relied on the fact that the Public Utilities Commission was directed by the Act, in fixing any rates, to have regard to providing a fair and reasonable return upon the appraised value of the company's property. The chairman proceeded to refer to the developments that had taken place in connection with fares in Vancouver City. It was expected that there would be some amending legislation passed early next year when the adjourned inquiry and appraisal would no doubt be resumed. Mr. John Davidson, one of the directors, who recently returned from a visit to British Columbia, addressed the meeting at length, and spoke with confidence regarding the state of the undertaking, and regarding the future. The chairman said that if they looked forward 30 years they would probably see Vancouver a great city like Liverpool; their enterprise had great possibilities.

Yorkshire Electric Power Co.

The net profit for the year ended December, 1919, after payment of mortgage and other interest was £54,133 (against £46,536 for 1918 and £33,258 for 1917), plus £10,225 brought forward. The dividend of 6 per cent. per annum on the cumulative preference shares requires £11,403; a dividend of 8 per cent. on the ordinary shares absorbs £20,358; there is put to general reserve (increasing it to £74,000) £15,000, and £17,596 is to be carried forward. Notwithstanding the change from war to peace conditions, the substantial progress made during past years has been maintained. The dividend compares with 7 per cent. for 1918, and 5 per cent. for 1917. In future dividends on the ordinary shares will be paid half-yearly. £96,460 ordinary capital has been subscribed during the year. The directors note with satisfaction the growing practice of power users to invest capital in the company in place of installing small units of power plant in their works for their sole needs. The company's consumers and directors of companies taking supply now hold more than one-fifth of the issued capital. During the year there was a large growth in the revenue on account of energy supplied both to individual power users and to authorised distributors. The continued increase in the cost of coal has emphasised the advantages of the company's supply to power users, and additional generating plant is required to meet the large and increasing demands for current, and the board will shortly bring forward proposals for raising the necessary capital. A commencement of bulk supply has been made to the Spenborough and Elland Urban District Councils, and terms have been agreed with the Corporations of Batley, Dewsbury, Todmorden, and Wakefield, from which a considerable demand will arise. "The company was formed in 1901 for the purpose of producing electricity on a large scale, and unifying supply over a wide area. The Government Electricity (Supply) Act . . . confirms the soundness of this policy. The Act further introduces certain legislative amendments which should facilitate future developments." Annual meeting, February 17th, at Leeds.

Melbourne Electric Supply Co. Ltd.

The report for the year ended August, 1919, now issued, refers to the effect of the strike of seamen in Australia and the shortage of fuel, leading to restrictions in the use of electricity (especially of power) which caused serious reduction in revenue. Gross profit on the Melbourne and Geelong undertakings £180,161, against £161,887 for the previous year, an increase of 11 per cent. After meeting London office expenses and debenture, &c., interest, and sinking funds, &c., £1,134 is written off capital expenditure, £10,000 is put to reserve for income tax and excess profits duty, £20,000 to gold bonds redemption account, and £20,501 to reserve. Dividends of 7 per cent. on the first cumulative preference shares and 10 per cent., free of British income tax, for the year on the ordinary, £50,051 is carried forward. Since the close of the year the directors have issued 20,000 preference shares at par, and are now offering 100,000 ordinary shares of £1 each at 5s. premium to the existing holders of consolidated ordinary stock (one new share for each £5 held). We extract the following figures:—

	Melbourne.		Geelong, inc. trams.	
	Aug., 1918.	Aug., 1919.	Aug. 1918.	Aug. 1919.
Consumers	36,870	42,430	3,148	3,374
Lighting, &c., in KW...	31,740	36,189	2,843	3,082
Motors (rated H.P.) ...	27,640	30,318	2,392	2,415
Total connections, KW.	59,380	66,507	5,235	5,497
Total units sold ...	32,839,227	35,069,000	1,677,700	1,551,042

Increase in consumers, 5,560 (15 per cent.); power supply 30,318 H.P. (increase 10 per cent.); total connections increase, 12 per cent.; total units sold, increase 7 per cent.; gross revenue, increase 6 per cent. Notwithstanding the heavy increase in the cost of labour, fuel, and materials generally, the company was able to avoid making any increase in its charges to consumers during the year.

London Underground Electric Railways.

Underground Electric Railways Co. of London, Ltd.—Interest at 1 per cent., free of tax, on the 6 per cent. income bonds of 1948 for the half-year. £34,000 carried forward. (Last year, 3 per cent.)

London Electric Railway Co.—Final dividend of ⅝ per cent. on the ordinary shares, making 1¼ per cent. for the year; £20,942 carried forward. (Last year 1¼ per cent., making 2 per cent. for the year.)

City & South London Railway Co.—Final dividend of 1 per cent. on the consolidated ordinary stock, making 2 per cent. for the year, the same as last year; £24,367 carried forward.

Central London Railway Co.—Final dividend of 1½ per cent. on the undivided ordinary stock, making 3½ per cent. for the year; final dividend of 2 per cent. on the preferred ordinary stock, making 4 per cent. for the year; dividend of 3 per cent. on the deferred ordinary. Carried forward £11,762. (Last year 4 per cent. on the undivided and 4 per cent. on the deferred.)

Metropolitan District Railway Co.—Final dividend of 1¼ per cent. on the 5 per cent. second preference, making 4 per cent. for the year. Carried forward £22,098.

Yorkshire (West Riding) Electric Tramways Co., Ltd.

Presiding at the annual meeting on Friday last, Sir H. S. Leon referred to the demands of labour and the question of fares. They fully recognised the right of all to demand higher wages in proportion to the rise in prices of articles of necessity, but they had also to recognise the rightfulness of the demand of investors for a fair return on their money. The board claimed that if a statutory wage was to be given there should be an alteration in the statute which fixed fares. It was impossible for such transport systems to work satisfactorily under existing conditions, tied on the one hand by the obsolete and inadequate statutory fare of one penny per mile, and on the other hand being compelled to grant the demands of labour to pay the extortionate prices demanded for the materials which they must have. The Government, regardless of any principle of justice, had until now turned a deaf ear to the owners of transport systems. For nine years no return upon their capital had been received. They were quite justified in demanding that as the cost of providing transport had so enormously increased, they should be given permission for a reasonable increase in the fares. The fare privileges given to the class called "working" should be revised, they were in a great many instances receiving considerably higher wages than many others in trade and business, and a halfpenny per mile was most unfair. The company's only hope was that the Government would in the immediate future deal fairly with the transport industry and permit them to raise their fares reasonably. The company's total revenue for the year increased by £16,518 (11.9 per cent.) to £157,086, but the operating expenses increased by £17,488 (23 per cent.) to £92,172. The wages bill for 1919 was 40 per cent. higher than for 1918, and 188 per cent. higher than for 1914. They would see the effect of a full year's operation of the wages awards of last year during 1920. They had paid the 6 per cent. dividend on the preference shares and purchased funded dividend certificates of £21,047 for £12,837. They had put £14,259 to renewals and depreciation. When the time came for large renewals to be undertaken they would cost more than they had contemplated in the old days, and they must make ample provision for these increased prices. The chairman later said that the manager, Mr. H. England, had had an anxious year, and he was going to have an equally anxious one in 1920. He wished publicly to acknowledge his services.

Costa Rica Electric Light & Traction Co., Ltd.—Year ended June 30th, 1919, net earnings in Costa Rica, after charging all expenses, £14,328, an increase of £3,824. Net deficit for the year £2,549, against £6,646 in the previous year. The gold premium has averaged 315 per cent. during the year, as against 345 per cent. in the previous year, and

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112 per cent. (the normal equivalent of the gold "Colon") in the year (1913-14) before the war. The depreciation of the company's profits caused by the fall in the value of the national currency is shown by the following figures: The net earnings in Colones for the year under review amounted to C.297,305—a record in the operations of the enterprise. At the normal exchange of 112 per cent. premium, or 10.60 to the £ sterling, these colones would have realised £28,047—so that the loss on exchange for the year was no less than £13,719. The interest on the 6 per cent. prior lien bonds has been paid in cash, but the holders of the 5 per cent. debentures received their interest in deferred warrants. Since the end of the financial year there has been a substantial rise in the sterling value of the colon, and should this continue they have every hope of being able to resume payment in cash of the interest on the 5 per cent. debentures on June 30th next.

Metropolitan Railway Co.—Report for the year ended December, 1919. Receipts, £1,712,952; expenditure, £1,279,074. Other receipts, £203,450. Total net income, £637,328, plus £19,211 brought forward. After deducting interest, renewals, appropriation, &c., £316,752; preference dividend, £239,107; and ordinary dividend, 25s. per cent. per annum; £19,864 is to be carried forward; £40,000 is put to general renewals, as against £20,000 in 1918. Though there has been a large increase in traffic, expenses have grown in a much greater ratio by reason of Government concessions to the staff and the higher cost of coal and other commodities. Consequently the amount received from the Government under their guarantee is considerably larger than in 1918. The passenger fares must be raised, and steps are being taken to this end in conjunction with the other London transport companies. Additions to rolling stock and electrical plant have become imperatively necessary, and orders have been placed for new trains and locomotives; negotiations are proceeding for the erection of additional generating plant at the Neasden power house.

Automatic Telephone Manufacturing Co., Ltd.—An explanation of the dividend disappointment in regard to this company has been issued, from which it appears that many of the patents have expired and others have but a comparatively short life, these patents representing £240,000, or 40 per cent. of the capital. Negotiations with an international syndicate have been entered into for the formation of a new concern under the title of International Automatic Electric Co., to acquire the right to carry on business in eleven European countries where the present company has no such right. The new company, it is proposed, shall have a capital of £920,000 in 200,000 7 per cent. cumulative preference, 360,000 ordinary, and 360,000 deferred, all of £1 each. The new preference will be exchangeable for those now in existence, while the whole of the new deferred will go to the syndicate as consideration for provision by the syndicate of additional capital for extensions up to £100,000, and manufacturing orders carrying a fixed percentage of profit from countries outside of United Kingdom to the following minimum amounts: £100,000 in 1920, £150,000 in 1921, and of £200,000 per annum in 1922 to 1927 inclusive. The ordinary and deferred shares will rank equally for further participation in the profits after each class has received 6 per cent.—*Financial Times.*

Tyneside Tramways & Tramroads Co.—The report shows that the surplus of receipts over expenses for 1919 was £7,177, plus £1,758 brought forward. Interest on mortgages, loans, &c., £1,349; 5 per cent. preference dividend, less tax; 5 per cent., less tax, on the ordinary; to reserve for renewals, depreciation, &c., £1,400; carried forward £2,237. For the year the traffic receipts showed an increase of £7,239. Car miles, 650,745 in 1919, against 647,980 in 1918; passengers carried, 11,637,053 in 1919, against 11,778,103 in 1918; total traffic receipts, £59,820 in 1919, against £52,581; gross profit, £14,120 in 1919, against £18,243.

General Electric Co., Ltd.—An extraordinary meeting will be held on February 14th for the purpose of passing resolutions making the 1,655,790 issued preference shares and 144,210 of the unissued preference shares "A" preference shares, and the 1,800,000 preference shares at present unissued 7½ per cent. "B" cumulative preference shares. The capital will then be £6,000,000, divided into 1,800,000 6½ per cent. "A" cumulative preference shares of £1 each, 1,800,000 7½ per cent. "B" cumulative preference shares of £1 each, and 2,400,000 ordinary shares of £1 each.—*Financial Times.*

National Gas Engine Co., Ltd.—Net profit for the year ended December, 1919, after providing for depreciation and allowing for management salaries, excess profits duty, and income tax, £106,387. Interim dividends of 5 per cent. per annum on the preference and 7½ per cent. per annum on the ordinary have been paid, and final dividends at the same rates are now to be paid, both less income tax, together with a bonus of 1s. per share (free of tax) on the ordinary shares. £50,000 is put to reserve fund and £46,174 is to be carried forward.

Globe Telegraph & Trust Co., Ltd.—Final dividend 14s. per share, making 10 per cent. net on the ordinary shares. Existing holders are being offered 60,376 ordinary shares at par in the proportion of one new share for every three now held. The *Financier* states that this issue is to enable the company to take up its proportion of the new issues of the Eastern and Eastern Extension Companies.

Spanish & General Wireless Trust, Ltd.—The "Financial Times" states that for the year ended June, 1919, the profit was £5,500, plus £483 brought forward, making £5,983 to be carried forward. The company will go into voluntary liquidation for selling the whole of the assets for fully-paid shares in a new company with wider powers.

St. James' & Pall Mall Electric Light Co., Ltd.—Balance dividend on the 7 per cent. preference shares for the half-year ending December 31st, 1919, of 3s. 6d. per share, and 8s. 6d. per share on the ordinary shares, making with the interim dividend a total of 12 per cent. for the year.

Vulcanite, Ltd.—Dividend at the rate of 10 per cent. per annum, less tax, and a bonus of 6d. per share, free of tax; bonus of 6d. per share on preference shares, free of tax. The capital is to be increased to £150,000 by the creation of 50,000 new ordinary shares of £1 each.

Stock Exchange Notice.—The Committee has ordered the undermentioned to be officially quoted:—

Vera Cruz Electric Light, Power & Traction, Ltd.—350,000 shares of £1 each, fully paid (Nos. 1 to 350,000).

Central Electric Supply Co.—£22,766 has been transferred to depreciation fund, £400 written off for discount on issue of debenture stock, and £6 is to be carried forward.

Hong-Kong Tramway Co., Ltd.—Final dividend of 1s. 3d. per share, making 2s. for the year 1919. Carried forward, £7,116.

Crossley Brcs., Ltd.—Dividend at the rate of 10 per cent. per annum on the ordinary shares for the half-year, making 8 per cent. for the year.

Frederick Braby & Co., Ltd.—Interim dividend of 5 per cent. on the ordinary shares, less tax.

Fellows Magneto Co., Ltd.—This company is offering for sale 250,000 ordinary shares of 10s. each at 18s. 6d. each.

Underfeed Stoker Co., Ltd.—Interim dividend at the rate of 5 per cent., less tax.

Smithfield Markets Electric Supply Co., Ltd.—Dividend of 2 per cent. on the ordinary shares for 1919. £1,300 carried forward.

STOCKS AND SHARES.

TUESDAY EVENING.

STOCK EXCHANGE markets are in a rather hesitant mood. The King's speech on Tuesday was read favourably, but it is felt that the general position both at home and abroad contains so many elements making for doubt and uncertainty as to cause investors to wait before venturing far into new commitments. The shadow of the Budget is at hand, and is bound to exercise a depressing influence for the next few weeks. This is felt, of course, mainly in the markets concerned with gilt-edged issues. Although it is frequently argued that whatever is bad for fixed-interest stocks must of necessity operate in the opposite direction where more speculative descriptions are concerned, the tide of enterprise in Stock Exchange markets is distinctly checked.

There was sharp disappointment at the dividend declaration of the Underground Electric Railways of London. That the income bonds would get their full 3 per cent. many men did regard as doubtful, but it was not expected that the rate would be dropped to 1 per cent., and, on this being announced, the price of the shares fell 8 points to 76, from which there was a trifling recovery as bolder buyers came in. Jobbing backwards, it is hardly surprising that the company should not have made the best of things, seeing how matters now stand between it and the Government, and some seem to think that in normal circumstances the board might have managed to squeeze out 2 per cent. However that may be, the market for the ordinary and the shilling shares, after being flat, rallied to some extent, and both issues show improvements. London and Suburban and similar shares keep on the dull side. Districts have fallen back to 20.

Business is less active amongst the shares of the home electricity companies, but further rises have occurred in Brompton, Charing Cross, Kensington and St. James, though City ordinary at 13¾ are 5s. down after their rapid and continuous rise. The dividend declarations are being awaited with unusual interest, though the optimists are fortifying themselves against possible disappointment by saying that the industry as a whole cannot be expected to recover to any noticeable extent until the current twelvemonth.

In the manufacturing group, Edisons have gone back to 25s., and British Aluminiums are a few pence lower. Of the telegraph shares, Callender's at 9⅜ shed their gain of last week, but Telegraph Constructions continue on the upward grade, and at 28½ are another £1 to the good. Various preference shares are dull, as the holders sell them in order to exchange into ordinary with greater prospects of advance in capital value. The new issue of the General Electric Company, referred to last week in this column, seems to be generally expected.

One very unpleasant feature of the week is a sharp fall in the price of Automatic Telephones, which slumped from 35s. to 22s. on the directors' decision not to pay any dividend in respect of 1919. The announcement was followed by a long

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circular setting forth that the company has been doing badly since the armistice, and that in its present condition there is little hope of improvement. It is proposed to form a new concern, with power to operate in various foreign countries and to transfer the interests of the Automatic Telephone to the newcomer. The scheme is certainly not conducive to immediate hopefulness for holders who paid higher prices for their shares, and the whole thing has come as a bombshell to those who were looking for improvement in the price, on the idea that the British Government would probably take over the company as a nucleus of a new automatic system for general use.

The cable market is not quite so good. Eastern ordinary at 195 being 5 points and China shares 10s. lower, though the remaining members of this group hold their substantial rises which occurred on the increased dividend announcements. The Globe Telegraph has come into line with a 10 per cent. dividend and new capital proposals. Strength stands out in Marconis, which have risen to 4 3-16 on a return to favour of the Marconi group as a whole. Marines stiffened to 2 13-16 and Americans rose to 30s. 6d., with a fair amount of business doing in all the shares. Another dramatic jump occurred in Bombay Tramways, the price soaring to 128. To the inquisitive, the extraordinary price is almost exasperating. The preference are harder at 15¼. Brazilian Tractions shed a couple of points. An odd anomaly is shown by Anglo-Argentine first preference being lower than the second preference. This may be partly explained by the fact that the seconds carry more arrears of dividend than their seniors.

Cromptons are a good market at 22s. 6d., and Babcocks rose to 3⅜. The armament and kindred groups remain somewhat undecided. Rubber shares are quiet and out of fashion. Revival in South Africans has diverted interest from base metal mining shares.

SHARE LIST OF ELECTRICAL COMPANIES.

Home Electricity Companies.

	Dividend 1917.	Dividend 1918.	Price Feb. 10, 1920.	Rise or fall.	Yield £	Yield s.	Yield p.c.
Brompton Ordinary	10	8	6¼	+ ¼	£6	7	0
Charing Cross Ordinary	4	4	3⅛	+ ⅜	5	6	8
do. do. do 4½ Pref.	4½	4½	2⅜	—	8	8	8
Chelsea	5	5	3⅛	—	4	12	4
City of London	8	8	13⅜	— ½	5	16	4
do. do. 6 per cent. Pref.	6	6	8⅜	—	8	4	8
County of London	7	7	9⅜	+ ⅛	7	3	7
do do 6 per cent. Pref.	6	6	9	—	8	13	4
Kensington Ordinary	7	6	5½	+ ¼	5	14	3
London Electric	Nil	Nil	1⅜				
do. do. 6 per cent. Pref.	5	5	8½	—	8	11	6
Metropolitan	4	5	3⅞	—	6	18	4
do. 4½ per cent. Prof.	4½	4½	2⅞	—	7	16	6
St. James' and Pall Mall	9	10	6⅜	+ ⅛	7	13	10
South London	5	5	2⅜	—	7	12	8
South Metropolitan Pref.	7	7	1	—	7	0	0
Westminster Ordinary	9	8	6	—	7	10	0

Telegraphs and Telephones.

Anglo-Am. Tel. Pref.	6	6	91½	—	6	11	2
do. Def.	1⅛	88/6	21*		7	1	2
Chile Telephone	8	8	6⅜	—	6	5	6
Cuba Sub. Ord.	7	7	10⅛	—	*8	14	4
Eastern Extension	8	8	19⅛	- ½	*5	2	7
Eastern Tel. Ord.	8	8	195	- 5	*6	2	7
Globe Tel. and T. Ord.	7	8	20	—	*4	18	6
do. do. Pref.	6	6	9½	—	6	6	4
Great Northern Tel.	22	22	26½	—	8	6	0
Indo-European	18	18	48⅜	—	6	18	4
Marconi	20	35	4 3/16	+ ⅛	6	0	0
Oriental Telephone Ord.	15	10	9 1/16	— ⅛	4	16	0
United R. Plate Tel.	8	8	8	— ⅛	*5	0	0
West India and Panama	1/8	1/8	1 5/16	—	5	9	6
Western Telegraph	8	8	20½	—	*4	17	7

Home Rails.

Central London Ord. Assented	4	4	58½	—	6	16	9
Metropolitan	1	1½	23	—	5	8	8
do. District	Nil	Nil	20	— ½		Nil	
Underground Electric Ordinary	Nil	Nil	2⅜	+ ⅛		Nil	
do. do. "A"	Nil	Nil	6/-	+6d.		Nil	
do. do. Income	4	5	78	—3		—	

Foreign Trams, &c.

Adelaide Sup. 6 per cent. Pref.	6	6	8⅞	—	7	14	10
Anglo-Arg. Trams. First Pref.	5½	Nil	3⅜	- ½		—	
do. do. 2nd Pref.	—	—	8⅜	—		—	
do. do. 5 Deb.	5	5	64½	—1	7	15	0
Brazil Tractions	—	—	55	—2		—	
Bombay Electric Pref.	6	6	15½	+½	8	17	8
British Columbia Elec. Rly. Pfce.	5	5	64	—	7	15	0
do. do. Preferrred	Nil	2½	57½	—	8	13	10
do. do. Deferred	Nil	Nil	52½	—	5	14	3
do. do. Deb.	4½	4½	64	—	6	15	
Mexico Trams 5 per cent. Bonds	Nil	Nil	46	—		Nil	
do. 6 per cent. Bonds	Nil	Nil	35½	—		Nil	
Mexican Light Common	Nil	Nil	22½	—		Nil	
do. Pref.	Nil	Nil	35	—		Nil	
do. 1st Bonds	Nil	Nil	52½	—		—	

Manufacturing Companies.

Babcock & Wilcox	15	15	3⅜	+ ⅛	*4	2	9
British Aluminium Ord.	10	10	1 3/16	— 1/16	5	16	3
British Insulated Ord.	25	12½	2 1/16	—	5	14	2
Callenders	25	25	3⅜	— ⅛	6	9	10
,, 6½ Pref.	5	6½	4⅜	— ⅛	7	0	6
Castner Kellner	25	20	4	—		—	
Crompton Ord.	7	10	22/6	+1/-	8	17	10
Edison-Swan, "A"	—	10	1½	— 1/16	8	0	0
do. do. 5 per cent. Deb.	4	5	79½	—	6	5	9
Electric Construction	10	10	1½	—	8	0	0
Gen. Elec. Pref.	6	6½	19/6	—	6	18	4
do. Ord.	10	10	41/-	—	*4	15	3
Henley	25	25	2 1/16	—	5	14	2
do. 4½ Pref.	4½	4½	3⅜	— ⅛	6	4	2
India-Rubber	10	10	15½	— ½	*6	9	0
Met.-Vickers Pref.	—	10	3 1/16	+ ⅛	5	0	4
Siemens Ord.	20	20	28½	+1	*4	2	0
Telegraph Con.							

* Dividends paid free of Income Tax.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Tuesday, February 10th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Oxalic	per lb.	1/5	...
a Ammoniac Sal	per ton	£95	...
a Ammonia, Muriate (large crystal)	,,	£75	...
a Bisulphide of Carbon	,,	...	...
a Borax	,,	£42	...
a Copper Sulphate	,,	£51	£3 inc.
a Potash, Chlorate	per lb.	11d.	...
a ,, Perchlorate	,,	1/4	...
a Shellac	per cwt.	£44	...
a Sulphate of Magnesia	per ton	£15	...
a Sulphur, Sublimed Flowers	,,	£28	...
a ,, Lump	,,	£25	...
a Soda, Chlorate	per lb.	6d.	...
a ,, Crystals	per ton	170/-	...
a Sodium Bichromate, casks	per lb.	...	...
METALS, &c.			
g Babbitt's Metal Ingots	per ton	£118 to £345	...
c Brass (rolled metal 2" to 12" basis)	per lb.	1/4	¼d. inc.
c ,, Tubes (solid drawn)	,,	1/7½ to 1/7¾	¼d. inc.
c ,, Wire, basis	,,	1/4¾	¼d. inc.
c Copper Tubes (solid drawn)	,,	1/10	¼d. inc.
g ,, Bars (best selected)	per ton	£171	£4 inc.
g ,, Sheet	,,	£171	£4 inc.
g ,, Rod	,,	£171	£4 inc.
g ,, (Electrolytic) Bars	,,	£132	£7 inc.
d ,, Sheets	,,	£156	...
d ,, ,, Wire Rods	,,	£147	£7 inc.
d ,, ,, H.C. Wire	per lb.	1/6	¼d. inc.
f Ebonite Rod	,,	3/-	...
f ,, Sheet	,,	2/6	...
n German Silver Wire	,,	3/-	3d. inc.
h Gutta-percha, fine	,,	13/-	...
h India-rubber, Para fine	,,	2/7	¼d. dec.
i Iron Pig (Cleveland Warrants)	per ton	Nom.	...
l ,, Wire, galv. No. 8, P.O. qual.	,,	£48 10/-	...
g Lead, English Pig	,,	£50 10/-	55/- inc.
g Mercury	per bot.	£22 10/-	10/- dec.
e Mica (in original cases) small	per lb.	6d. to 4/6	...
e ,, ,, ,, medium	,,	5/- to 10/-	...
e ,, ,, ,, large	,,	12/6 to 25/- & up	...
g Phosphor Bronze, plain castings	,,	1/8 to 2/-	...
g ,, ,, rolled bars and rods	,,	2/2 to 2/6	...
g ,, ,, rolled strip & sheet	,,	2/3 to 2/9	...
d Silicium Bronze Wire	per lb.	1/11¾	¼d. inc.
r Steel, Magnet, in bars	,,	1/7	...
g Tin, Block (English)	per ton	£391 to £392	£4 inc.
n ,, Wire, Nos. 1 to 16	per lb.	5/3	3d. inc.
White Anti friction Metals	per ton	£90 to £345	...

Quotations supplied by—

a G. Boor & Co.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
r W. F. Dennis & Co.

Victoria Falls.—The *Financial Times* recently recorded the results of a survey of the Victoria Falls and an investigation into the possibilities of their employment for the production of electrical energy. The velocity of the Zambesi at the lip of the falls was found to be 700 yards per hour, giving an estimated volume of 704,970 cu. ft. per minute. The maximum available head was stated to be 380 ft. to the level of the tail water; about 10 ft. of this would be deducted for the height of the turbines above the surface of the water. To allow for the rise of the water in the canon during the flood period, the turbines would necessarily have to be constructed at a much greater height, probably 65 ft. above the normal level, thus reducing the head to about 315 ft. Mr. C. W. Carter, the author of this report (furnished by the Rhodesian Munitions and Resources Committee), states that unreliable data previously issued estimated the power possibilities of the falls at about one hundred times more than could be arrived at by actual measurements. As far back as November 24th, 1905, however, the Electrical Review gave a report of the investigations of the African Concession Syndicate, which will be found to agree very closely with the results of this later survey of the position. The syndicate in conjunction with leading Continental and American engineers, computed the available head as being 330 ft., actually less than that now reported. Mr. Carter estimates the electrical equivalent of the power available as 263,000 kw., allowing an efficiency of 85 per cent., and including further losses due to pipe friction, &c. The syndicate stated that a total of 500,000 h.p. could be utilised, which is equivalent to about 300,000 kw.

It will be seen from this that there is not such a great disparity between the present calculations and those of fourteen or fifteen years ago. The falls, however, are still 700 miles from the Rand, and the prospect of spanning that distance with a transmission line seems to be equally remote.

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TRANSFORMERS FOR ELECTRIC FURNACES.

At Manchester, on January 27th, Mr. J. L. Thompson's paper, an abstract of which appeared in our issue of January 30th, was read and discussed before the North-Western Centre of the Institution of Electrical Engineers.

Mr. H. G. Furlong agreed generally with the author's opening remarks, but protested against the comparison which he made between the core and the shell type of transformer. Coils wound in a continuous length were suitable either for the core or circular shell-type transformer. The same machine was capable of winding coils for a rectangular shell-type transformer, and circular turns could be wound in one continuous length; so that the difficulty of the joints was entirely overcome. In the rectangular-shell type there was a greater length of core on which the leakage flux would cut the punching in a parallel direction on the core tapping, but at the same time there was a greater amount of iron in the rectangular-shell than in the core type, so that so far as the losses due to leakage flux were concerned, there was no difference between the two types. Surely the author did not design a core-type transformer for furnace work with H.P. tappings unless they were put in the centre of the winding so as not to interfere with the reinforced turns, or materially affect the balance of load in the L.P. parallel coils. The same arrangement could be made on the core type as on the shell type. The author stated in London that twelve times as many breakdowns occurred in the core type as on the shell type transformer, and that it was, therefore, necessary to make the core-type transformers so that they could be repaired on site. That was a mis-statement so far as the manufacture of transformers generally was concerned. With regard to the tappings, he was in entire agreement with the author. If the tappings could be entirely omitted the transformer would be much more reliable. Boosters or induction regulators could be used for regulating the voltage, and if these broke down the main transformer could still be used for working the furnace as the author suggested. His patent for obtaining half turns was very ingenious, but considerable difficulty would probably be experienced due to the extra length of L.P. lead which was necessary to bring the end of the half turn from the bottom of the transformer through the top of the tank. Also a considerable amount of additional reactance would be caused, and additional losses, due to the half turn encircling the bottom cast-iron base and the top casting. Further, the heavy leads would have to be joined at the bottom of the tank where it was almost impossible to inspect. If these objections could be overcome his patent would make it possible to obtain a very much more economical proportion of material on the shell-type transformer. Furnace lay-outs were usually in the hands of the furnace manufacturers, with the result that there were very few lay-outs (if any) in this country that could not be considerably improved.

Dr. Miles Walker explained that a great deal of trouble had arisen through careless original lay-out, and very often it had been difficult to reduce the reactance to the right amount. In this connection, he believed that many engineers who were dealing with the matter did not fully appreciate the fact that one could reduce the reactance just as well by increasing the diameter of the leads. In actual practice most electric furnaces used about ten times more copper than was needed, because nine-tenths of the copper was not carrying any current at all, or it might even be carrying current in the wrong direction. Increasing the voltage in the transformer was not always possible, on account of the internal conditions of the furnace. Another matter was that the low power-factor on the L.T. side of the furnace was not entirely due to the reactance of the leads. He had made some definite calculations, and was quite convinced that a phenomenon, which might be called delayed resistance, existed.

Mr. J. Frith was surprised that a more intimate connection had not been established between switchgear and transformer designers. Large transformers were at the mercy of the switchgear, and usually the failure of a transformer was—at any rate by its designer—put down to failure of the switchgear control; the paper was a little inadequate in that respect. The effect of the arc might introduce a great difficulty in the design of the transformer; there was very often a double swing in change over of current, in a purely arc furnace.

Mr. A. G. Ellis thought it rather a pity that the paper was more or less confined to one class of (steel) furnace, and almost to one type of transformer. The manufacturers of arc resistance furnace apparatus, and of the electrical gear connected therewith, had had rather a rough run for their money; they had to buy experience sometimes under very strange conditions. Now that the war conditions were over, and they had got behind them most of their troubles, there was a lull in the demand for apparatus, and they could not apply to the extent that they desired the experience they had gained. Even now there were certain points in specifying transformers and electrical equipment for electric furnaces which tended to give the customer a worse piece of apparatus than he would really get if he simply said what he wanted, and left it to the manufacturer to make the apparatus. Some engineers thought they would get a better rated piece of apparatus by specifying the actual current. He put in a plea for the British standard rating, especially with this class of apparatus. If they could get down to a standard rating it would be to the general benefit both of the engineers who installed plant and the manufacturers who made it. He was surprised that the question of core *versus* shell type of transformer had been raised. He thought they had settled that last year. There was really nothing in this controversy; it depended on the views formed from experience and what one had been brought up to. Increasing the power of the furnace was a matter which exercised the furnace-makers very much. To increase the number of phases *ad lib.* was rather dangerous, because the more phases there were the more complicated was the switchgear, and consequently greater liability to break down. The difficulties associated with half-turn design were chiefly mechanical ones. Low pressure leads had given rise to more trouble than anything else.

Mr. R. G. Mercer explained that from experience gained when at the Ministry of Munitions, he very quickly found that the transformer maker—no matter who he was—was the last person, generally speaking, to blame for the failure of transformers in electric steel furnaces. In the first place, the furnace maker was partly to blame, because in those days he traded very largely on the transformer manufacturers' guarantee that the transformer would stand up to 20 per cent. overload for a considerable period of time, and the consequence was that he used the full capacity of the transformer without any thought of temperature rise or the overload which the transformer was subjected to, quite apart from all question of surge. As time went on, it began to be appreciated that the transformer was the most important part of an electric furnace, and its breakdown involved in nearly every case very great delay, whereas a breakdown in any of the auxiliary gear was a matter of small moment. Mr. Thompson had not mentioned anything about present methods whereby surges were very largely limited. They had now an automatic voltage-current regulator which took care of the furnace from the initial cold stage, and some of the furnaces in this country were being converted to the new method, and the rest, in a short time, would begin to follow. The proposal to raise the voltage had disadvantages, and the user would obviously suffer unless he had a carbonaceous atmosphere.

Mr. A. Ratcliffe's views, apart from the question of design, were generally in agreement with the opinions expressed in the paper. It was only right that the supply company should have the power of imposing such restrictions as would ensure that the supply to other consumers would not be interfered with by the operation of furnaces. Presumably any authority which undertook to supply a furnace would be able to deal with 1.6 and 2.3 times the normal load, but he did not think they should be expected to deal with the enormous surges and rushes which occurred. Failure of insulation of switchgear and transformer terminals, &c., might have been due to the heavy auto-transformer effect, but he felt that in many cases it had been due to surges arising from furnace conditions, and that they were more likely under the conditions which arose when transformers were switched into circuit. He had seen evidence of sparks having flashed across distances of 4 or 5 in., and, of course, the results were disastrous. It showed that the strain on switchgear, end turns, and transformer windings was a very real one. Fortunately, experience had shown that in many cases the cure for this state of affairs was the insertion of auxiliary contacts in the switches with charging resistances between the main and the auxiliary contacts, to enable the transformer to push up magnetisation, and avoid the rush when the main contacts came in. It was also possible for these surges to take place in switching out a transformer, which fact could only be put down to some effect due to chattering contacts on the switches, such contact being frequently the cause of surges. External reactances should be fixed as near as possible to the cable head, immediately after the isolating links; otherwise one would simply have, as he had seen in the last fortnight, a current transformer acting as a choke coil. The normal pressure between the terminals of the transformer and earth would be about 3,800 volts. Actually the arc flashed over through a ¼ in. thickness of Empire cloth giving a spark voltage, by estimate, of not less than 100,000 volts, which was conclusive proof that the trouble was not imaginary. It would be minimised to some extent by an increase of the supply pressure. The H.P. cables would, he thought, be capable of absorbing the shocks to some extent.

Mr. F. E. Hill explained that furnace manufacturers wanted to make conditions as easy as possible for the furnace, and did not mind very much about the transformer. It was not possible to reduce the number of tappings. If the L.P. voltage could be raised a little it should be considered, because it cut down the current of the transformer, which was desirable. In connection with rating he had one specification of a furnace transformer for about 2,000 K.V.A., 25 cycles. They specified a temperature on full load of 45 deg. C., a temperature rise of 50 per cent., and overload continuously at 55 deg. C., which would have made the iron loss about 4.6 times the copper losses. Mr. Thompson had only dealt with transformers up to 25,000 volts, but he might have given some consideration to higher voltages. The curves showing K.V.A. ratings against price and weight referred to "nominal

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K.V.A. ratings," which was a very misleading term. The author meant the actual K.V.A., but it would be fairer to call it the rated K.V.A. Furnace transformers, even with equivalent K.V.A., were very much more expensive than power transformers.

Mr. Binns said that failure, when it occurred, was invariably attributed to bad design or careless workmanship on the part of the transformer makers. Sheffield steel manufacturers were very prone to this fault. In some cases the electric furnace had been discarded after several breakdowns due to mishandling, where, if there had been a proper appreciation of the apparatus, it would not have suffered the setbacks which resulted from the testimony of those who failed in its use due to ignorance. He would increase the author's figures referring to locations and operation; a minimum distance when stated as satisfactory by the manufacturers tended to become the maximum when space was being allocated by the user. He could not agree that the core type transformer must of necessity suffer from the defects mentioned by the author, or that the shell type suffered from the disadvantages given as hereditary defects; it was all a question of design. To get out a design which might be quite satisfactory for one class of work and then put it forward as the best for all purposes was wrong. Assuming a 3-phase furnace was to be installed, it was generally better to install a 3-phase transformer; this became all the more necessary as the size increased. For a large furnace (8,000 K.V.A. or upwards) the use of single-phase shell type (incidentally the use of 3-phase shell type was not a practical proposition for this purpose) would increase the difficulties of the installation owing to induction in the leads, to such an extent that they became impracticable also. On the other hand, where single-phase transformers were required, as in single and 2-phase furnaces, the circular shell type had definite advantages. Put briefly, it was not a case of core *v.* shell type, but of a design to suit the particular case, which generally would be obtained in the circular shell with the coil faces vertical and the axis horizontal for single-phase work and in the 3-phase core type, again with the coil faces vertical for 3-phase furnaces. The two largest steel furnaces at present in service in this country were each of 15 tons capacity, using two 1,500-K.V.A. single-phase transformers Scott connected. The furnaces were identical except for periodicity of circuit. No tappings were used in the main transformers except the Scott tappings. The voltage variation in 20-volt steps, from 100 volts to 200 volts, was obtained by use of an auto regulating transformer. Voltage regulation, to which the author gave considerable attention, required very careful consideration. Tappings in the main transformers were to be avoided wherever possible. The three largest carbide furnaces in this country were of the 3-phase type, and were each equipped with 3-phase core-type transformers. As far as possible increase in size of steel furnaces was concerned, the author had not mentioned the use of two arcs in series, by which means the voltage could be raised to about 200 volts. The 15-ton furnaces mentioned were of this type, designed by Mr. Victor Stobie. This method made possible the use of furnaces up to approximately 60 tons with the electrodes at present available. So far as carbide furnaces were concerned, the largest built on the Continent was about 25,000 K.V.A., or roughly three times the capacity of the largest in use here. The author's ideal for a furnace transformer was good, although, except in extreme cases, it was not necessary to introduce the complication of an external reactance.

Mr. G. F. Sills thought that furnace manufacturers in the past had been optimistic about what the current was doing; they had claimed a steady current. It was essential that the transformer should be sound mechanically. He deprecated the use of springs in transformers to hold the main connections together. Furnace transformers should be rated at their maximum continuous capacity, *i.e.*, at which the temperature rise of the oil would go up to its maximum. However, trouble was more likely with the oil than with an ordinary transformer where the load came on at different periods of the day and fluctuated.

Mr. Sonner complained that the paper contained nothing about the efficiency of any of the transformers. He thought that an external reactance would be more desirable, and that the reactance in the transformer should be kept as low as possible on account of the relation between efficiency and cost; the efficiency of the transformer was solely a matter of cost.

Mr. J. L. Thompson, in reply, said he was sorry the question of the core *v.* shell type had been brought up again. He did not mention it in the paper in order not to bring forward any criticism of the two types. He referred to horizontal furnace transformers because it showed a new departure. The core being a laminated structure it would give the rigidity derived from being supported by stanchions. His experience had been mainly on the shell type of transformer. With regard to the losses due to the half turn suggested in the paper, there was bound to be a little extra loss on that half turn on account of its close proximity to the iron core. The reactance due to that small increase could be kept within limits by arranging the positive and negative links of the respective coils in parallel. He was in agreement that the rating of the transformer should be more definite so that they might compare transformers of different manufacture throughout the country and of Continental manufacture also.

WIRELESS DIRECTION FINDING.

By Capt. H. J. ROUND.

(*Abstract of paper read before the* Institution of Electrical Engineers.)

(*Concluded from page* 187.)

When Zeppelins were well at sea, night errors were not usually serious, but aeroplanes nearly always gave trouble. It must be remembered that the aeroplane, being small and having the aerial flying out backwards, does not usually radiate a wave in which the electrical lines are predominantly vertical and the magnetic lines horizontal. If this vertically polarised radiation only were present, a receiving loop at a distance would receive no signals when its plane was at right angles to the direction of the aeroplane. If, however, the aeroplane is at a height and some of the magnetic field of the wave reaches the loop in such a manner that it is partly vertical in one plane and with the lines leaning forward towards the receiver in the other plane (fig. 7), a current will be induced in the loop, and the resultant zero position, if the frame is rotated, will be produced by the sum of the two currents due to this effect and that of the vertically polarised wave. The error produced becomes negative instead of positive if the aeroplane reverses its direction. A horizontal loop will receive from an aeroplane flying at a height, on account of this twisted field. An aeroplane flying towards or away from a station gives no error. All the above were daylight results, but it was suggested by Eckersley that this aeroplane effect was produced at night by the reflection from irregu-

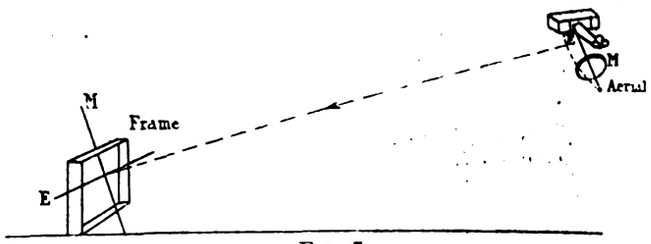


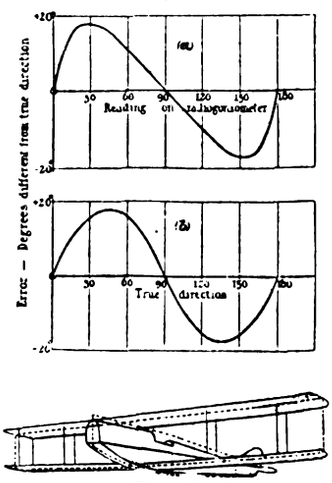
Fig. 7.

larities in the Heaviside layer, and there is good evidence that this theory is true. Again, a horizontal loop receives during night variations, and Eckersley has proved experimentally that the strength on the horizontal loop and the night variation agree with the theory in a remarkable way.

Daylight errors, aside from instrumental ones, were much more difficult to notice. They were seldom as much as the possible errors of the instruments. Apparently it is a bad thing to place stations on the edge of high cliffs, near high trees, or near a wood. One station on the edge of a cliff had an error of an apparently complete rotation through 3 degs. By increasing the distance of the station from the cliff edge from $\frac{1}{8}\lambda$ to 2λ the error was completely removed.

Refraction over a coast line undoubtedly exists, and Eckersley has obtained a fairly accurate estimate of the refractive index of the coasts of Palestine and Cyprus, this being

Fig. 8 (*a*) and (*b*).



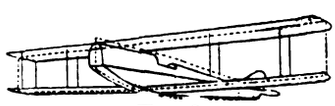


Fig. 9.

checked by a large number of stations. The presence of hills on one side of a station, even some miles away, tends to give bad daylight minima in that direction.

In connection with daylight errors G. M. Wright has been very accurately investigating the more minute instrumental errors which occur, and the probability is that new stations to be erected in the future will much more definitely locate errors of site, daylight variation, and deflections from the normal.

The extent to which direction-finding was trusted by the authorities was really remarkable, and I can instance one case

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where a most important event in the history of the British Navy was brought about by an observed motion of less than 1½ degrees in the daytime. With so many possible errors at night, one gained a false confidence in the beautiful intersections made by using only two stations and only had occasional shocks when the German fleet was found to be well inland. I personally preferred four stations, the last one being a check on the other three.

A system of good rapid land-line communication to a centre was very essential, and our Post Office in England and the Army authorities in France did magnificent work in this direction.

Besides these groups of stations, many single stations were erected, particularly for submarine work, and very valuable results were obtained. I very much doubt whether a signal was ever made by a German submarine without our stations recording the position.

One of our difficulties was rapid searching over long ranges of wave-length. The first real solution of the problem on Bellini-Tosi lines was indicated by G. M. Wright in 1915, who suggested that the aerial tuning condensers should be short-circuited and a closer coupling made between the search coil and the aerial inductances. I revived the method for continuous wave work, and it enabled me to obtain a circuit with only one condenser to tune—a particularly necessary condition with continuous waves as the tuning is so fine. Independent heterodyne circuits were troublesome on direction finders because of the unequal action of the heterodyne on the two aerials. Also the addition of the extra heterodyne condenser reduced the simplicity of the one condenser circuit, therefore, self-heterodyne circuits were adopted. In the first trial of this system at a coast station I noticed again very serious errors and bad minima. This turned out to be the "Vertical" in a greatly exaggerated form, the reason being that, as the frame is now untuned, the component representing the directional receptive power of the aerial has been considerably reduced, and the component representing "Vertical" reception is now of a sufficient relative magnitude to affect materially the observed direction. A simple solution was obtained which was suitable for all waves above 1,000 metres, and consisted in earthing the mid-points of the two direction-finder coils. With only slight modifications of apparatus this remained our standard continuous-wave apparatus during the remainder of the war. This was also the basis of the "aperiodic" spark direction-finder when the cascade amplifiers were produced.

Up to 1917 we had used soft tubes; tubes of a harder character we could not use, as we had erected such a high standard of sensitiveness that in transferring to hard valves we should have lost a lot of useful results. However, Lieut. W. J. Picken succeeded in June, 1916, in getting five high-frequency magnifications on 200 metres by tuned circuits with much harder stable tubes, and he obtained extraordinary magnification.

Latour's ideas had produced a moderately aperiodic amplifier, but the magnification was still short of the best soft-valve arrangements, and the wave-length was still too long, especially for Army purposes. A three-valve cascade amplifier, built with fine wire coils of one layer, gave a result as good as the Latour amplifier, but with the addition of more valves a grid potentiometer became necessary to prevent oscillations. The copper inter-valve windings were now replaced by resistance wire wound to exactly the same dimensions, which wire for all ordinary work consisted of No. 48 "Eureka." The set now allowed of the use of six valves plus a rectifier, with practically no adjustments and a flatness of tuning which was almost all that could be desired. The much more difficult range of 100-300 metres required by the Army was then attacked. Messrs. Edison & Swan offered to draw nickel-chrome wire down to 1 mil in thickness. The resistance of this wire for the same length is about 3½ times that of No. 48 "Eureka." This was very satisfactory, and a very good degree of flatness was obtained with the seven valves over the range of wave-length required. The magnification is not so good as the longer wave sets, but it was a very great improvement on anything hitherto produced. Cascade sets with a range of from 30 to 50 metres can easily be produced if such wave-lengths are ever required. A set of 11 valves has been made of approximately equal sensitiveness from 250 to 10,000 metres.

"Aperiodic" amplification was now all that could be desired, a rather heavy consumption of valves and valve current being the only disadvantages. At one group of naval stations a pair of 7 H.P. charging engines were found necessary, and 130 valves were running continuously. Almost at once, quick-search one-condenser aperiodic direction finders came into use for spark waves.

Direction finders for 200 metres, constructed with 11 or 22 valves in cascade, enabled us to watch with ease certain "buzzer" intercommunicating sets, with no more error than on the longer wave sets. In these 22-valve sets, 11 valves were connected with quasi aperiodic transformers, a loose tuned coupling was then inserted, and another 11-valve set added. In addition, usually one or two low-frequency amplifiers were added at the end. I measured the total high-frequency magnification at about 500,000. High-frequency amplifiers were used for two reasons. First, a self-heterodyning cascade amplifier is, for some not obvious reason, much less subject to microphonic noises than is a single valve; and secondly, the amount of continuous-wave current produced in the aerial by the self-heterodyne is very considerably less in the case of a cascade amplifier than in the case of a single valve. This enables stations quite close to one another to search over overlapping ranges of wave-length without howling at one another.

I cannot say too much for the high standard of all the operators with whom I came into contact. The keenness of the men really made a doubtful art successful. Some of the men showed very great interest in the growth of the subject technically, and many valuable suggestions came from them. Two in particular made for me all the original cascade amplifiers. One general feeling amongst the Naval Intelligence operators is to meet the one operator who controlled the German Zeppelins and warships. They always imagined he was one particular man who was a super-operator. On several occasions with nine or ten Zeppelins in a raid, all frantically trying to communicate with home for bearings or otherwise, wireless occasionally got into a horrible tangle. At that moment the super-man would arrive, take control, and in a twinkling all would be peace and order.

With regard to atmospherics, during daytime, on one or two occasions, the positions of thunderstorms were approximately determined and checked, but this was not often possible. At night time, particularly in spring and autumn, X's exhibited very frequently—in fact most of the time in England—a sharp direction which varied a little round the position of 165 deg. E. of N. The minimum is often extremely sharp, exactly like a well-defined station. It was suggested that this direction was curiously near the magnetic meridian. We were able to use this direction of X's for interception purposes, as it was fortunately almost at right angles to the direction of the Heligoland Bight. Signals on a vertical aerial, absolutely inaudible owing to X's, were clear without X's in a frame roughly placed at 75 deg. E. of N.

Quite early in the war several ships of His Majesty's Navy were fitted with direction-finding apparatus. Commander Dorling, of H.M.S. *Warspite*, succeeded in obtaining an error curve (fig. 8*a*). The crowding of all the readings towards the 0 deg. and 180 deg. directions, *i.e.*, fore and aft, was very troublesome for taking readings, and we modified the Bellini-Tosi system to correct these errors, which amounted in other cases to as much as 30 deg.

Only since the Armistice have I had an opportunity of trying direction finders on aeroplanes. The four-engine Handley-Page, which went to Newfoundland, was fitted with an extemporised Bellini-Tosi, using an aerial system exactly as on board ship. One aerial was lengthwise round the wings, and the other lengthwise round the fuselage (fig. 9). A correction which was made on the ground was found to hold good when the plane was in the air. An eight-valve long-wave amplifier set gave very satisfactory signals. Magneto noises which were extremely bad were overcome by shielding the magneto leads and, what was more important still, by shielding the complete receiver system with the exception of the aerials. When the engines were running all out, almost complete silence could be obtained. This set was used effectively in the flight from St. John's to the United States, during which flight directions were taken on Clifden. Similar machines have been fitted since, and the same satisfactory results obtained.

I believe the chief use made of the corrected Bellini-Tosi system for ships was in convoy work, but previously the Tenth Cruiser Squadron and other ships had used it during cruising. All this later work on ships was done with Wright's inductive loop or "aperiodic" aerial, and Wright has during the last year developed an extremely small and practical ship direction-finder for use with this type of corrected frame. It is intended to apply the necessary corrections on every ship, with periodical examinations of the corrections when the ship is in port, exactly as a ship's compass is treated.

One advantage a warship has over most merchantmen is that there is fitted a gyro compass with repeater compasses, one of which can be near the direction-finder. If no gyro compass is fitted, the exact direction of the ship is extremely difficult to get simultaneously with the reading taken on the radiogoniometer, especially if the ship is turning or yawing. A useful addition to a ship's direction-finder would be a magnetic compass repeater.

Fig. 8*a*, which is approximately the original error curve of the *Warspite*, was obtained on a Bellini-Tosi system consisting of two frames each placed at 45 deg. to the fore and aft line of the ship. In the first form the shape of the curve was rather puzzling, because the error was plotted against the readings. On replotting the errors against the true directions (fig. 8*b*), the curve became a sine curve.

The Irish Peat Industry.—It has been calculated that the peat fuel supply available in Ireland is equal to about 2,000,000,000 tons of coal. One of the drawbacks to the industry—apart from the several inherent ones—is the fact that the peats must be cut by spade, one at a time, which is slow and laborious work. Recently attempts have been made to invent peat-cutting machines, which would greatly speed up production and lessen cost and bring the industry within the limits of profitable commerce. It is understood that these attempts have taken tangible form, and that at least one peat-cutting machine is now in operation.

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CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Scientific Management.

I was much interested in reading the discussion on Capt. Scott Maxwell's paper to note the remarks of a late employer of mine, who complained of lack of humanity in scientific management.

All I can say is that after being on a variety of jobs in this country and Canada, I never came across a place where less humanity was displayed by the management than in the factory for which this gentleman is responsible.

It makes me sick to see men like this trying to obstruct a system which would give the workman who wants to really work a square deal.

Humanity is the one thing above all others that Taylor stood for. He believed in what Edison calls "human engineering," and he did not believe in the "lump of labour idea which seems to be taken as true by employers and employés alike in this country.

There is a right job for every man, and it is up to the employers to fit the man to the job, and also so to organise industry as to eliminate unemployment.

Scientist.

February 4th, 1920.

The Rate of Exchange.

For weeks past the rate of exchange in New York and Montreal has been moving against us; to-day the pound is worth between 13s. 8d. and 14s. in New York. Such rates mean the continuation of high food prices in this country, as so much of it is imported from "The West," and that does not brighten our outlook.

But in Great Britain it ought to bring considerable possibilities within the grasp of the manufacturer for the expansion of his trade and for getting a secure foothold in a market which may have been hitherto closed to him. British prices quoted in dollars and cents in the United States and Canada should compare very favourably with prices for similar goods manufactured over there.

It is only a reiteration of the present day war cry of "Production" to say the more we can sell on an adverse exchange the sooner will we return to normal conditions.

M. B. Macdonald.

Edinburgh,
February 6th, 1920.

Petrol and Electricity.

With reference to your statement in the leaderette "Petrol and Electricity" that the cost of energy for propelling a railless trolley-car is about 1¼d. per mile, may I point out that this is on an average road with an average drawbar pull of 60 lb. per ton.

On flat steel tracks (such as should have been laid in our streets any time since 1894) this would fall to 10-12 lb. per ton and the cost to ¼d. They would also be available for every vehicle.

Abolish tramways, relegate horses to by-ways and agricultural districts, and make roads that are imperative for successful motor traction and the (so called) "Traffic Problem" disappears.

Ernest G. Pink.

Ashford, Kent, *February 5th*, 1920.

University Training.

Once again in your "Situations vacant" columns appears a "class bar" advert. It states, "must have university degree or equivalent." So much for democracy in the U.K. The advertisement in question relates to a position as laboratory assistant in connection with high-tension magneto testing, practical experience on magnetos essential. Why then these bars, these obstacles to the ambitious manual worker? It would appear that the advertiser is class prejudiced, or is no student of psychology. Having had practical workshop experience, combined with technical study, either from Polytechnic institutes, or correspondence schools, practical experiments in model making, years of close application to a study of mathematics, physics, &c.; given a natural talent for scientific investigation and ability, either inherent or acquired, to draft plans and originate new devices, may not a "hand" aspire to become a "head"? A man may be penalised by lack of a classical education, according to such stipulations, and all his careful preparations for advancement may be nullified. If England is going to hold any place among the leading industrial nations she must encourage those who have acquired qualities and character to fit them for a vocation. The successful business man of to-day and the future must be a psycho-analyst; one able to put aside notions of birth and biased opinions as to the benefits derived from employing university graduates. Swank and bluff go a long way in some instances in the U.S.A., but there, more attention is paid to a scientific selection of applicants, and if the employé shows ability, he can climb to higher positions, but here—Oh ——!

G. W. Roffe.

London, N.W.
February 7th, 1920.

[Whilst sympathising with our correspondent, we must demur to his conclusions on several grounds. First, he gratuitously assumes that the demand for a "university degree or equivalent" is a "class bar," and undemocratic; this idea is very much out of date. Scientific training is indispensable to the efficiency of the skilled technical electrician in such a position as the one in question, and it will be noted that it need not involve training at a university—the "equivalent" can be obtained at a technical college, as our correspondent himself suggests. Secondly, the advertisement contains no reference to a "classical education"; has he never heard of the degree of Bachelor of Science? Thirdly, Mr. Roffe compares this country with the United States, where, as a matter of fact, the college training is vastly more generally acquired and recognised than it is here. One of the great lessons of the war was that we must follow the examples of the United States and Germany in employing technically trained men in our works. Here, as there, the highest posts in the engineering profession are open to men from the ranks, and it would be easy for us to cite several instances of such advancement. We recommend our correspondent to read the advertisement again with more care and discernment, and to forward his application for the post at once.—EDS. ELEC. REV.]

Projector Lamps.

A friend has been inquiring of me about a high-efficiency incandescent lamp that has been recommended to him for use in a projector lantern, giving about 2,000 C.P., the filament being no more than ½ in. long and suitable for the voltage usual in the larger South American towns. If any of your readers have ever come across such a lamp will they kindly furnish me with details of it and the name of the manufacturer. The ordinary half-watt lamp of that candle power for 220 volts is too large to get into the lantern, and, of course, with such a length of filament much of the light would be wasted. I have suggested the use of a "Pointolite" lamp, of which you gave details not long ago, but we are intent on learning more about the other lamp.

Norwich, *February 9th*, 1920.

William Roe.

Electrolytic Meters.

With regard to Mr. C. W. Marshall's article on cheap house service meters, the statement that electrolytic meters "are not used to any great extent" is rather sweeping, considering that two prominent makers of that type of meter cannot cope with present orders. As your correspondent rightly states, a cheap meter is wanted, but I am of the opinion that 5 amperes is rather a large size, seeing that the maximum lighting demand of the average house does not exceed 2 amperes, and is likely to be less when the half-watt lamp is further developed. A 5-ampere meter demands heavier moving parts and consequently more friction, thus making it difficult to bring in the lower loads, to say nothing of increasing the cost.

I think that however much the cost of a motor meter may be reduced it will never be able to compete in price with the electrolytic meter, and if the disadvantages of refilling and resetting in the latter type can be successfully overcome, there is no doubt that the electrolytic meter will have a sale equal to, if not greater than, that of the motor type, always assuming that the price is right.

H. W. M.

February 9th, 1920.

With reference to the article on "Cheap House Service Meters" by Mr. C. W. Marshall, appearing in the ELECTRICAL REVIEW of the 6th inst., it would give the impression to readers that the use of the electrolytic meter for direct current is on the decrease. As far as we are aware this is not the case; our experience is just the reverse, and points to the fact that the use of electrolytic meters—of our make at any rate—is very much on the increase.

The extreme accuracy of the Bastian meter, together with its simplicity and low price, all tend to this end, and is a great inducement to engineers to continue the use of meters for registration, rather than resort to a system of charging which does not involve the use of meters at all for small consumers; and in fact a very great number are supplied by us specially for installing in small houses.

The Bastian Meter Co., Ltd.
ALBERT E. SALISBURY, *Managing Director.*
London, N.W., *February 10th*, 1920.

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ELECTRICAL IMPORTS AND EXPORTS OF JAPAN.

The following statement shows the import and export trade of Japan in 1918 in electrical and similar goods. For purposes of comparison, figures for 1917 have been added, together with a note of increases or decreases.

IMPORTS.

Country whence imported	1917 Yen	1918 Yen	Inc. or dec. Yen
Posts and materials for electric lines.—			
United States	9,000	16,000	+ 7,000
Insulated electric wire.—			
United States	47,000	70,000	+ 23,000
Steam turbines.—			
United States	164,000	275,000	+ 111,000
Gas Engines, petroleum engines, and hot-air engines.—			
United Kingdom	29,000	—	- 29,000
Germany	1,000	—	- 1,000
Sweden	48,000	15,000	- 33,000
United States	180,000	480,000	+ 300,000
Asiatic Russia	4,000	5,000	+ 1,000
Kwantung Province	—	5,000	+ 5,000
Other countries	1,000	—	- 1,000
Total	263,000	505,000	+ 242,000
Steam engines.—			
United Kingdom	205,000	22,000	- 183,000
United States	88,000	416,000	+ 328,000
Kwantung Province	—	13,000	+ 13,000
France	42,000	—	- 42,000
Germany	42,000	3,000	- 39,000
Total	399,000	463,000	+ 64,000
Steam boilers and parts.—			
China	100,000	—	- 100,000
Kwantung Province	29,000	116,000	+ 87,000
Asiatic Russia	6,000	1,000	- 5,000
Philippine Islands	—	2,000	+ 2,000
United Kingdom	1,000,000	1,285,000	+ 195,000
Norway	—	19,000	+ 19,000
Russia	—	50,000	+ 50,000
United States	1,377,000	6,015,000	+4,638,000
Other countries	110,000	47,000	- 63,000
Total	2,712,000	7,535,000	+4,823,000
Dynamos, motors, transformers, &c.—			
Kwantung Province	—	17,000	+ 17,000
United Kingdom	49,000	38,000	- 11,000
Germany	2,000	—	- 2,000
United States	1,077,000	2,976,000	+1,899,000
Other countries	2,000	30,000	+ 28,000
Total	1,130,000	3,061,000	+1,931,000
Telegraphic and telephonic instruments and parts.—			
United Kingdom	7,000	1,000	- 6,000
France	1,000	1,000	—
Denmark	3,000	14,000	+ 11,000
United States	50,000	75,000	+ 25,000
Total	61,000	91,000	+ 30,000
Water turbines and Pelton wheels.—			
United Kingdom	23,000	—	- 23,000
France	—	13,000	+ 13,000
Switzerland	133,000	32,000	- 101,000
Sweden	136,000	4,000	- 132,000
United States	14,000	33,000	+ 19,000
Total	306,000	82,000	- 224,000
Incandescent electric lamps.—			
United Kingdom	2,000	4,000	+ 2,000
United States	12,000	39,000	+ 27,000
Other countries	1,000	1,000	—
Total	15,000	44,000	+ 29,000
Watt meters.—			
United Kingdom	42,000	23,000	- 19,000
Switzerland	252,000	201,000	- 51,000
United States	185,000	236,000	+ 51,000
Other countries	1,000	—	- 1,000
Total	480,000	460,000	- 20,000
Ammeters and voltmeters.—			
United Kingdom	2,000	1,000	- 1,000
Switzerland	1,000	—	- 1,000
United States	164,000	217,000	+ 53,000
Total	167,000	218,000	+ 51,000
Accumulators.—			
United Kingdom	21,000	—	- 21,000
Germany	—	4,000	+ 4,000
United States	15,000	22,000	+ 7,000
Total	36,000	26,000	- 10,000
Filaments for incandescent lamps.—			
United Kingdom	118,000	107,000	- 11,000
France	33,000	7,000	- 26,000
Switzerland	1,000	—	- 1,000
Sweden	23,000	3,000	- 20,000
United States	240,000	202,000	- 38,000
Total	416,000	320,000	- 96,000
Carbon for electric use.—			
United Kingdom	13,000	20,000	+ 7,000
France	—	3,000	+ 3,000
United States	210,000	251,000	+ 41,000
Other countries	3,000	1,000	- 2,000
Total	226,000	275,000	+ 49,000

EXPORTS.

Country to which exported	1917 Yen	1918 Yen	Inc. or dec. Yen
Electrical machinery and parts thereof.—			
China	698,000	1,005,000	+ 307,000
Kwantung Province	757,000	1,513,000	+ 756,000
Hong Kong	42,000	62,000	+ 20,000
British India	330,000	207,000	- 123,000
British S.S.	27,000	53,000	+ 26,000
Dutch India	46,000	275,000	+ 229,000
French Indo-China	1,000	11,000	+ 10,000
Asiatic Russia	241,000	13,000	- 228,000
Philippine Islands	20,000	34,000	+ 14,000
Siam	5,000	16,000	+ 11,000
United Kingdom	84,000	33,000	- 51,000
France	—	245,000	+ 245,000
Italy	9,000	—	- 9,000
Switzerland	9,000	—	- 9,000
United States	8,000	2,000	- 6,000
Canada	12,000	10,000	- 2,000
Chili	2,000	20,000	+ 18,000
Argentine	—	20,000	+ 20,000
Egypt	—	28,000	+ 28,000
Cape Colony and Natal	39,000	83,000	+ 44,000
Australia	148,000	296,000	+ 148,000
New Zealand	12,000	53,000	+ 41,000
Other countries	3,000	5,000	+ 2,000
Total	2,493,000	3,984,000	+1,491,000
Telephones and parts thereof.—			
China	203,000	182,000	- 21,000
Kwantung Province	67,000	172,000	+ 105,000
Hong Kong	—	4,000	+ 4,000
British India	3,000	4,000	+ 1,000
Dutch India	1,000	42,000	+ 41,000
Asiatic Russia	131,000	12,000	- 119,000
Philippine Islands	—	1,000	+ 1,000
Russia	22,000	—	- 22,000
United States	1,000	—	- 1,000
New Zealand	—	1,000	+ 1,000
Other countries	2,000	3,000	+ 1,000
Total	430,000	421,000	- 9,000
Electric insulated wire.—			
China	1,129,000	1,312,000	+ 183,000
Kwantung Province	566,000	622,000	+ 56,000
Hong Kong	139,000	173,000	+ 34,000
British India	464,000	1,349,000	+ 885,000
British S.S.	45,000	119,000	+ 74,000
Dutch India	165,000	1,025,000	+ 860,000
French Indo-China	17,000	40,000	+ 23,000
Asiatic Russia	159,000	70,000	- 89,000
Philippine Islands	—	44,000	+ 44,000
Siam	60,000	44,000	- 16,000
Other Asiatic countries	2,000	—	- 2,000
United Kingdom	4,000	63,000	+ 59,000
France	—	10,000	+ 10,000
United States	—	7,000	+ 7,000
Peru	—	13,000	+ 13,000
Chili	10,000	86,000	+ 76,000
Argentine	8,000	305,000	+ 297,000
Egypt	—	107,000	+ 107,000
Cape Colony and Natal	78,000	214,000	+ 136,000
Australia	169,000	2,485,000	+2,316,000
New Zealand	103,000	231,000	+ 128,000
Other countries	1,000	5,000	+ 4,000
Total	3,119,000	8,324,000	+5,205,000

Yen = 2s. 0½d.

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	1917	1918	Inc. or dec.
Electric lamps.—	Yen	Yen	Yen
China	376,000	482,000	+ 106,000
Kwantung Province ...	167,000	242,000	+ 75,000
Hong Kong	69,000	157,000	+ 88,000
British India	239,000	267,000	+ 22,000
British S.S.	16,000	25,000	+ 9,000
Dutch India	56,000	108,000	+ 52,000
French Indo-China ...	13,000	31,000	+ 18,000
Asiatic Russia	1,243,000	37,000	− 1,206,000
Siam	9,000	51,000	+ 42,000
United Kingdom	33,000	143,000	+ 110,000
France	6,000	135,000	+ 129,000
Italy	—	61,000	+ 61,000
United States	230,000	53,000	− 177,000
Canada	296,000	239,000	− 57,000
Other North American countries	—	5,000	+ 5,000
Peru	2,000	18,000	+ 16,000
Chile	2,000	15,000	+ 13,000
Argentine	2,000	17,000	+ 15,000
Brazil	—	1,000	+ 1,000
Other South American countries	—	3,000	+ 3,000
Egypt	4,000	55,000	+ 51,000
Cape Colony and Natal ...	3,000	28,000	+ 25,000
Other African countries ...	4,000	—	− 4,000
Australia	71,000	379,000	+ 308,000
New Zealand	1,000	11,000	+ 10,000
Hawaii	—	3,000	+ 3,000
Philippine Islands ...	5,000	7,000	+ 2,000
Other countries	—	3,000	+ 3,000
Total	2,847,000	2,570,000	− 277,000

NEW PATENTS APPLIED FOR 1920.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by MESSRS. SEFTON-JONES, O'DELL AND STEPHENS (successors to W. P. Thompson & Co., of London), Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

2,346. "Mechanical ignition device for petrol, &c., engines." M. LING-BEVINGTON. January 26th.

2,348. "Electrically-heated irons." V. SUMMERHAYES. January 26th.

2,354. "Electric switch of the tumbler type." S. E. FOSTER. January 26th.

2,356. "Electric relays for protective and operating gear." A. E. MOORE. January 26th.

2,372. "Electrical resistance furnaces." H. ETCHELLS and H. A. GREAVES. January 26th.

2,378. "Electrically-heated irons." H. CHESHIRE and CRANMER & CHESHIRE. January 26th.

2,382. "Directive radio-telegraph or telephone receiving systems." F. J. CHAMBERS. January 26th.

2,383. "Means for rendering electric light switches, lampholders, &c., visible in dark." W. EMMERSON. January 26th.

2,398. "Sparking plugs." H. E. HOLLOWAY. January 26th.

2,402. "Combined reflector shade and lamp-lock for electric lamps." H. R. WATSON. January 26th.

2,424. "Shades for incandescent electric lamps." G. E. OSMOND. January 26th.

2,434. "Sparking appliances for ignition of internal-combustion engines." OTTO-WERKE GES. January 26th. (Germany, April 27th, 1918.)

2,440. "Telephone switchboards." S. FISHER. January 26th.

2,445. "Magneto starters." J. F. ADYE. January 26th.

2,461. "Electric pocket lamps." E. BLONDY. January 27th. (France, February 20th, 1919.)

2,465. "Obtaining multiphase currents." A. M. TAYLOR. January 27th.

2,472. "Process for manufacture of electric incandescent lamps." S. O. COWPER-COLES. January 27th.

2,492. "Machine to obtain continuous currents without commutator, &c." J. E. SALTHOUSE. January 27th.

2,504. "Protective arrangement for electric distribution systems." J. R. BEARD and ELECTRICAL IMPROVEMENTS, LTD. January 27th.

2,518. "Ignition of internal-combustion engines." E. LANZEROTTI-SPINA, and THOMAS TRANSMISSION, LTD., and K. J. THOMSON. January 27th.

2,521. "Electrical heater." D. LYON. January 27th.

2,525. "Magnet coils." SIEMENS-SCHUCKERTWERKE. January 27th. (Germany, October 19th, 1918.)

2,528. "Electric foot and food warmer." L. A. EDWARDS. January 27th.

2,542. "Protective devices." BRITISH THOMSON-HOUSTON CO. (General Electric Co., U.S.A.) January 27th.

2,592. "Commutating assembling devices." TOLEDO STANDARD COMMUTATOR CO. January 27th. (United States, March 3rd, 1917.)

2,608. "Electric lamp fitted with shade or reflector." C. WEST. January 28th.

2,635. "Shield for sparking plugs." J. E. BARROWS. January 28th.

2,636. "Incandescent electric lamps." CROWTHER & OSBORN, H. J. OSBORN, and W. J. PATTISON. January 28th.

2,655. "Electric burglar-detainer." F. W. WASSELL. January 28th.

2,657. "Suspension of electrodes in electric furnaces." NORSKE AKTIESELSKAB FOR ELEKTROKEMISK INDUSTRI NORSK INDUSTRI-HYPOTEKBANK. January 28th. (Norway, January 28th, 1919.)

2,666. "Fittings for holding incandescent electric lamps, &c." W. H. BAYLEY, G. A. TAYLOR and J. T. TAYLOR. January 28th.

2,687. "Wireless telegraphy and telephony." E. HOUGHTON and PORTHOLME AIRCRAFT CO. January 28th.

2,688. "Electric resistances." BRITISH THOMSON-HOUSTON CO. (General Electric Co., U.S.A.) January 28th.

2,703. "Continuous electrical mechanical filter." A. F. MESTON. January 28th.

2,710. "Electro-deposition of metals on iron and alloys of iron." R. J. FLETCHER. January 28th.

2,712. "Magneto-electric ignition apparatus for internal-combustion engines." AMERICAN BOSCH MAGNETO CORPORATION. January 28th. (United States, April 8th, 1919.)

2,724. "Electric switches." IGRANIC ELECTRIC CO. (Cutler-Hammer Manufacturing Co.) January 28th.

2,726. "Means for securing field magnets of dynamo-electric machines." A. KETTLEWELL and C. H. VIDAL. January 28th.

2,730. "Connecting devices for electrical apparatus, &c." A. J. CATTLE and C. J. THORNEWILL. January 28th.

2,740. "Sparking plugs." J. E. BARROWS. January 29th.

2,772. "Thief-proof magneto cut-out." B. GOODYEAR. January 29th.

2,781. "Speed-control arrangements for dynamo-electric machinery." SIEMENS-SCHUCKERTWERKE. January 29th. (Germany, July 3rd, 1917.)

2,814. "Short-circuiting device for electric ignition apparatus." O. IMRAY. (Bosch Akt. Ges.) January 29th.

2,815. "Electric starting devices for internal-combustion engines." O. IMRAY. (Bosch Akt. Ges.) January 29th.

2,816. "Sockets or caps for incandescent electric lamps." H. H. BERRY. January 29th.

2,818. "Detachable ceiling fixture for electric pendants, &c." F. T. CASH. January 29th.

2,822. "Electric transformers." F. E. BERRY. January 29th.

2,824. "Electro-mechanical attachments for indicating vacant seats in theatres, &c." E. G. PYNE and H. D. PYNE. January 29th.

2,835. "Cleaning, adjusting and testing apparatus for sparking plugs." T. CHALK. January 29th.

2,839. "Electrical resistance control." L. HULBERT. January 29th.

2,848. "Sparking plugs." GILARDONI FILS ET CIE. January 29th. (France, October 4th, 1919.)

2,850. "Intercommunication, &c., telephones." W. STOTT and TELEPHONE MANUFACTURING CO. January 29th.

2,858. "Distribution on single-phase and two-phase alternating current systems." A. M. TAYLOR. January 27th.

2,889. "Frictional electrical machines." J. H. COWEN. January 30th.

2,901. "Conduits, &c." W. P. THOMPSON (Compagnie Generale de Telegraphie et de Telephonie). January 30th.

2,902. "Excitation of oscillating circuits." R. B. GOLDSCHMIDT. January 30th. (Belgium, November 18th, 1913.)

2,919. "Electric switches." G. COMBONI. January 30th. (Italy, February 8th, 1919.)

2,943. "Magneto platforms for internal-combustion engines." G. M. L. GRIFFITH and GRIFFITH & CHARNOCK. January 30th.

2,956. "Dynamo-electric machines." BRITISH THOMSON-HOUSTON CO. and A. A. POLLOCK. January 30th.

2,957. "Electrical systems of power transmission and regenerative braking." BRITISH THOMSON-HOUSTON CO. (General Electric Co., U.S.A.). January 30th.

2,971. "Electro-magnetic control arrangements." C. MAIER. January 30th. (Switzerland, February 8th, 1919.)

2,983. "Combined electric lamps and condensers for kinematograph projectors." L. HENSHAW and J. W. HINKS. January 31st.

3,000. "Transmission by high-frequency currents." L. N. BRILLOUIN. January 31st. (France, January 31st, 1919.)

3,001. "Windings for dynamo-electric machines." J. W. HOWARD and SIEMENS BROS. DYNAMO WORKS. January 31st.

3,053. "Recording sound transmitted telephonically." A. F. SYKES. January 31st.

3,068-9. "Wireless transmitters." W. T. DITCHAM. January 31st.

3,070. "Insulation of electrical conductors." W. T. HENLEY'S TELEGRAPH WORKS CO. and M. ROBERTS. January 31st.

3,073. "Electric switches." L. TRABET. January 31st. (France, September 16th, 1919.)

3,076. "Electric lamps for use in presence of explosive gases." G. M. MEYER. January 31st.

3,077. "Connectors for electrically-heated apparatus." K. W. JOHANSSON. January 31st. (Sweden, February 24th, 1919.)

3,078. "Electrical connectors." K. W. JOHANSSON. January 31st. (Sweden, November 7th, 1919.)

3,081. "Cooling arrangements for electrical machinery." SIEMENS-SCHUCKERTWERKE. January 31st. (Germany, October 7th, 1918.)

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1918.

21,269. ELECTRIC BELL OR BUZZER. C. W. H. Honor. June 4th, 1918. (137,349.)

21,568. ELECTRIC LAMPS OR TORCHES. J. Burri. October 8th.' (133,662.)

21,653. AUTOMATIC TEMPERATURE CONTROL FOR ELECTRIC IRONS. S. L. Goldsbrough. December 24th, 1918. (137,352.)

1919.

694. TELEPHONE CIRCUITS. B. S. Cohen. January 9th, 1919. (137,367.)

913. SPARK PLUGS. W. W. Bugh. January 13th, 1919. (137,372.)

1,811. AUTOMATIC TELEPHONE SYSTEMS. Automatic Telephone Manufacturing Co. and P. T. Bates. January 24th, 1919. (137,390.)

4,188. ELECTRICAL SWITCHES. J. H. Thorne. February 20th, 1919. (137,410.)

4,955. TROLLEY FOR ELECTRIC TRAMWAYS. G. Odierno. February 27th, 1919. (137,417.)

4,990. ELECTRICAL PUSH SWITCHES FOR MINES OR OTHER GASEOUS PLACES. A. H. Marsh. February 28th, 1919. (137,418.)

6,743. ELECTRIC ARC-INCANDESCENT LAMPS. A. Garbarini. July 3rd, 1918. (129,259.)

7,148. ELECTRIC SIGNALLING CONTROLLED BY MECHANICAL VIBRATIONS. J. Gardener. March 22nd, 1919. (137,433.)

7,336. ELECTRIC LAMPS. L. S. Vello. March 23rd, 1918. (124,756.)

7,799. TROLLEY HEADS FOR ELECTRIC TRAMCARS AND OTHER VEHICLES. H. R. Tidswell and S. K. Kirkland. March 28th, 1919. (137,437.)

8,877. ELECTRIC SIGNALLING APPARATUS FOR CARS ON ELECTRIC AND OTHER RAILWAYS. H. Schaub and C. Kunzli. April 23rd, 1919. (125,948.)

14,842. ROTARY RECTIFIER OF ALTERNATING CURRENT. A. D. Macropoulos. June 12th, 1919. (137,477.)

17,534. ELECTRIC CUT-OUTS. A. H. Railing, C. C. Garrard and W. Wilson. February 26th, 1919. (137,489.)

20,877. ELECTRIC LIGHTING APPARATUS FOR CYCLES AND MOTOR CYCLES. C. von der Weld. September 19th, 1918. (132,782.)

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THE

ELECTRICAL REVIEW.

VOL. LXXXVI. FEBRUARY 20, 1920. No. 2,204.

ELECTRICAL REVIEW.

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RAILWAY ELECTRIFICATION.

ACCORDING to recent reports, the necessity for immediate action to relieve the congestion on suburban railways has reached an acute stage. At the general meeting of the London, Brighton, and South Coast Railway Co. last week, the chairman stated that during the peak load the density of traffic on the railway between London and Croydon, and the number of trains entering and leaving the London termini, were so great that it was not possible to "squeeze in" even a single additional train, and the only hope of amendment lay in the extension of electrification; the relief afforded by the quicker working of electric trains was such that if they could electrify the whole of their suburban services they would be able greatly to improve the travelling facilities. *The Government was considering the problem.* Again, at the meeting of the Lancashire and Yorkshire Railway Co. on the same day, the chairman said the directors were satisfied with the results obtained on all the sections already converted to electric traction, and wished to extend the system to the line between Manchester and Oldham, Shaw, and Royton; but, again, *the matter was in the hands of the Government*, and until it was known what policy the Government would adopt with regard to the future of the railways, it was impossible to incur large expenditures—unless the Government provided the capital. Practically the same condition obtains in connection with the Great Eastern, South-Eastern, and other railways in urgent need of electrification.

The responsibility rests upon the Minister of Transport. Emphatic statements have been repeatedly made regarding the intention of the Government to embark upon large schemes of electrification of the railways, and the blessings to be derived from unified control; yet here we have various railways each capable of putting in hand such schemes, but blocked by the indecision and inertia of the very department which made such glowing promises. There is no need for the Ministry to undertake the design of railway schemes—let it delegate to the railway companies, which possess the staff and experience required, the duty of preparing the designs and carrying out the work. We do not wish to see the old conditions revived under which a consulting engineer felt it to be his duty to design the dynamos when he was called upon to advise on an electricity supply scheme—it is for the central authority to deal with the fundamental conditions and the results to be aimed at, not to busy itself with details, and there is no necessity for long deliberation over well-established principles.

Whatever the ultimate policy of the Government with regard to the railways may be, electrification is bound to come. Let the Government, therefore, guarantee the capital and allow the railway companies to go ahead with the work.

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The Cost of Living and Trade.

It is stated, this week, that the cost of living advanced a further 5 per cent. during January, and there is reason to believe that while the rate of exchange in America continues unsatisfactory and the world competition to secure supplies of food and raw materials causes selling prices to advance, yet higher figures will be reached. Under the terms of the settlement with the railwaymen, they will automatically receive, on the cost-of-living basis, some millions a-year more. Almost inevitably, demands from other bodies will follow, preventing industry from reaching that state of stability which is so urgently necessary. Organised labour is not conspicuous for moderation; if it were, it would avoid agitations for ever-shorter hours until industry had had time to adapt itself to altered conditions. The House of Commons will shortly consider the question of a 48-hour week, while outside deliberations are proceeding for a still shorter week. The question now is how far one can go without seriously reducing output and increasing the cost of production.

Few matters are of more extreme importance, both now and for the almost immediate future, when we shall need all the trade that we can get, than the strength of our industrial position. At present that position is being weakened, and some of the most well-disposed employers are becoming weary of being in business, because of its overwhelming anxieties, and want to get out. We regard the claims of the workers most sympathetically, as our readers are aware, and we are anxious to see justice done to all—labour, black-coated staff man, and capitalist; but it needs to be shouted from the house-tops that there is danger ahead unless we pay regard to the national industrial good and refrain from the pursuit of mere selfish interest. "Betterment" for one section of the community may mean more acute distress for another. We have before us a New Zealand newspaper in which, in considering the electrical engineering and plumbing trades, a writer, after showing that New Zealand is now manufacturing in large quantities goods that were solely imported from Britain and other countries before the war, remarks: "The increased wages paid to the mechanic in the Old Country and the moderate tariff at present in existence, are factors which have enabled the Dominion manufacturers to enter into competition with the imported lines." We have not a word to say against British Colonial manufacturing, but it is high time that everybody recognised that there is a point where higher wages means reduced demand, unless the cost per article can be reduced by increased production. If we drive trade elsewhere, whether it be to the Colonies or to foreign countries, we shall be guilty of worse than folly, for we shall be laying up distress for others besides ourselves.

Trade Tours.

The Department of Overseas Trade has issued a small booklet giving a great deal of information respecting the touring exhibitions of British manufactures, which are probably to be organised by the Department. It is proposed that the exhibitions shall proceed to the Dominions, to South America, to the Far East, and to the U.S.A. For firms wishing to avail themselves of the opportunity thus afforded it should be possible to run for two years for about 200 guineas for a full unit of approximately 10 ft. frontage, and 120 guineas for half a unit. Facilities will also be offered for combined exhibits, either through trade associations or in groups. In order that the organisation may be completed at the earliest possible date, exhibitors should indicate what their requirements are likely to be. They should do this at the D.O.T. offices at the Fairs which open at London, Glasgow, and Birmingham next week. As the Dominions Tour must start at an early date, we would urge our readers to arrive at a decision as quickly as possible. Arrangements will be made for special kinema films showing processes of manufacture to be displayed in a number of towns just prior to the arrival of the exhibition, so that public interest may be stimulated in advance. The Department is now considering the establishment of showrooms at certain Continental centres in connection with the Commercial Secretariats or Consular offices. These will be available for a series of smaller exhibitions of from 25 to 35 exhibitors, which will succeed each other at intervals of one month, or less. If manufacturers and traders will get into touch with the Department, it will be possible to gauge the probable amount of support that will be forthcoming. We hope that the whole subject of these official exhibitions will receive immediate attention from those whose duty it is to decide the policy of participation.

Three-Phase Power.

The article which we published in our last issue, on the power plant of the Austin Motor Co., is of special interest, in that it is an example of the supersession of direct current by three-phase, and the subsequent extension of the latter on a vastly greater scale. As we have previously pointed out, we in this country are far too much wedded to the use of direct current, and this practice has distinctly handicapped us in the development of the electrical industry, not only at home, but also in our export trade. Unless we adopt the most up-to-date practice at home, we cannot be in a position to compete with it abroad. It will be noticed that a frequency of 50 cycles has been found preferable to 25, that there are over 500 motors in use, mostly squirrel-cage, and that the crane motors are of the slip-ring type, with resistance regulation. Only for charging the handy battery trucks is direct current required.

The experience of the Works Engineer's Department of the Company, first with the D.C. and subsequently with the A.C. system, has enabled a thoroughly practical comparison of the two methods to be made in relation to factory driving and lighting. This experience has told entirely in favour of the A.C. system. The chief difficulty with the D.C. generators and motors is the commutator and brush gear, which may be quite satisfactory so long as the machines work under steady conditions, not overloaded; but with irregular loads and overloading, which are bound to occur in any works of considerable size where extensions and alterations are of daily occurrence, and the electrical equipment cannot be immediately adapted to suit the purpose in hand, trouble with commutators and brushes sparking becomes insistent, involving labour charges and shut-downs, with loss of output. A.C. induction motors meet these conditions much better, and tide over the difficult times until a permanent arrangement can be made, with less trouble than D.C. motors. Under the best conditions the A.C. motors have the advantage of simpler wiring, no shunt or series field connections to be sorted out, cheaper prime cost, and more robust construction. All the speed variation required is easily obtainable by alteration of the pulley ratios, the motor being run under the ideal condition of constant speed. The only points requiring attention are keeping the motor clean by blowing out with compressed air once a week, or at other periods, according to the surrounding conditions and the lubrication. Though over 500 A.C. motors are in use day and night in this factory, under all sorts of conditions, about one breakdown per week or 10 days, and that not a serious one, represents the casualty list. The method employed is to standardise so far as possible, adopting a few sizes only, and keeping a reasonable number of spares, so that on the slightest failure the motor affected is taken down, and within a few minutes another is put in its place with a minimum of delay. Another point in favour of alternating current is that full advantage can be taken of medium pressure up to 550 or 600 volts for economical transmission, for use directly on the motors, lighting at low pressure being supplied through highly efficient transformers at suitable places. This is done very satisfactorily with delta primary and star secondary, with 110 volts phase to neutral, meeting every requirement of the factory. The average power factor obtained is between 0·80 and 0·85 for the whole system.

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THE ELECTRICITY COMMISSIONERS.

The Minister of Transport has appointed Sir John F. C. Snell, M.Inst.C.E., to be chairman of the Electricity Commissioners, and Mr. H. Booth, O.B.E., of the Board of Trade, Mr. W. W. Lackie, C.B.E., M.Inst.C.E., M.I.E.E., and Mr. Archibald Page, M.I.E.E., to be Commissioners. All communications for the Commissioners should be addressed to The Secretary, Electricity Commissioners, Gwydyr House, Whitehall.

Photo by] [Romney.

W. W. Lackie.

Sir John F. C. Snell is a past President of the Institution of Electrical Engineers and a Member of Council of the Institution of Civil Engineers. He was formerly in practice as a consulting engineer in Westminster, as senior partner of Messrs. Preece, Cardew, Snell & Rider, and has been borough electrical and tramways engineer at Sunderland.

Mr. H. Booth, O.B.E., Principal Clerk in the Board of Trade, was a member of the Electric Power Supply Committee.

Mr. W. W. Lackie, C.B.E., joined the Electricity Department of the Glasgow Corporation in 1892, and was appointed chief engineer in 1904, and manager-engineer in 1915. He is a past president of the Incorporated Municipal Electrical Association, and the West of Scotland Institution of Engineers and Shipbuilders, and has been chairman of the Scottish Centre of the Institution of Electrical Engineers.

Mr. Archibald Page, who has resigned the general managership of the Clyde Valley Electrical Power Co. to become an Electricity Commissioner, joined the staff of the Glasgow Corporation Electricity Department in 1899, and occupied the position of deputy city electrical engineer from 1905 until 1917, when he became associated with the Clyde Valley Power Co. Mr. Page is a past chairman of the Scottish Centre of the Institution of Electrical Engineers.

The foregoing announcement will be welcomed by the electrical industry, which has waited long enough, in all conscience, for it; let us call to mind that it was in April, 1916, that Mr. Ernest T. Williams expounded to the Institution of Electrical Engineers his scheme for the complete reorganisation of electricity supply in this country—nearly four years ago! Let our readers turn back to Mr. Williams's scheme, as we have done, and they will be astonished at the close resemblance between his original conceptions and the provisions of the Electricity Supply Act of 1919, as regards not only the fundamental principles involved, but also the methods of putting them in force.

The fulfilment of that far-sighted scheme has been entrusted to the four men named above, with one other not yet appointed. That the Board of Commissioners thus formed will meet with the approval and command the confidence of the electrical industry we fully believe; every one of them is well known to the industry, and each has an admirable record of experience and achievement in his own branch of work to justify his selection. We have but one criticism to offer—one that, we are certain, will be endorsed by many of our readers—namely, that the name of Mr. S. L. Pearce is not included in the list.

Mr. Pearce, for many years, has stood at the head of the municipal electrical engineers of this country; he has presided over the fortunes of the largest undertaking of its kind with an efficiency and competence which need no emphasis from us; he has also played a leading part in the problem of National Electricity Supply, having presided over the Committee of Lancashire and Cheshire Engineers whose admirable reports exerted so great an influence on the course of events—particularly the second, which largely foreshadowed that of the Williamson Committee itself.

Surprised at the omission of his name from the list of Commissioners, we immediately inquired of Mr. Pearce the reason, and he informs us that "no invitation to join the Board of Commissioners was extended" to him. We are absolutely at a loss to understand the circumstance, which appears to us inexplicable. However, in his brief reply to our inquiries, Mr. Pearce says that "it is up to us now to all pull together and support the chosen Commissioners in

Photo by] [Gilfillan

Arch. Page.

the great work that lies before them," and with that generous sentiment we cordially agree. We trust that their labours will be fruitful, and crowned with a full measure of success; they have an exceedingly difficult and delicate task to accomplish, calling for the highest qualities of strength, wisdom, and discretion; and we hope that all electrical men will endeavour to smooth their way, and thus unite in promoting the national welfare.

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ELECTRICITY IN SMALL DWELLINGS.

The extensive schemes which are being prepared to alleviate the present housing shortage afford an unprecedented opportunity to the electrical industry in general. Now, undoubtedly, is the time to press for the installation of electrical wiring and fittings while dwellings are in process of construction. Much of the reluctance to install electricity in existing buildings is due to the anticipation of the expense likely to be incurred in cutting away for wires and conduits, and the subsequent restoration. This trouble however, would be entirely eliminated if builders, or those responsible for building, were far-sighted enough to arrange for the use of electricity in the same way as gas is at present provided for. They might even go so far as to provide for electricity alone, in which case the resultant saving in brickwork—fireplaces, flues, and chimney stacks—would more than compensate for the expense incurred. The superiority of electricity over gas for domestic purposes cannot be overlooked, and its growing ascendency should receive attention in all schemes of reconstruction.

Where space has to be cut down to a minimum, the air is given a higher value by the employment of electricity,

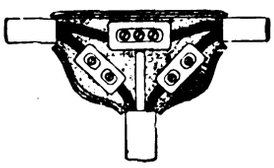

Fig. 1.—"Henley" Joint Box.

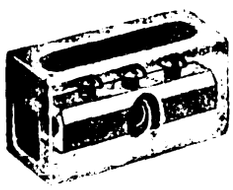

Fig. 2.—"Henley" Connector.

which does not vitiate the atmosphere in the very least. Electricity is clean and smokeless, ensuring a much longer period of service for interior decorations and fixtures. There being no actual combustion on the premises, the risk of fire is greatly reduced, and also, as previously remarked, if cooking and heating are done electrically, fireplaces and flues become unnecessary.

If a tenant takes a house and finds it already fitted with most of the requisites for lighting and cooking electrically, he will almost certainly elect to use them, as it will mean little or no expense to himself, while the advantages are obvious. On the other hand, he will hesitate to install electricity on his own responsibility, as, should he wish to vacate the house, the wiring, erected at his expense, becomes the property of the landlord, and has to remain where it is, and in his new dwelling he may have to start all over again.

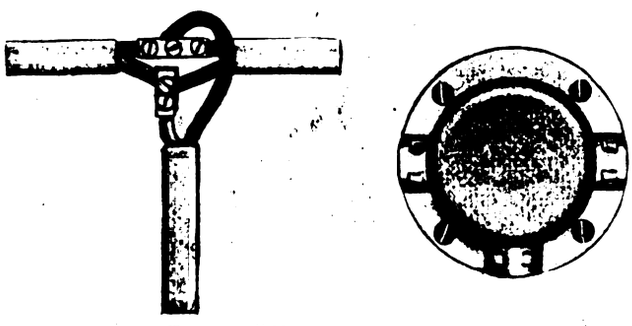

Fig. 3.—"Henley" Tee Box.

One of the first considerations to occupy the attention of builders and prospective consumers is the system of wiring to be adopted. The three points to be studied are cheapness, effectiveness, and sightliness. The conduit system, although effective and possessing many advantages, is generally out of the question in small buildings, where the low rental will not recoup the outlay involved. Wiring in wood casing is at the present time even more expensive, and so it becomes necessary to look for a good open or "surface" system. The method of wiring with porcelain cleats at intervals can be made very effective and unobtrusive, but there is always a tendency for the leads to separate, slacken, and sag down, thus becoming very unsightly. There are, however, several modern systems devised to avoid these defects; of these the "Henley," "Kaleeco," and "Stannos" are probably the best known. The main idea of such systems is, of course, to comply with the three requirements referred to above, and chief attention is paid to the external or visible features of the installation. If the leads from the mains can be installed while a building is being erected, little trouble is encountered, as all cutting-away of the fabric is obviated.

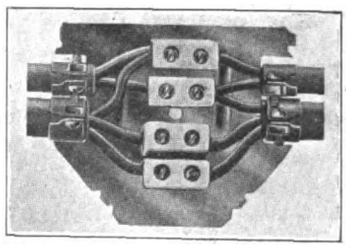

Fig. 4.—"Kaleeco" Joint Box.

Wires run in a roof may be fixed with porcelain cleats, and where they are brought in at right angles to a joist, the latter should be drilled with two holes about an inch apart, through which the wires are threaded. If run parallel with a joist in the ceiling or roof, they can again be fixed with cleats.

The wires in the "Henley" system are made up in pairs and sheathed with metal, which takes the place of a conduit

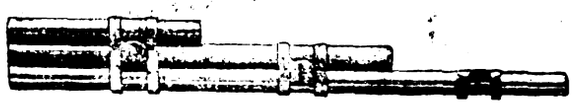

Fig. 5.—"Stannos" Wiring and Clips.

or other external protection. Wires running together are retained in position and clamped by means of small clips, which prevent sagging. Where leads are exposed, they may be painted the same colour as the wall or background to render them inconspicuous. Jointing is effected by means of small porcelain and brass connectors enclosed in small joint boxes (figs. 1, 2 and 3). Branches are taken off by means of small tee boxes of tinned brass.

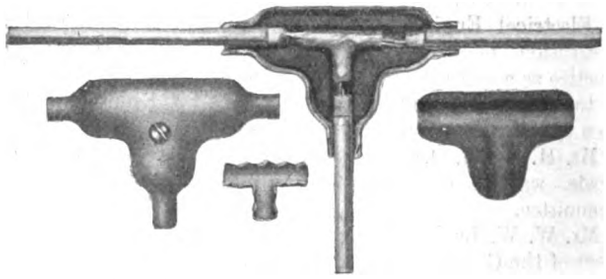

Fig. 6.—"Stannos" Water-Tight Joint Boxes.

"Open" wiring can also be effected by means of the "Kaleeco" system, in which sheathed conductors are employed. Single wires are circular in shape, while multi-core cables are of flat section. The distinguishing feature of the "Kaleeco" wiring system is the method of jointing. The joint boxes consist of two parts, backplate and cover of tinned brass. The backplate can be slotted to take any arrangement of wires, and the slotting produces tongues which are fixed to the wires by means of bonding clamps (fig. 4) and tightened by bolts and nuts.

The backplate is fixed in position and the joints are made with porcelain-sheathed connectors. Lugs are provided on this plate which fit into slots cut in the cover, and are bent over, thereby obviating the use of fixing screws or bolts to hold the two parts together. Wires covered in silk or glace cotton in various colours are supplied, in order that external wires may harmonise with their surroundings.

The "Stannos" system is another effective form of open wiring—similar in many respects to the "Henley" system. The wires employed are of the metal-sheathed type, which

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can be used either for two-wire work, or by the utilisation of the copper sheath as a conductor, for concentric systems. Metal clips are used for retaining the wires in position (fig. 5), and a protective steel covering (fig. 8) can be used in positions where exposed wires would be liable to be damaged. The small joint-boxes employed in the "Stannos" system consist of a soft metal base and cover, two porcelain linings, and a soft metal channel connector (fig. 6).

The original mode of distribution was to tap off the mains for each house, which meant great expense in the provision of suitable underground junction boxes. The cheapest way of supplying a block of houses is to make one tapping only from the street mains, and then run leads along the front (or back) of the row of houses, taking off a branch at each dwelling or pair of dwellings. These branches can be made secure and weatherproof at a mere fraction of the cost of separate underground joints.

Figs. 7 and 9 show this principle carried out by Messrs. Siemens Bros., the originators of the "Stannos" system. The houses are served by leads entering above the front doorway, and the outside cables are very unobtrusive.

Fig. 7.—"Stannos" Service Main.

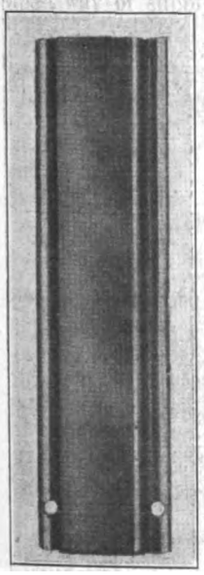

Fig. 8.—Protective Covering for Wires.

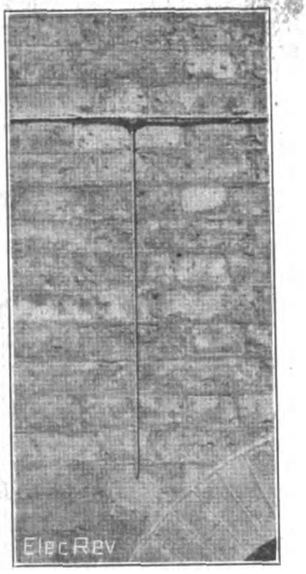

Fig. 9.—"Stannos" Service Branch.

Many methods of payment for electrical energy in the case of small houses are in vogue; probably the best system is that adopted by the Fixed-Price Light Co. This company's system was described in the Electrical Review of May 15th, 1914, and has proved so effective that little or no modification of the original scheme has been found necessary. The company carries out complete installations and charges a weekly amount for each lamp installed, varying with the candle-power. All replacements are made by the consumer. The meter system employed by many supply authorities is expensive both in first cost and in maintenance, and for this reason is gradually giving place to the more economical method of flat-rate payment. To guard against excessive consumption in houses receiving a supply on the "fixed-price" system, current limiters are usually installed, which act when more than a certain number of lamps are in use in any one dwelling. The recently inaugurated Wolverhampton scheme is run on these lines. Meters of the 1d. and 1s. prepayment type are frequently placed in houses, and although a charge has to be made for their maintenance, there is no doubt that many consumers prefer this method of payment by degrees.

In conclusion, as an example of completely electrical dwellings, we would draw attention to the experiment carried out at Glasgow. Two houses were fitted with electrical heating and cooking apparatus, lighting, and household appliances. The cost for a year's running was £32 in one case, and £35 in the other, and the occupants expressed great satisfaction with the scheme, and gave electrical methods preference over the usual domestic routine.

Faraday Works War Fund.—A general meeting of the subscribers to Faraday Works (Gent & Co., Ltd.) War Fund was held on the 2nd inst. at Leicester. The chair was taken by Mr. I. H. Parsons, supported by Messrs. Waddington and Skinner. Mr. Parsons briefly reviewed the organisation and history of the fund. In the early days of the war the employés made weekly collections in aid of the Prince of Wales's Fund, and in April, 1915, it was agreed to devote future funds to cases of need among the firm's employés with H.M. Forces. Parcels were sent according to a properly established plan during three or four years, and a sum was handed to each man on his return. Money grants were also made to widows and other relatives of fallen men. From time to time contributions were forwarded by the committee to a number of charitable organisations. The Treasurer reported that although the weekly collections had ceased, he had a balance in hand of £109. It was decided by the meeting that part of this should be distributed among relatives of fallen men, the balance to be spent in entertaining all returned men at a dinner and social evening. The firm had expressed a wish to erect a permanent roll of honour to record the part which its employés had taken in the war. It had been decided to fix a marble tablet outside the works bearing the names of fallen men, and to erect a roll of honour inside the works. The employés have expressed a wish to subscribe part of the cost, and this has been agreed to. The committee has now been made a standing one, as Gents' Social Committee. The Secretary (Mr. W. E. Dunt) would be glad to receive the present addresses of any men who joined up when in the firm's employ, but who may now be in other employment.

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EXTENSIONS AT STUART STREET GENERATING STATION, MANCHESTER.

The latest extensions at the Stuart Street station of the Manchester Corporation electricity department comprise, as already briefly reported in our pages, a 25,000-kw. turbo-alternator, together with condensing plant and cooling towers, and four large water-tube boilers with economisers. It has been necessary to remove a portion of the original plant which was installed in 1902—namely three 1,500-kw. alternators driven by vertical reciprocating engines, and twelve 12,000-lb. per hour water-tube boilers, to make room for the new turbo-alternator, condenser, and boilers respectively. Considerable structural alterations were necessary in the boiler house. The old roof had to be removed and steelwork erected to carry the new economisers and to support the existing bunkers.

The four new boilers, shown in fig. 1, are of Messrs. Babcock & Wilcox's marine type, fitted with superheaters and Green economisers. The boilers normally evaporate 91,000 lb. per hour, but have a continuous overload rating of 104,000 lb. of water per hour from, and at, 212° F. The working pressure is 225 lb. per sq. in., and the superheat 275° F. The boilers have a total heating surface of 14,000 sq. ft. and the superheaters 5,145 sq. ft., the grate surface being 416 sq. ft. The main steam drum is 4 ft. 6 in. in diameter, 37 ft. long, and weighs 12 tons. There are 56 sections of tubes per boiler, each section having 12 tubes 17 ft. long. Each boiler has four chain grates driven by Brampton chains from the stoker shafting, which is placed in the ash passage. This shafting is driven through reduction gearing by one A.C. and two D.C. motors, one of these motors being always used as a stand-by to the other two. Forced and induced-draught plant is fitted to each boiler, there being four 45-in. diameter forced-draught fans, each direct-driven by a 36-B.H.P. motor at 360 R.P.M. They are capable of maintaining a pressure of 0·5 in. W.G. under the grates, and will deliver sufficient air for the combustion of coal at the rate of 36 to 40 lb. per sq. ft. of grate surface per hour.

Two of the boilers have each one 60-in. diameter induced-draught fan, direct driven by a 70-B.H.P. motor at 360 R.P.M. These fans draw the gases from the economisers, and discharge into 7 ft. 6 in. diameter steel chimneys, which have a height of 93 ft. above the grates. The fans are capable of maintaining a draught of 2 in. water gauge at the economiser outlets. The other two boilers have one 85-in. diameter fan, which discharges the gases into an existing brick chimney. The motor for this fan, which is chain-driven, is of 155 B.H.P. The speed of the motor can be regulated by rheostatic control from 585 to 450 R.P.M.

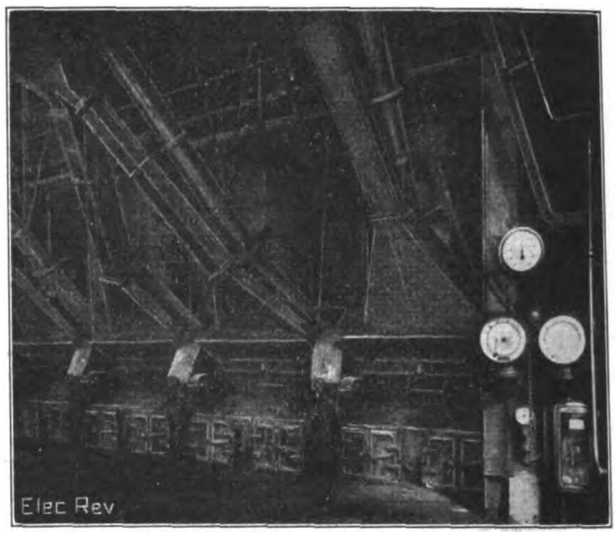

Fig. 1.—B. & W. 91,000-lb. Water-Tube Boilers.

Suitable dampers are provided for isolating each economiser. Each boiler has two economisers installed above it, each economiser having 256 tubes and a heating surface of 3,697 sq. ft. The gases enter the economisers at a temperature of 560° F., and are discharged at a temperature of 375° F., the temperature of the feed water being raised 100° F. The overall efficiency of the boiler, superheater and economiser is 82 per cent. when burning "slack."

Some modifications have been made to the coal chutes, &c., and the fuel now used consists of coke breeze and coal, and is fed on to the grates on the "sandwich" system—

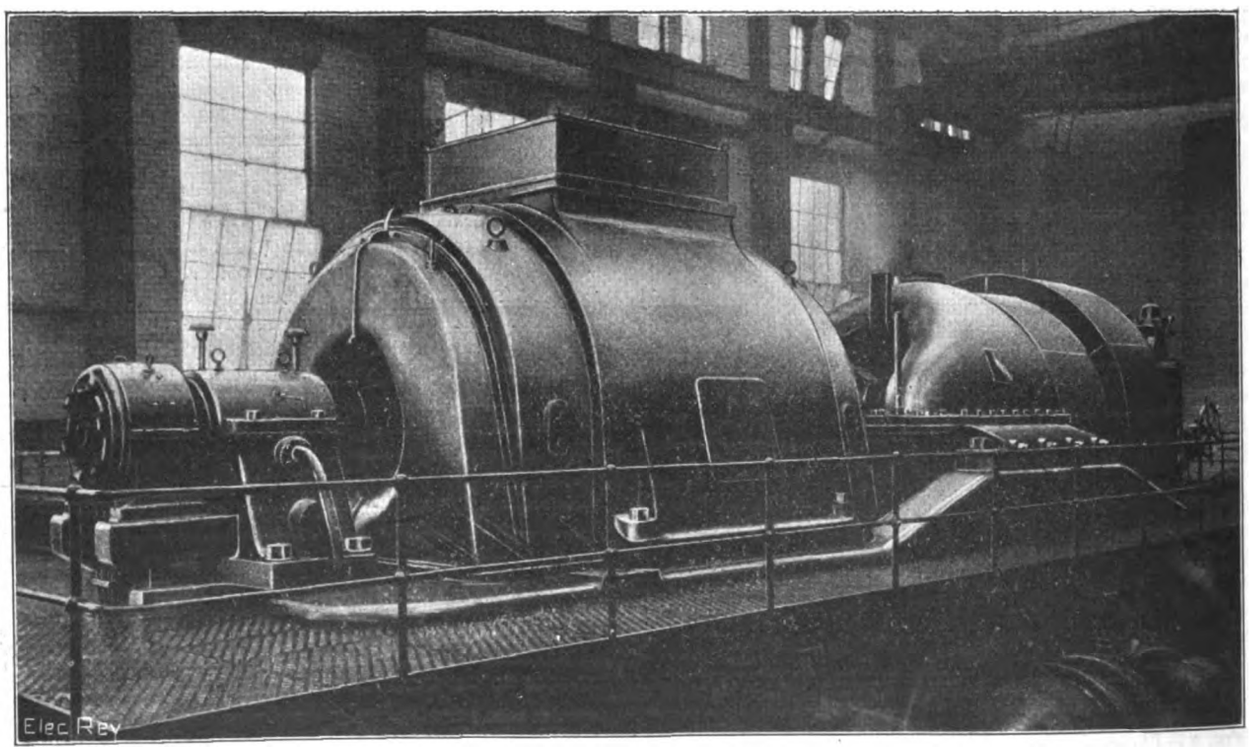

Fig. 2.—Alternator End of Metropolitan-Vickers 25,000-kw. Turbo-Alternator.

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that is, a layer of coal on top of a layer of coke. An additional coal elevator and a conveyor of the push-bar type, having a capacity of 60 tons per hour, have been supplied by Messrs. Jenkins, Ltd., of Retford.

The new feed pump was supplied by Messrs. Weir and Co., of Cathcart, and is capable of delivering 25,000 G.P.H. when running at a speed of 5,000 R.P.M. It is of the single-stage type, direct driven by an impulse steam turbine, fitted with a ratio governor of the differential-

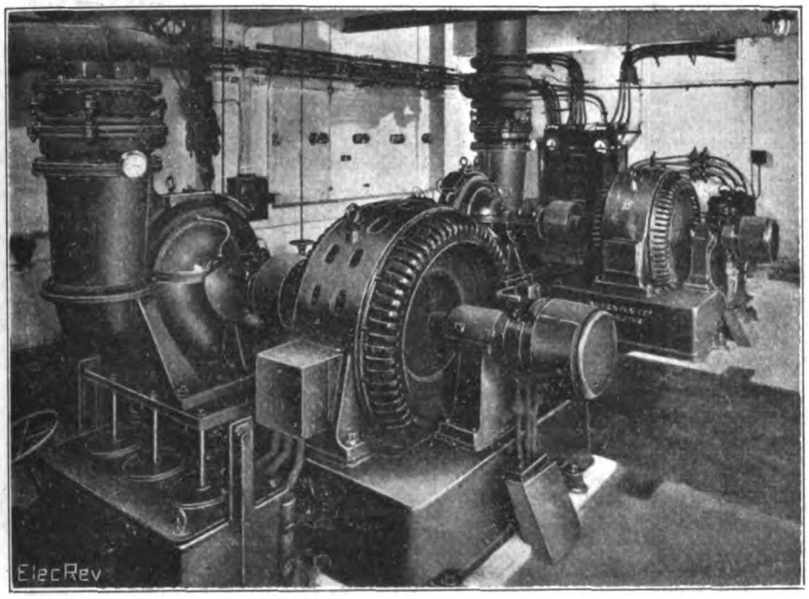

Fig. 3.—Mather & Platt Circulating Pumps.

piston type, also an overspeed governor. The exhaust steam is discharged through a nozzle into the hotwell tank, and is used to heat the feed water.

Messrs. Richardsons, Westgarth & Co., of West Hartlepool, were the main contractors for the turbo-alternator and condensing plant. The contract for the three-phase alternator, fig. 2, which has a maximum rating of 25,000 KW., at 0·85 power factor, 6,600 volts, 50 cycles, was sub-let to the British Westinghouse Co., now Metro-

cast-steel concentric pipe inside the turbine casing. The high-temperature steam, therefore, does not come into direct contact with the casing. The main governor operates the throttle valves by means of oil relays; hand-operated nozzle valves are also fitted to the turbine. The over-speed and emergency governor is of the centrifugal spring-loaded type, fitted to the shaft, and is set to operate at 10 per cent. overspeed; levers are also fitted to this governor, so that it may be operated by hand in case of emergency. Two oil pumps are driven by gearing from the end of the shaft in the usual manner, but a separate steam-driven reciprocating oil pump has also been installed for starting and shutting-down purposes. This pump is fitted with an automatic governor, which will start the pump when the oil pressure falls to 27 lb. per sq. in., if the main pumps fail to maintain the supply.

It is interesting to note that the alternator stator was built up on site to avoid the difficulties which would have been experienced if such a heavy weight (70 tons) had had to be handled with the existing crane. An exciter is fitted to the machine, but arrangements are made so that the supply of energy for excitation can be taken from the station battery when required. Ventilating fans are fitted on the rotor, which runs at a speed of 1,500 R.P.M. These fans draw air direct from the atmosphere through wet air filters of the rotary type, which were supplied by Messrs. Heenan and Froude, Ltd. Duplicate A.C. motors, with direct-driven pumps, are provided for circulating the spray water and rotating the filters.

Messrs. Reyrolle's self-balanced protective gear has been fitted to the alternator.

The main cables connecting the alternator to the oil switch are of the single-core, lead-covered, paper-insulated type, 1 sq. in. in cross section, three being used per phase.

The condenser, which is of the "Contraflo" type, is on the turbine room floor, the turbine and alternator being about 16 ft. above this level. The condenser is mounted on

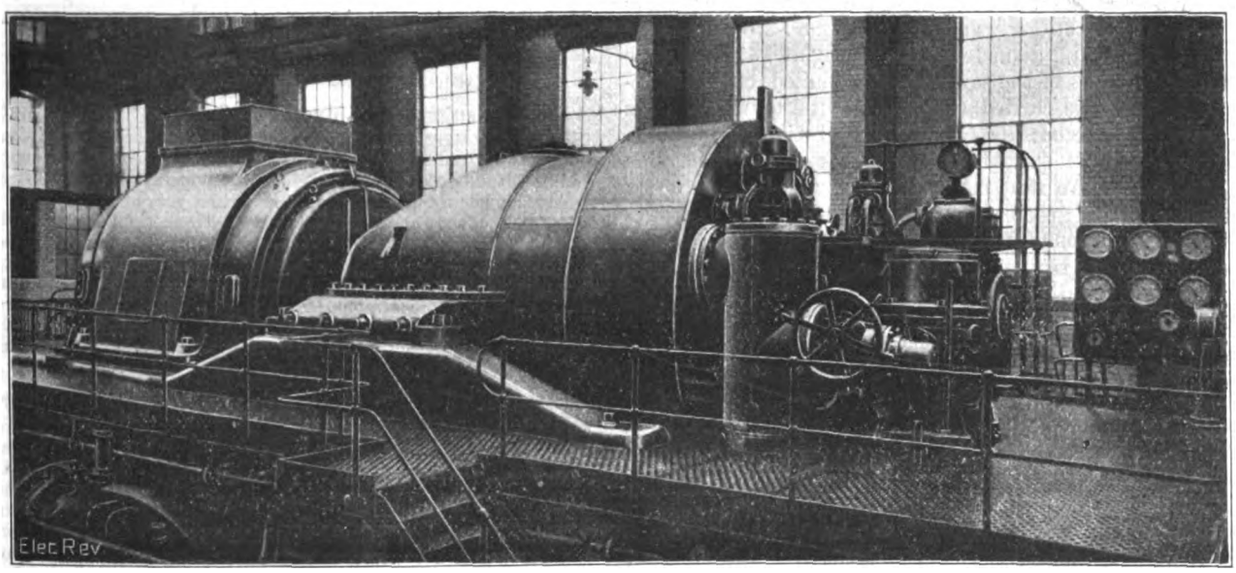

Fig. 4.—Turbine End of Metropolitan-Vickers 25,000-kw. Turbo-Alternator.

politan-Vickers Electrical Co., Ltd. The turbine is of the impulse-reaction type, the steam pressure at the stop valve being 200 lb. per sq. in., the temperature of the steam 600° F., and the vacuum 28 in. of mercury.

Steam is supplied to the separator through an 18-in. pipe, and thence through two 12-in. diameter pipes to the valve chests, which are fitted on each side of the turbine. The steam passes to the nozzle chest, which is in the form of a

spring supports, and is bolted direct to the turbine exhaust flange. The shell is of mild steel, and was built up on site. The amount of water circulated through the condenser is 1,800,000 gallons per hour; the tubes are of 1-in. external diameter, and the total cooling surface is 40,000 sq. ft.

The air and water-extracting pumps are of the "Kinetic" type. Each set runs at 1,475 R.P.M., and is capable of maintaining the vacuum and of dealing with the full-

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load condensate. One set is driven by an A.C. motor, the other being driven by a De Laval steam turbine. Each set has three steam jets for air extraction, and arrangements are also made so that the auxiliary turbine exhaust steam may be used in the jets, or diverted into the kinetic tank and used to heat the condensate. Messrs. Mather & Platt, Ltd., have supplied two 27 in. circulating water pumps, each direct driven by a 550-B.H.P., A.C. motor at 590 R.P.M., and capable of dealing with 60 per cent. of the full-load

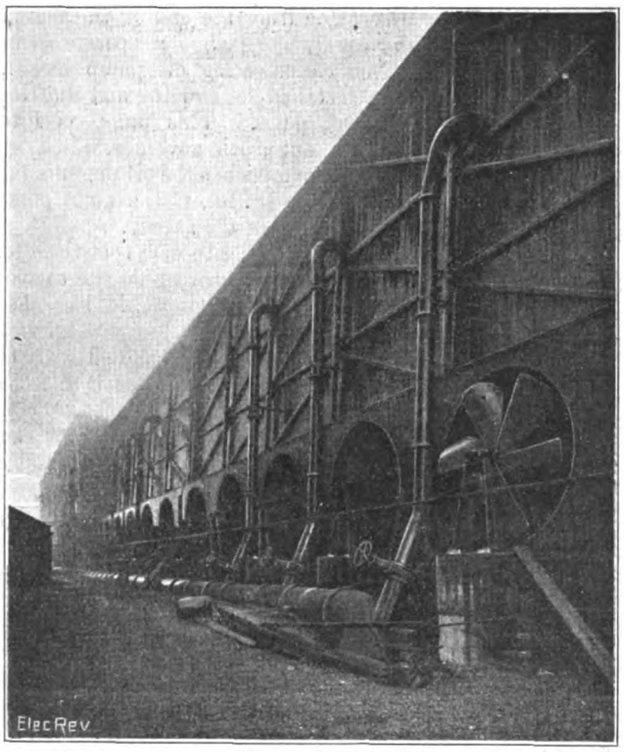

Fig. 5.—Cooling Towers.

requirements; these pumps, fig. 3, are installed in a room which is external to the main building.

Two cooling towers, fig. 5, have been supplied by Messrs. Charles Bradshaw & Co., and have a total capacity of 1,320,000 gallons of water per hour, the temperature being reduced from 95° F. to 75° F. when the atmospheric temperature is 60° F. and humidity 80-85 per cent. Twenty-four 11-in. diameter fans running at 165 R.P.M. are fitted to the sides of the towers and mounted on through-shafts, which are carried on lignum vitæ bearings inside the towers. The outside bearings are of the oil-ring type, and are fitted with special waterproof covers. On one side of the towers are the motor houses, which contain six 80-B.H.P. motors; each motor runs at 730 R.P.M., and drives two shafts, *i.e.*, four fans, by means of chains. The towers are divided into sections corresponding to the motors, and the troughing and pipes are so arranged that each section can be worked quite independently of the others.

The main 6,600-volt switchgear was supplied by the British Thomson-Houston Co., and comprises one 3,000-ampere alternator oil switch, three 2,000-ampere group-feeder switches, and one feeder board with six switches. The large switches and the feeder switches are the H 6 and H 3 types respectively, with two oil tanks per phase. The whole of the equipment is mounted in moulded stone cubicles.

Brick cubicles have been built for the transformers which have been installed in connection with the supply of energy for the A.C. motors. Two cubicles are in the boiler house, two adjoining the circulating-pump house, and one beside the cooling-tower motors.

The 6,600-volt switchgear for controlling the supply to these transformers is erected on the switchboard gallery in the turbine room, and comprises a number of the Manchester standard sheet-iron cubicle type of sub-station panels. An iron-clad Fluvent board, with knife switches and fuses, is mounted on top of the boiler-house transformer cubicles, and black enamelled slate panels with knife switches have been fitted in the pump and tower motor houses to control the 420-volt circuits.

The whole of the cable work has been done by the Stuart Street staff; the H.T. and L.T. cables for the auxiliary circuits being three-core, paper-insulated, lead-covered and armoured.

The war memorial tablet illustrated in fig. 6 was erected by the men employed at the Stuart Street works, to the

Fig. 6.—War Memorial Tablet.

honoured memory of 25 of their comrades who volunteered for service and gave their lives in the great war.

In conclusion, we have to thank Mr. S. L. Pearce, chief engineer and manager, for supplying and permitting the publication of the particulars set out above. The photographs were taken by Messrs. Grundy & Sons.

The Neuhausen Aluminium Co.—During the war the German State-guaranteed War Metals Co. entered into a contract with the Aluminium Industry Co., of Neuhausen, for the supply of aluminium, which is said to be still in operation, notwithstanding that the war requirements expired over a year ago, and the German company is still under the obligation to accept deliveries. To do so now would be all the more burdensome, as the basis price was arranged in Swiss francs (5.50 fr. per kilo is mentioned), and would, therefore, involve a considerable sacrifice owing to the increasing fall in the mark. A friendly arrangement, however, has been made with the German Government, under which the contract has been determined on the payment of a sum of 11,000,000 fr. to the Swiss company.

Norwegian Aluminium.—The managers of the A. S. Hoyangfaldene (Norsk Aluminium Co.) state that it was possible for the company to begin the production of aluminium last October, but owing to the difficulties in connection with supplies of coal and transport services, the company has been unable to increase the deliveries of raw materials to the level corresponding to the utilisation of the full capacity of the plant. There are, however, reasons for believing that this will take place in the near future. At present the electrode factory is turning out electrodes for the company's use, which was the original object in view, although considerable quantities could also be produced for sale, but the demand in Norway is inconsiderable at present, presumably on account of the restricted activity at the smelting works. The prospects for the export of aluminium seem to be favourable. No doubt the unfavourable rate of exchange for Germany renders it difficult for exports to be sent to that country, where the consumption is very large just now. On the other hand, the consumption appears to be increasing in other industrial countries, and there is every reason for believing that this will continue. The sale prices are still low as compared with the costs of production, but it is considered probable that the advance which has begun will be maintained.

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THE IDEAL HOME EXHIBITION.

(*Concluded from page* 201.)

Messrs. Arthur Lyon & Wrench, Ltd., 36, Victoria Street, London, S.W. 1, exhibit electric lighting sets suitable for country-house lighting; as shown at other recent exhibitions; a combination electric motor positive pump, with a capacity of 500 gallons per hour; a motor-generator set driven off the Olympia main supply, and giving an output of 50 to 70 volts, 25 to 35 amperes; a small ½-h.p. motor for driving a sewing machine or other household appliances requiring small power, and some domestic heating and cooking accessories for working in conjunction with L.W. house-lighting plant.

The Austin Motor Co., Ltd., 479-483, Oxford Street, London, W. 1,—This is a working exhibit of an entirely British-made 0.75-kw. automatic electric lighting plant for a country house or farm, and a 10.5-h.p., 100-volt, automatic plant for country mansions, reference to the commencement of the manufacture of which was recently made in our pages. The smaller set under the name "Autoplant" is suitable for an installation up to a total capacity of 800 c.p. with 25-volt standard metal-filament lamps, or 1,500 c.p. with half-watt lamps. The set comprises a 1.75-h.p., four-stroke, single-cylinder engine designed to run at 1,100 r.p.m. on either petrol, benzole, or town gas; and is supplied complete with all piping, &c. The cylinder is water cooled, the radiator taking, not the usual form, but that commonly employed for office and room warming purposes, as shown in fig. 11. The engine is direct coupled to a compound-wound dynamo giving an

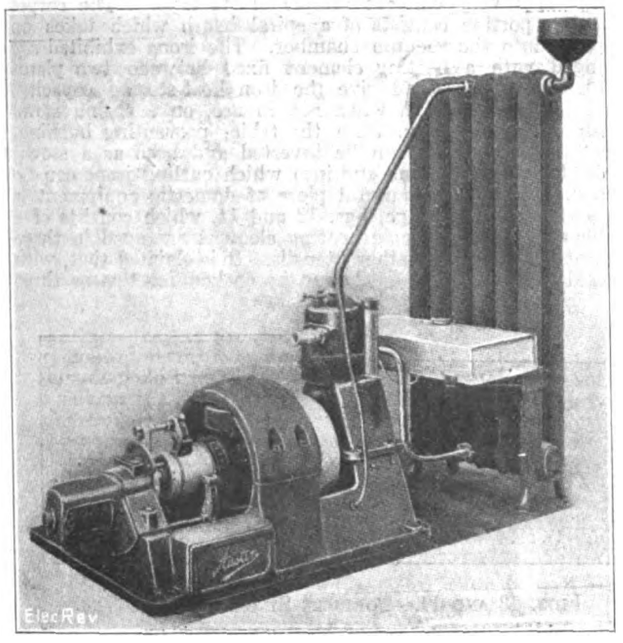

Fig. 11.—Austin 0.75-kw. Lighting Set.

output of 30 to 22 amps., at 25 to 35 volts, or 15 to 11 amps. at 50 to 75 volts; a battery of from 126 to 180 amp.-hours capacity, according to the number of lights, is used with the plant, a feature of which is a "master instrument" which maintains the voltage on the lights at a constant value, although the dynamo may be giving a varying voltage for charging the battery. It is claimed that the plant is entirely automatic in its action, *i.e.*, self-starting, stopping, and regulating, even the h.t. ignition current being taken from the dynamo. Plant with capacities up to 12 kw., as well as 50-volt sets can be supplied.

Messrs. R. A. Lister & Co., Ltd., 47, Victoria Street, London, S.W. 1, exhibit electric lighting and power plant, suitable for country houses or where a main supply is not available, which is claimed to be automatic in action. The plant is suitable as a standby on board ships or elsewhere, and in such a case starts up automatically on the failure of the main supply; it also tests itself daily, and gives indication if not operating correctly. A feature is that the usual large storage battery is not necessary, a few cells suffice to work the plant automatically and light a few lamps without the engine running. The vertical, water-cooled, enclosed-type engine is of substantial construction, fitted with automatic lubrication, h.t. magneto ignition, and pump-fed carburetter. In addition to the centrifugal mechanical governor, a magnetic governor is fitted to the engine, which regulates the speed according to the load, thereby maintaining constant voltage at all loads. The shunt-wound dynamo is automatically lubricated and coupled to the engine either by a flexible coupling in the larger sizes, or by belt in smaller, single-cylinder sets, which have outputs of from 0.52 to 1.95 kw., 11 to 35 amps., at 55 volts. The direct coupled 1, 2, and 4-cylinder sets, fig. 12, run at 850 r.p.m., and give 3 to 18 kw., 27 to 163 amps., at 110 volts. An automatic controller is provided to start the engine up smoothly, the compression being released until sufficient speed is attained to

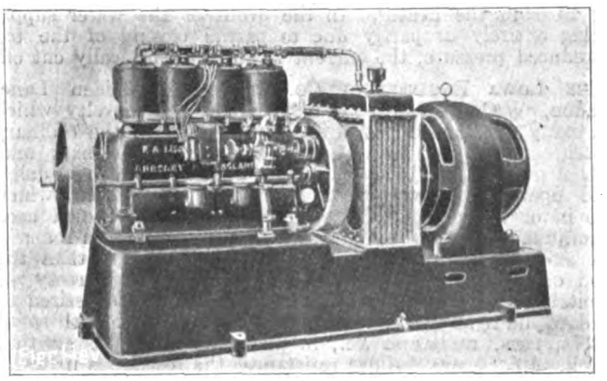

Fig. 12.—Lister-Bruston 18-kw. Lighting Plant.

ensure easy starting. The enamelled switchboard is fitted with a voltmeter, two ammeters, a Bruston relay, circuit breaker, fuse, and the necessary terminals are plainly labelled.

The Aster Engineering Co., Ltd., Wembley, Middlesex, has a working exhibit of a single-cylinder, semi-automatic house lighting set running on gas, but which will run equally well on petrol or paraffin. The exhibit is complete with all the necessary equipment, the design being sturdy throughout. The engine is of the 4-cycle type with mechanically operated overhead valves, and is air cooled; lubrication has received special attention, and a simple form of carburetter is fitted.

Messrs. Studebaker, Ltd., 117-123, Great Portland Street, London, W. 1, show the compact "Lally Light" house lighting plant, consisting of a generator direct driven by a ball-bearing petrol engine, and a set of accumulators. A duplicate set may be seen working outside at the rear of the stand. The 1.5-h.p., 1,800-r.p.m. engine has only three moving parts, namely, the piston, connecting rod, and crankshaft. There are no valves to grind, no connecting rods, push rods, cam shafts, &c. Thermo-siphon cooling with an ordinary water tank is employed. A float-feed type carburetter is fitted, and the h.t. magneto is direct connected to the crankshaft by means of a flexible coupling. A centrifugal governor running in an oil bath acts through a rocker arm directly on the balanced plunger throttle which governs the mixture in the engine. Simplicity in design has been aimed at throughout; the set weighs only 322 lb., it being 27 in. long by 14 in. wide.

Carron Co., 50, Berners Street, London, W. 1.—Amongst this selection of fireplace suites, some of which are seen working, are both coal and gas fires, as well as the firm's well-known electric fires of various sizes and styles.

The Dowsing Radiant Heat Co., Ltd., 39, York Place, Baker Street, London, W. 1, has on view a large number of samples of its manufactures in the shape of domestic electric heating and cooking appliances, including radiators, cookers, kettles, irons, toasters, &c., as described on various occasions in our pages. A special feature is made of electrically-heated clothing, while electro-medical apparatus on view includes electric light baths and various forms of vibrators. The De Vry portable kinema projector, which we described fully some time ago, is also to be seen in use at this stand. Messrs. Dowsing have taken up a selling agency for this apparatus, which is very compact, self-contained, and may be connected to any existing lighting fitting. It has been used with much success in schools and by educational authorities in different parts of the country.

The Filbar Electric Heater, Ltd., 46, Berwick Street, London, W. 1, is showing electric water heaters and sterilisers; the latter apparatus consists of a tank holding water on the bottom of which rests a tray for carrying the instruments to be sterilised, and which can be lifted out at will while the water is boiling. Parallel to this tank is a second tank containing a float which works in conjunction with a switch and cuts off the current should the water fall to a pre-determined level. The electric water boiler is designed to deliver a limited amount of hot water in a short space of time. The amount of water necessary can be drawn off at boiling point 30 to 60 seconds after the cold water has reached the desired level in the gauge. Immediately after the boiling water has been ejected, the apparatus is again ready for use. The

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boiler can be used in a room where there is no water supply by the addition of a small tank; the heating element cannot be switched on until water has been admitted to the boiler, and water is admitted by a push rod valve which closes on the pressure being released. The "hotspring" automatic water heater is a small apparatus which can be easily fitted (and as easily removed) to the water main or to any existing cold water tap, the handle of which controls the whole apparatus. The only operation necessary to obtain a flow of hot water up to 160 deg. F. is to turn on the cold water tap, which action operates a water switch. When the tap is closed current is automatically cut off and current cannot be switched on to the heating elements unless water is flowing through the heater. In the event of the water supply failing entirely or partly due to partial closing of the tap or reduced pressure, the current is also automatically cut off.

The Lowa Engineering Co., Ltd., 25, Maiden Lane, London, W.C. 2.—The "Lowa" switch is a novelty which has many applications; it is slightly larger than the ordinary switch, and can be easily substituted for the ordinary one. It is a modification of the tumbler action in which a dolly-head operates a lever moving through a quadrant which cuts in or out groups of special resistances, and when used in conjunction with a lamp or series of lamps effects a remarkable saving in energy when less light is required than the rated c.p. The switch is suitable for bedroom, nursery, or hospital use, and for many purposes where it is desired to regulate the light given. It is also adapted for use with small motors, fans, radiators, &c., in place of the usual starting switch. In "Lowa" slider resistances the resistance material is sandwiched between metal strips which form the contacts, thus helping to eliminate the wear which takes place where the contact bears directly on the wire. The resistance units are contained in a strong cast frame, the insulation being of mica throughout; they are compact, occupying small space, and the resistance material used is claimed to be impervious to climatic conditions and to moisture.

Messrs. Belling & Co., Montague Road, Edmonton, London, N. 18, show a selection of electric cooking, heating, and cleaning appliances for domestic use, including fires, water heaters, sweepers, a washing machine, and table appliances as exhibited at other recent exhibitions.

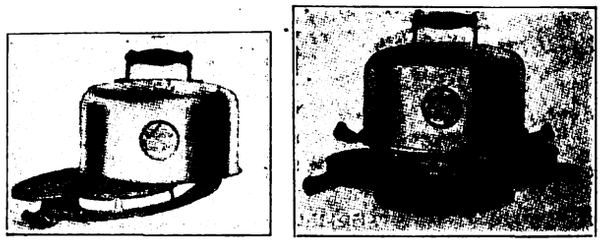
The British Electric Transformer Co., Ltd., 50, Oxford Street, London, W.1.—This stand takes the form of a model kitchen in which flame fires, ovens, boilers, grills, and other electrical "comforts" for the home are on view, some of which are seen in operation, and demonstrations are given at frequent intervals.

Quead, Ltd., 47, Marylebone Lane, Oxford Street, London, W. 1.—This exhibit takes the form of a selection of electric fires, and includes period style sheet metal fires which are seen in operation for the first time, and which can be supplied to match any period of decoration. A table cooker combination is also on view for the first time, and the firm's electric iron is efficient, having a consumption of only 475 watts for a full size iron on full heat. A feature is the provision of means for regulating the heat whereby full or half heat can be used for heating up quickly, and then a good ironing temperature maintained by cutting down the current so that only one quarter is used, hence its name, "Quarter heat" iron. The handle is of the "always cool" type, and a special rest is fitted on which the iron can be stood end up, thus avoiding the necessity of a special stand. The consumption of the firm's 12-in. fans at maximum speed does not exceed 36 watts; the construction is robust, and the guard is so designed as to avoid the rattling common to so many. The Quead electric soldering iron consumes 100 watts for every hot point; a substantial sheath protects the element which is practically air tight, thus helping to reduce heat loss and to prolong its life. The cable is connected in such a manner that should the iron be dropped there is no sudden pull on the leads, and close contact is effected between the element and the bit. The simplicity of construction renders replacement an easy matter.

Messrs. Siemens Bros. & Co., Ltd., Woolwich, London, S.E. 18, exhibit the "Stannos" system of wiring buildings for electric light and power, features of which are low cost and the possibility of installation with minimum disturbance to the fabric and interior decoration of the building. Further particulars of the system will be found on another page of this issue in an article on electricity in small dwellings.

Messrs. Callender's Cable & Construction Co., Ltd., Hamilton House, Victoria Embankment, London, E.C. 4.—This exhibit takes the form of electrically lighting two portions of rooms completely on the "Kaleeco" system of wiring, also referred to in the article mentioned above, and shows the suitability of the wire and accessories for efficiently, yet unobtrusively, wiring on the surface, different classes of houses. The system consists of a circular metal sheathed single and flat metal sheathed multicore insulated wires, simple junction boxes provided with efficient bonding clamps, wall clips, continuity bar, and earth clip. It is neat, easy to erect, and very inexpensive. The conductors consist of tinned high-conductivity copper wires, insulated with two layers of vulcanised india-rubber taped with proofed tape, the whole vulcanised into a homogeneous body. The multicore wires have the cores laid side by side, the distinctive coloured proofed tapes ensuring easy tracing, and sheathed under heavy hydraulic pressure with a strong tube of metal forming a flattened section. The metallic sheathing, although stiff enough to prevent sagging between the fixing clips properly spaced, is easily bent round cornices. The junction box consists of a backplate and cover of tinned brass, inside which the wires are joined together as required by means of porcelain sheathed connectors. The backplate is slotted on site to any arrangement of wires called for, two slots being cut at each wire entry, leaving a tongue to which the metal sheathed wire is clamped by means of the bonding clamp which embraces wire and tongue, and is tightened up by a screw and nut. When the backplate has been fixed to the wall or other support and the internal connections have been made, the cover is marked and cut to fit over each bonding clamp. It is secured by small lugs, provided on the backplate, which pass through suitable openings in the cover and are bent over, no screws or nuts being used for this purpose. Efficient electrical continuity of the metallic sheathing throughout the installation together with reliable earthing, are secured by use of the complete range of "Kaleeco" accessories. Decorative wires braided with silk or glace cotton and accessories enamelled to match—when fixed on the surface, blend with existing decorations, and are practically unnoticeable. The system calls for no special switches, ceiling roses, fuseboards, or fixing blocks, all of which may be chosen to suit the architectural features of the building and the taste of the client.

Messrs L. G. Hawkins & Co., 116, Charing Cross Road, London, W.C.2, exhibit a comprehensive display of domestic electrical appliances, ranging from heating pads to electric washers and vacuum cleaners. The "Universal" vacuum cleaner is a very efficient sample of its type. The carpet sweeping portion consists of a spiral brush which takes up the dust into the vacuum chamber. The irons exhibited are arranged with a heating element fixed between two plates which exclude air, and give the iron heat-storing capacity. These irons are rested, when not in use, on a spring stand which isolates the iron from the table, preventing burning. The "tourist's" iron can be inverted and used as a stove; it also has a hole in one end into which curling irons can be slipped. Another very useful piece of domestic equipment is the portable single range, figs. 13 and 14, which consists of a double-shell oven, a single heating element arranged in three concentric circles, and other utensils. It is claimed that, with the aid of this range, meals can be cooked for two or three



Figs. 13 and 14.—Portable Single Range Ovens.

persons. An all-metal immersion heater is another exhibit. This is quite a small appliance, designed for boiling small quantities of liquid in a short time. A fusible plug to protect the heating element can be supplied with all appliances, and a special connector plug is included with almost all the heating apparatus. The coffee urns and hot-water kettles are of high artistic merit—a pleasant change from the usual rigid lines. The "Geyser" electric washer and ringer employs the unique high-speed propeller principle of washing. A powerful circulation of hot suds is driven through the clothes by means of a propeller in the bottom of the tank, and the water is drawn back through the clothes by suction. There is no wear on the clothes, they remain always under hot water in a perforated zinc cylinder kept constantly revolving by means of the propeller. The tank is all metal, and the steel frame is electrically welded. The zinc cylinder, and the inside of the galvanised steel tank are both copper plated, and then nickel plated, as a protection against rust and corrosion. The electric ringer is reversible, and has a positive safety release, and can be used at the same time as the washer or independently.

Amongst the other exhibits of electrical interest the Bastian Electric Co., Ltd., show electric fires of various types and water heating apparatus. The Falkirk Iron Co., Ltd., exhibits radiators and cooking ranges, while Messrs. Boulton & Paul, Ltd., have on view a complete generating plant for country house use, comprising a paraffin engine direct coupled to a generator which is capable of lighting 75 20-watt 16-c.p. lamps or the equivalent. The stand of the Rawlplug Co., Ltd., whose products should be of considerable utility in the home, attracts well-deserved attention. In the labour-saving section, which finds accommodation in the gallery, Mr. G. E. W. Crowe has an interesting exhibit of electrical heating and cooking appliances, all of which goods are made in Canada.

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Mr. R. B. Stewart demonstrates "Time Saver" electric washing machines, while the "Modern Home" washers and wringers are shown by the Pneuvac Co., Ltd. Wallach Bros., Ltd., demonstrate the merits of vacuum cleaners, as does also the Hoover Suction Sweeper Co., Ltd. Electrically-heated mats, muffs, travelling pads, therapeutic bandages, and other similar articles are on view at the stand of M. E. du Bois & Co. These useful devices are fitted with a "regulator," enabling the temperature to be varied to suit requirements, and also with a "resistance plug," to enable them to be used at any pressure from 100 to 250 volts. Other electrical appliances for the home are on view at the stands of Messrs. Benham & Sons, Ltd., Magic Appliances, Ltd., Duncan Watson & Co., Chas. F. Beck & Co., Ltd., S. G. Leach & Co., Ltd., and the Electric Appliances Co., Ltd.

The Exhibition, which closes on February 25th, has proved a popular success; it was visited on Tuesday morning last by T.M. the King and Queen.

CORRESPONDENCE.

Letters received by us after 5 p.m. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

University Training.

Mr. G. W. Roffe's letter raises a point which a number of men who are endeavouring to strive upwards would be pleased to see discussed in your columns—the value of technical education by correspondence. As one who has had a few years of it, I consider it fills a long-felt want, namely, to give technical education during practical work.

We are told that the best workman is the one who is interested in, and who studies his work. But do employers take this view?

My experience in seeking employment is gradually forcing me to the conclusion that a man who can only do one kind of job, and that almost automatically from constant repetition, is considered before an all-round man.

I agree that specialisation is necessary. But my experience in charge of different shops teaches me that a good all-round man who has studied his work can conquer quite a number of jobs quickly. Employers in their demand for specialisation seem to miss this point. I am not suggesting that capital should train labour. In these days of "returned heroes" surely employers might at least consider the applications for employment of those who show they are "striving upwards," even if only by correspondence tuition.

G. Nicholson.

London, E. 6.
February 13th, 1920.

Projector Lamps.

Re your correspondent's inquiry concerning projector lamps, the following particulars may help him. The lamp which takes the place of the arc is the Mazda C incandescent, which has a filament consisting of four parallel helical coils, side by side in the same vertical plane, and about half their diameter apart. A mirror behind the lamp reflects the light thrown backward so as to fill up the spaces between these coils, producing the equivalent of an intensely brilliant, solid filament. It is used professionally in the States, where the current is alternating; where D.C. is the supply, the usual arc is reckoned best. The lamp is used with the usual condenser system, and is made in two wattages, 600 and 900. Its average life is about 100 hours, and it operates at about 30 volts. The makers of the complete equipment are The Precision Machine Co., Inc., New York, U.S.A.

F. G. Humberstone,
Chief Operator-electrician, "A.W." Circuit.

Weymouth.
February 16th, 1920.

The I.E.E. Council and the Territorial Centres.

Into the general question of leaks I will not enter, but since a leaky argument is one which will not hold water, I must say a word in reply to your editorial comment on the reason I gave at Liverpool for not swamping elected members of Council of the I.E.E. with chairmen of Centres. In the first place, the articles clearly contemplate that fundamentally the Institution shall be ruled by members of Council elected by ballot by the whole body of members from the country. Secondly, chairmen of Centres are usually, and properly, chosen for personal reasons of local suitability, irrespective of the branch of the profession they represent, whereas the ordinary members of Council should be, and are, as far as possible, representative of all branches. Thirdly, the number of members attached to the various Centres differs greatly, and therefore individual members of small Centres would have an undue proportion of representation on the Council. Fourthly, the change in personnel of the Council each year would be too great, since the chairman of a Centre only has a seat on the Council for two years instead of the three years of an ordinary member of Council. Lastly, there is the "more plausible objection" you advance. May I emphasise the fact so ably put forward at Liverpool by the president that the Council must be supreme, and stands on a totally different footing from a Territorial Centre Committee. There might be much to be said for a London Centre, but the work of its committee would be confined to local administration in connection with London meetings, and the London Centre would have to be just as much subordinated to the Council as the other Centres. The work of the Council differs radically from that of local committees, and the two do not admit of comparison. In conclusion, may I point out that Mr. Robertson's remarks about Students' papers were based on a misapprehension; no distinction is made in the publication of such papers between those of London and provincial Students.

C. H. Wordingham.

London, S.W.
February 16th, 1920.

Electrolytic Meters.

In reply to the letter from "H. W. M.," my statement that electrolytic meters are not used to any great extent was based on personal observation, and I am quite willing to withdraw it if satisfactory statistics to the contrary are produced. It would be interesting to have authentic figures as to the actual numbers of meters of the electrolytic and motor type at present in use in Great Britain. I do not agree with "H. W. M." regarding the size of meter which is desirable. The increasing use of electrical domestic appliances, radiators, &c., tends to justify the 5-ampere size as compared with the 2-ampere one. Concentration on a 5-ampere model would, I think, more than justify the very small amount of extra material needed, and would result in a cheaper meter. "H. W. M." evidently thinks it impossible for the motor meter to compete with the electrolytic meter on a price standpoint; that is, of course, merely a statement of his own opinion.

Referring to the letter of the Bastian Meter Co., Ltd., as will be seen from my reply to "H. W. M.," I intended to convey the impression that the electrolytic meter is used to a *relatively* small extent. If Mr. Salisbury will publish figures as to the production of his type of meter, perhaps the motor meter makers will put up theirs for comparison, and so give us a quantitative idea of the relative positions of the rival types. Mr. Salisbury's claims as to accuracy and simplicity are thoroughly justified, but it is questionable whether the filling and maintenance costs do not annul the advantage of low initial price. The satisfactory nature of his business is, however, sufficient criterion of the fact that many people share his opinion.

C. W. Marshall.

Carluke.
February 16th, 1920.

Officers' Association (Employment Bureau).

Now that the Ex-officers' Employment Bureau is moved from Dashwood House to Grosvenor Place, it has lost the services of some voluntary interviewers in the city who have done such excellent work for two years past. They must be replaced by Westminster men. Will any experienced business men, who are able to give their services for one or more mornings or afternoons per week, call or write to

J. A. Goudge,
Hon. Secretary,
Officers' Association (Employment Bureau).

32, Grosvenor Place, S.W. 1.
February 17th, 1920.

Awards Delayed.

A letter appeared in the Electrical Review of January 30th signed "W.O. Electrical Staff," which drew attention to the non-payment by the War Office of awards (granted by Government-appointed arbitrators) to civilian staffs employed in power stations under their control.

In connection with this it is interesting to note that, at a certain War Department power station, the staff, right from the beginning of the late war, have had the mortifying experience of seeing and hearing of other power station employés' salaries and wages advanced by leaps and bounds, in accordance with the ever-increasing cost of the necessities of life, while their own wages remained at the pre-war level, and to get an increase or bonus they had in some cases to resign, or threaten to resign their posts; in one case, having succeeded after great efforts in getting the increases when long overdue, back pay was not paid.

The result of all this has been that practically the whole of the staff have been compelled in their own interests to join some protective organisation, whereas previous to the war, not one of the staff in question belonged to any trade union.

At the present time the combined efforts of three trade unions have so far failed to get the latest 5s. award paid to

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the men, although at a power station of a similar capacity, under the Air Ministry's control, this award was paid out last December. Neither has the 92s1 award been granted to members of the staff to whom it applies, although due from March 31st, 1919.

This deliberate breeding of discontent amongst the staff concerned is bound to have a very detrimental effect on the loyalty of the staff, and on the working of things generally, is sure to find expression in one way or another, and is the result of the War Office not recognising the spirit of the "fair wages clause."

War Department Power Station Staff.

February 14th, 1920.

LEGAL.

HULL PROSECUTIONS.

A SEQUEL to the recent electricity shortage at Hull, and the first cases of the kind concerning the improper use of electricity, were heard at Hull Police Court when George H. King, tradesman, and George A. Lamb, secretary, were charged with unlawfully laying electric mains and connecting with mains belonging to the Corporation.

Major H. BELL, the city electrical engineer, in the course of the proceedings, pointed out that there were the most urgent reasons why these connections should not be made without the knowledge of the Corporation. There must be the fullest co-operation between the suppliers of the current and the consumers, or the results would be serious. If every consumer did as defendants the supply would have to stop.

In the case of King, he possessed a knowledge of electricity, and he utilised an overhead telephone wire from one of his shops to another to convey the current; it was explained that it was dangerous to use telephone wire for current for lighting because of the latter's high voltage.

In the other case, defendant fixed up a cable for outdoor lighting for his premises.

In both cases, it was pointed out, the current was registered through meters, and there was no question of the energy not having been paid for.

Each defendant was fined £2 2s.

UNIVERSAL RADIO SYNDICATE, LTD. (IN LIQUIDATION) *v.* BAXENDALE.

IN the Commercial Court of King's Bench, on February 12th, Mr. Justice Roche heard an action in which plaintiffs claimed by their liquidator damages against their former managing director, Mr. Arthur Baxendale, in respect of an alleged breach of agreement, or in the alternative an account of profits made by him by work which he had undertaken in breach of his duty when employed by the syndicate.

Mr. Douglas Hogg, K.C., with whom was Mr. Raynor Goddard, appeared for the plaintiffs, and Mr. Compston, K.C., was for the defendant.

Mr. DOUGLAS HOGG, in opening plaintiffs' case, said that the claim related to the erection of a Poulsen wireless installation at the Eiffel Tower by Mr. Baxendale in conjunction with Mr. Elwell, who was the managing engineer to the syndicate, the contract for which he had appropriated and used for his own benefit. The syndicate was formed with the object of exploiting the Poulsen system of wireless telegraphy in respect of which the syndicate held a licence, and Mr. Baxendale held the position of managing director under an agreement dated September, 1912. The syndicate set to work to make known the advantages of the system, and it was successful in obtaining contracts with the Government. It was desired to have an installation at the Eiffel Tower by which communication could be set up with America. In the early part of 1913 Mr. Baxendale was able to arrange with Mr. Husson in Paris for him to act for the syndicate in endeavouring to obtain authority to use the Eiffel Tower for trying the Poulsen system, and in March of that year he communicated with a French telegraph company interested in the installation of the wireless system, after which there was a long correspondence. At the end of December, 1914, the syndicate had failed to get sufficient capital to carry out their option to buy the Poulsen system, and on January 19th, 1915, they went into voluntary liquidation, and on January 21st Mr. Baxendale wrote a letter which modified his original agreement under which he was paid at the rate of £1,500 a year. He wanted a lump sum in settlement of his claim.

His LORDSHIP: I did not know that he could remain a managing director after the liquidation, but he could remain a manager.

Mr. DOUGLAS HOGG: On February 11th, 1915, he proposed that on payment of £500 to forgo his claim against the syndicate, and in consideration of that payment, he undertook to continue to give every assistance in the liquidation until the following September, and practically to give advice up to January 1st. There was reason to believe that at about that date a letter was written by Mr. Hussen to Mr. Baxendale, as managing director of the Radio Syndicate, regarding the Eiffel Tower contract, and other letters on the same subject were written to Mr. Elwell. At the end of March, 1915, Mr. Elwell went to France. The syndicate thought he had gone only in connection with arrangements for a holiday for his wife and not on business matters. On his return, however, he invited various companies to tender for different parts of the installation at the Eiffel Tower. When, in May, it was found out what was going on, Mr. Baxendale was spoken to. He (Mr. Baxendale) admitted that he had sent Mr. Elwell because he did not think the syndicate could carry out the contract. The correspondence showed that Mr. Elwell was acting for Mr. Baxendale, and that the contract for which they were negotiating was for £98,500 odd for an installation for purely military purposes. In November, 1915, litigation was commenced between Mr. Elwell and the syndicate in respect of his salary, and in 1917 Mr. Baxendale made efforts to stop Mr. Walrond (the liquidator) from proceeding against Mr. Elwell. Counsel then read correspondence for the purpose of showing that in 1914 and 1915 Mr. Baxendale was negotiating with the authorities in France, especially the military authorities, in view of the erection of the installation, and that in 1915 he sent Mr. Elwell out to France to try to get the contract for himself. Mr. Douglas Hogg submitted that under these circumstances Mr. Baxendale was liable in damages for breach of his duty to the syndicate.

At the conclusion of the plaintiffs' case, Mr. COMPSTON submitted that there was no case for him to meet, as the documents did not reveal any implied terms with regard to the inability of Mr. Baxendale to carry on any business he liked so long as he to the best of his ability assisted the liquidator in winding up the syndicate's affairs. There was no engagement that he would not enter into competition with the company.

His LORDSHIP said he was against counsel on that submission.

Mr. COMPSTON argued that the liquidator could not legally carry on any fresh business during the winding up. He could not enter into any contracts except where they were necessary to enable the existing assets of the business to be disposed of to the best advantage.

Mr. ARTHUR BAXENDALE was called, and gave evidence as to what had taken place after the liquidation was decided upon, and the position taken up by the advisory committee. He said that the committee was opposed to taking up any new business. He had been absolutely ruined by the collapse of the business, in which he had put £1,200. He told his co-directors that he was going to work as hard as he could for the reconstruction of the company, but he was unable to bring it about. Up to the end of 1915, for a whole year, he was working with that object in view. The patents were nearing expiration, and had now expired, the station being worked by the Government. The first he heard about the French installation was in 1915.

His LORDSHIP here interposed, and asked had any effort been made to arrange this matter.

Counsel intimated that there had been a proposal.

Mr. BAXENDALE: I understood that the whole point was to get my shares. I was asked if I was willing to sell, and I replied that I was unable to do so.

His LORDSHIP, in giving judgment, said that the action was similar in nature to an action in which the present plaintiff and Mr. Elwell were concerned, which was tried some three months ago before him, and he then formed a view on the case which he still entertained in the present case. The defendant had entered into a contract on his own behalf, and must account to the company for any benefit he had received under that contract. He agreed that when the liquidation came into force the defendant was no longer bound by his contract of employment, but by an agreement he undertook to render advice and assist in the liquidation. He (the judge) was satisfied that the beneficial winding up of the company required that such a contract should be entered into. He was also satisfied that the company could have got the contract with the French Government. The defendant did not offer this contract to the company, but, in fact, went behind the back of the company, first, because he mistook his rights, and then because his feelings led him away. He was in conflict with the advisory committee, and therefore secretly arranged with the French Government for business which might have become of considerable value. He had undertaken to assist the liquidator as representing the existing company, not a company to be reconstructed, and he did something detrimental to the liquidation. He (his Lordship) held that there was an implied obligation not to do anything of the sort. He was still connected with the syndicate in liquidation, and his position enabled him to get the contract. The plaintiff had a right to the account for which he asked, but he was satisfied that so far as money was concerned there was not any large sum to come from the contract. On the whole it seemed to him that an account should be taken if the parties could not agree. Something ought to be done to put an end to these matters. His judgment was for the plaintiff with costs of the action for an account.

Mr. DOUGLAS HOGG said he was prepared to take judgment for £200 and so avoid further proceedings.

Mr. COMPSTON asked that judgment might be suspended as to taking an account until he had had time to consider the question.

His LORDSHIP said he was willing to do that on payment of the costs.

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BUSINESS NOTES.

Industrial Electric Supply Council for the North-East Coast.—At a conference in Newcastle-on-Tyne on 10th inst., held under the presidency of the Lord Mayor (Mr. Walter Lee), it was decided to set up a District Council under the National Joint Industrial Council for the electricity supply industry for the North-East Coast, which will include Northumberland, Durham, and the Cleveland district of Yorkshire.

Catalogues and Lists.—Automatic and Electric Furnaces, Ltd., 281-283, Gray's Inn Road, W.C. 1.—Pamphlet No. 18, "The Magnetic Sclerometer," describing experiments in steel-hardening, and a reprint from the *Colliery Guardian* dealing with Wild-Barfield electric furnaces.

Sterling Telephone and Electric Co., Ltd, Telephone House, 210-212, Tottenham Court Road, W. 1.—Publications Nos. 270 to 275 inclusive. These pamphlets deal with (taking them in numerical order):—Electric shaft signals, mining telephones, "Ferro-Case" telephones, bells, and buzzers, indicators (bell, &c.), and accumulators. Fully priced and illustrated.

The Empire Roller Bearings Co., Ltd., 13, Victoria Street, S.W. 1.—"Preliminary catalogue" (14 pp.) of roller bearings for use in various situations, including shaft bearings and axle boxes. Illustrated.

The Hoover Suction Sweeper Co., Ltd., Walmar House, 288-292, Regent Street, W. 1.—"Cleanliness" (27 pp.), a well illustrated and neatly produced booklet recording the evolution of the vacuum sweeper and cleaner. The "Hoover" suction sweeper is illustrated in detail, and photographed in action. Also a fac-simile of the certificate of the Institute of Hygiene awarded to the company.

Mr. H. W. Sullivan, 368 and 369, Winchester House, E.C. 2.—List "W" 1,920, 24 pp., "Standard Condensers and Wireless Apparatus." An illustrated and priced catalogue of condensers, small transformers, rheostats, valves, &c., for "wireless" work.

Trade Announcements.—As briefly announced here last week, an amalgamation of interests has been effected between the Electrical Apparatus Co., Ltd., and Messrs. Bray, Markham and Reiss, Ltd. Both are specialists in the manufacture of motor-control gear—the former having a complete line of gear for industrial purposes and the latter having specialised more particularly on Admiralty-type apparatus during the war. The joint enterprise will be run under the ægis of the E.A.C., but the technical management of the B.M.R. Works will continue as in the past, under the expert guidance of Mr. E. N. Bray. It is hoped that the increased resources of the combination will result in greater efficiency all round.

Messrs. Fuller's United Electric Works, Ltd., have transferred their sales department from Chadwell Heath to Iddesleigh House, Caxton Street Westminster, in order to cope with increased business. Telephone number: "Victoria 6863-4"; telegrams: "Blocbat Vic., London." The company will shortly open a showroom on the new premises for the exhibition of their products.

The L.P.S. Electrical Co. have removed their offices and stores to L.P.S. Works, Avenue Road, Acton, W. 3. Telephone: "Chiswick 1920" (two lines); telegrams: "Engineyor Act, London."

Mr. Stanley Carr has opened offices at 2 and 3, Red Lion Court, Fleet Street, E.C. 4, as the Telephone Maintenance Co. He has been associated with the telephone trade for 25 years, and will carry out all descriptions of telephone work.

The Electrical Engineering and Development, Ltd., has commenced business at 82, Victoria Street, S.W. It has been formed, with Mr. E. Schattner as managing director, for the purpose of developing and placing electrical inventions on the market, for sale of patents, acquisition of foreign electrical patents, and the development of export trade by arranging agency agreements. It is stated that an electrical testing department for inventions is being equipped, and engineers have been appointed as representatives in the principal industrial countries.

Strikes.—During the past week there has been a strike of nearly 1,500 employés of the Pirelli-General Cable Works, Ltd., at Southampton. *The Times* reports that the grievance was that the employés were not receiving the standard rates of wages as paid by other cable-making firms. The version given by the *Daily Herald* is as follows:—The Unions involved are the National Federation of Women Workers and the Electrical Trades Union. A fortnight ago representatives of the E.T.U. and the Federation met the employers on a question of wages. The meeting was adjourned until Tuesday of last week. On that day the employers, however, refused to negotiate with the E.T.U. on the ground that it did not represent the men. The reply of the E.T.U. and the Federation was to dispatch telegrams to the shop stewards, and within five minutes the whole works had stopped. The *Daily Herald* stated that instructions were understood to have been sent out to members of the E.T.U. all over the country not to use the wires or cables produced by Messrs. Pirelli.

A Sheffield paper reports that 100 employés of the D.B. Battery Co., Ltd., came out on strike on Tuesday morning.

Copper and Lead Prices.—Messrs. F. Smith & Co. report:—February 17th: Copper (electrolytic) bars, £130, £2 decrease; ditto sheets, no change: ditto wire rods, £145, £2 decrease; ditto H.C. wire, 1s. 5½d., ¼d. decrease; silicium bronze wire, 1s. 11½d., ¼d. decrease.

Messrs. James & Shakespeare report:—February 17th: Copper bars (best selected), sheets and rod, £173, £2 increase; English pig lead, £54 10s., £4 increase.

Trade with Greece.—Credit Facilities.—Some facility with regard to the opening of credits abroad for payment of goods to be imported into Greece has been afforded by the following Government regulation:—

Merchants able to produce a certificate from the Financial Inspector of their district proving that they have been recognised as engaged in business for the period of two years up to date, are no longer called upon to deposit guarantee in cash. In lieu, thereof, the Government accept the merchant's personal guarantee for 40 per cent. of the value of the credit opened.

Commercial circles in Greece have welcomed this innovation, and hope that still greater facilities will shortly be granted to importers from foreign countries.

Lead.—In their report for February 14th, Messrs. James Forster & Co. state:—

As far as supplies are concerned, the future is full of gravity. There is no indication from Australia of the opening of the Broken Hill Mines which have now been shut down for nine months. From Spain we can expect very short supplies. The Penarroya Co., producing three-fourths or more of the total output of that country, has disposed of the whole of its production for this year on the Continent, and for months past this well-known brand has been practically absorbed in France. From Mexico or America we cannot hope to make up the shortage or anywhere approaching it. General consumers are not active, but still consumption increases, and must increase. The electrical cables and accumulator trades are very busy, and the outlook is towards an enormous expansion. Export trade is getting much too big to be encouraged in view of supplies.

Messrs. G. Cawson & Co. report:—

As we have so frequently pointed out, there are ample supplies of lead available—so long, however, as speculators continue to buy forward lead at extreme figures, the price of prompt metal seems of little importance to them. Some figures have recently been published, calculating that there may be a short supply of lead later in the year. All figures at present are most misleading. Apart from the Government stocks, there is a large quantity in store held privately and further quantities will probably be stored to help to sustain the market. Arrivals this week have been fairly heavy, but exports are trifling. A great point is made of the falling off in Australia, the fact being that Australia is still producing 80,000 to 100,000 tons of lead per annum, so that with available stocks we are sure of getting regular shipments. America remains more or less out of the market, except for bonded Mexican lead. The outlook is no clearer; we still maintain that present prices are far too high, and not justified by the position. There is no disguising the fact that so long as speculators continue to buy and force up prices, consumers must follow and pay up when necessary to cover their requirements.

Liverpool Electrical Dispute.—Our Liverpool correspondent says that Mr. L. G. Tate, the general secretary of the National Federated Electrical Association, has issued a circular appealing to members to make a levy of 5s. per cent. of the total wages paid during the last financial year, stating the reason as follows:—In the Liverpool area the Electrical Trades Union have asked for wide concessions, such as 4s. 6d. per day country allowance, overtime at the rate of time and a half for the first four hours, and then double time, dirt money, danger money, payment for meal times when working night shifts, &c. The circular goes on to state that if these payments are given in Liverpool they will be enforced in other parts of the country. The result has been a complete withdrawal of labour, and Liverpool members were asking what the N.F.E.A. were willing to do if they remained loyal to the Association. There is thus every prospect of a protracted dispute for which a settlement must sooner or later be found. Whether the representatives of the N.F.E.A. on the District Joint Industrial Council were empowered to agree to the new terms or not, it is evident that there have been misunderstandings, and it would appear to the writer a much more wise and saner course to pursue conciliatory methods, instead of hoping for a lasting settlement by the assertion of either side's ability to hold on.

Book Notices.—The *Journal* of the Röntgen Society, Vol. XVI, No. 62, January, 1920 (40 + xviii, pp.), 5s. net. London: Percy Lund, Humphries & Co., Ltd. The "Electrical Notes" review the most recent developments in radiology and kindred research work. Included in the *Journal* are interesting articles by Prof. W. H. Bragg, Dr. A. C. Jordan and other well-known scientists.

"Education and Training for the Electrical and Allied Engineering Industries." A report of the Education Committee of the British Electrical and Allied Manufacturers' Association. London: E. Arnold. Price 3s. 6d. net.

"*Bulletin* of the National Electric Light Association." Vol. VII, No. 1. January, 1920. 92 pp. New York: $3 per annum.—The first number of the new volume has been considerably enlarged and reconstructed. Among many other interesting features are remarkable photographs of electric lighting in New York and elsewhere.

A leaflet issued by Mr. R. Bowden, c/o Messrs. Elt & Co., 14, Bedford Row, W.C. 1, gives a brief summary of some important alterations in the law affecting British patents and designs.

"Wireless Telegraphy" (second edition). By W. H. Marchant, pp. ix + 294; 201 figs. London: Sir Isaac Pitman & Sons, Ltd. Price 7s. 6d. net.

A.O.E.C. Meeting.—The annual general meeting of the Association of Officers and Staff Members of Electricity (Power and Supply) Companies of Great Britain, was held on Tuesday last, when the report of the Executive Committee was submitted. The report stated that Sir A. B. W. Kennedy had accepted the presidency, and pointed out that the new Clause 17 of the Electricity (Supply) Act, for the protection of employés, was practically identical with the proposals put forward on behalf of the Association. The accounts showed a credit balance of £183.

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The Ediswan Staff Association.—This Association is carrying out an attractive programme of social events during the winter season at the Ponders End Works. One of these gatherings was held on the evening of Saturday, February 7th. About 100 members sat down to dinner in the staff café, Dr. C. E. Hiatt presiding. Subsequently a largely-attended concert was provided, Mr. F. H. Holyday officiating as musical director. The recently organised Pierrot Troupe, recruited from the ranks of the staff, made their initial bow to the public, and gave an extremely creditable performance of choruses, duets, solos and humorous interludes, the members of the troupe being: Mrs. Laughton, Miss Horne, Miss M. Warren, Miss N. Bourne, Miss Young, Miss M. Young, Miss E. Outten, Miss Walker, Messrs. H. G. Holyday, G. Tuffill, T. C. Black and E. C. Pembery. Other contributions to the programme were furnished by "Little Jack" and Mr. J. Moore.

Social Club at Enfield.—In connection with the Enfield Ediswan Cable Works Social Club, a successful inauguration social and dance was held on Saturday, February 7th, in the George Spicer schools, Enfield. The company was represented by the president, the Rt. Hon. Viscount Grimston, director, and the following vice-presidents: Mr. F. Plutte, managing director, Mr. A. V. Downton, technical director, and Mr. G. Heffernon, works manager. Various departmental managers, members of the staff, and 300 employés were present. Viscount Grimston, who presided, was given a very hearty reception. He said he regarded the club as a very happy step in the right direction for the promotion of good feeling and social development, and he expressed the opinion that the club could do much good; he wished it success. In referring to present day unrest, he said that we were in danger of becoming somewhat hidebound in our attitude towards present day problems, and tending to level down, and lose our sense of proportion, and wider vision. At the close of the first half of the musical programme Mr. Downton proposed a vote of thanks to Viscount Grimston and Mr. Plutte, and read letters of good wishes from Sir Ralph Ashton and Mr. J. Aspin, two other directors. Viscount Grimston responded. Dancing formed the second part of the programme. The evening was a very enjoyable one, thanks to the artists, the entertainment committee, and some members of the staff. Mr. Ernest Hupfeld is the club's enthusiastic secretary. A series of socials, whist drives, dances, &c., is contemplated.

All through a Calendar.—We hope we succeed in hiding the blushes as we publish the following communication received from the City Electrical Co., of 1, Emerald Street, W.C. In the ordinary course we only publish the correspondence which damns us for our faults, but in this instance we recognise that we are doing the reader, the firm interested, the trade as a whole, and incidentally our humble selves some slight service by giving expression in print to what so many have it in their hearts to say:—

"We thank you for your very courteous acknowledgment of our calendar in the columns of the REVIEW. How widely read and valued are your commendations is evidenced by the extraordinary number of applications we have received for copies. We should esteem it a great favour if you could find space to intimate to your readers that a second issue is being prepared, and all applications will be filled as speedily as may be. The result has convinced us of the value of the REVIEW as an advertising medium, and we have handed your advertising department a 52 insertion contract, the first of which we hope will appear in the current issue. We have purchased the Vulcan Works, Hoxton, which enables us to make the expansion that the great increase in our business has made necessary. Our stocks of new Motors, Dynamos, and Switchgear can now be considerably increased for the service of ELECTRICAL REVIEW readers."

Wages for London Kinema Operators.—The London and Home Counties branch of the Cinematograph Exhibitors' Association of Great Britain and Ireland and the E.T.U. have approved the following rates and conditions for their members employed in the Metropolitan area, *i.e.*, within a 15 miles radius of Charing Cross. There are two main classes, chief operators and second operators. The first class is to be paid the district rate of a journeyman electrician (at present 1s. 9½d. per hour) as a minimum, and chief operators in charge of producing plant the rate of a charge hand electrician (now 1s. 11½d. per hour). A chief operator is defined as one with four years' experience in the work. Second operators are to receive a minimum of 1s. 3d. per hour—the necessary period for qualification being two years. Where the weekly takings of a theatre exceed £120, a chief operator must be employed, but otherwise a second operator may be engaged and paid 2d. per hour extra. Apprentices or probationers must be paid £1 per week for the first six months, rising to £2 for the fourth six months, after which period they become eligible for classification as second operators. Men and women are to be paid equal rates. The maximum working day will consist of 8 hours (Sundays 5 hours). Holidays are to be granted as follows: One week after six months' service, and two weeks after one year. These rates are to take effect as from December 1st, 1919.

Mazda Staff Concert.—A Mazda Bohemian concert was held on February 6th at the Falstaff Hotel, Eastcheap, E.C. An excellent programme of music was rendered, most of the artists being members of the Mazda House staff. The function, the first of its kind since the outbreak of war, was a reunion, the energetic organisers, captained by Mr. W. E. Bush, having brought together many former members of the staff. The chair was occupied by Mr. E. Coote, who, at the unanimous request of the audience, caused a message of sympathy to be sent to Mrs. Willcox, accompanied by earnest wishes for the speedy recovery of Mr. F. W. Willcox, the general manager of Mazda House, who, we regret to learn, has been seriously ill for some weeks.

Whitley Councils for Electricity Supply.—A meeting of the No. 6 District Joint Industrial Council was held in Bristol on Monday, February 16th. Mr. H. Faraday Proctor, chairman, reported the completed list of the employers' representatives as follows:—Mr. H. Faraday Proctor, Alderman G. Pearson and Councillor A. E. Thomas, Bristol; Alderman Sir H. T. Hatt, Bath; Mr. W. J. Bache, Cheltenham; Mr. F. H. Corson, Gloucester; Mr. G. Charlton, Weston-super-Mare; Mr. A. B. Randall, Salisbury; Alderman G. H. Stevens, Swindon; Mr. H. Leather, Minehead; Councillor J. E. Kingsbury, Taunton; Mr. J. Eliot Mills, Keynsham. A return of the undertakings in the area which are paying the 5s. award was reported, also a return of the undertakings which have adopted the 47 and 48 hours' week. A levy to meet the expenses of the District Council was decided upon, an equal amount being required from the undertakings and from the Trade Unions.

Dissolutions and Liquidations.—REX ACCUMULATOR CO., LTD.—Winding up voluntarily. Liquidator, Mr. M. Leggett, Dashwood House, 9, New Broad Street, E.C. Meeting of creditors was called for Wednesday, February 18th.

HEYES & Co., electrical engineers, Douglas Side, Wigan.—Mr. W. A. Heyes and Mr. L. O. Heyes have dissolved partnership. Mr. W. A. Heyes will attend to debts and continue the business.

German Copper Prices.—A wireless message says that the German Raw Copper Association has increased its sale price by 372 marks to 8,877 marks the 2 cwt.—*Times.*

New Norwegian Electrical Company.—The Aktieselskab Nordiske Kabel og Trasdfabriken has decided to raise its capital from 5,000,000 to 10,000,000 kroner.

Catalogues Wanted.—Mr. Edward Birin, Latvian Consul in London, asks for catalogues of electrical machinery and lighting accessories to be sent to him at 4, Draper's Gardens, Throgmorton Avenue, E.C. 2.

The German Glow Lamp Trust.—The combination of wire lamp makers in Germany, to which reference was recently made in this journal, has now been constituted by the formation of a partnership company under the title of the Osram Werke G.m.b.H., Kommandit Gesellschaft, Berlin. The company, which has an ordinary share capital of 1,000,000 marks and a partnership capital of 29,000,000 marks, incorporates the glow lamp works of the German Incandescent Gas Light (Auer) Co., the A.E.G., and the Siemens & Halske Co., and negotiations are proceeding with a view to the inclusion of other glow lamp makers in the country. Mortgage bonds for 30,000,000 marks, and of the 4½ per cent. type, redeemable at 102 per cent., have been issued, and will shortly be offered by a banking syndicate for subscription. The parent companies are all represented on the board of directors, to which a delegate of the National Bank also belongs.

British Trade with Turkey.—We welcome, after between five and six years' suspension, the *Journal* of the British Chamber of Commerce of Turkey and the Balkan States. It makes its re-appearance, the first number since August, 1914, as a monthly Trade journal issued from Constantinople, under date January, 1920. We tender to the organisation our good wishes for uninterrupted and useful service in the interests of British trade. The opening notes, headed "In Memoriam," include a list of the Englishmen in the British community in Constantinople who served in the war and made the great sacrifice. A general survey of the trade situation follows. It goes without saying that the economic and financial situation in Turkey is critical. There is great congestion of goods at Constantinople, some intended for Turkey, and more for South Russia. There is a full list of members of the Chamber, and a good deal of general business information.

Auction Sale.—By direction of the Disposal Board, Ministry of Munitions, MESSRS. HARRIS & GILLOW will sell by auction at Shoreham Camp, Sussex, on March 3rd and 4th, the camp buildings, building material, &c., and a quantity of electrical appliances, &c., including switches, meters, pendants, switchboards, &c.

THE ASSETS AUCTIONS CO. will sell by auction, on February 25th, at Newington Causeway, several tons of brass rod and large quantities of brass terminals, copper plates, lampholders, &c. For full particulars see our advertisement pages to-day.

French Profit-Sharing Proposal.—The *Economic Review* quotes *Petit Marseillais*, stating that according to the Bill submitted to the French Chamber seeking to make compulsory the participation of employés and salaried persons in their employer's profits, the employer should dispose of at least 15 per cent. of his net profits in this manner: 10 per cent. should be divided among the employés in proportion to their average salary for the year; the remaining 5 per cent. should be placed to a regional union fund with the object of distributing the profits equally among employés and workers of the same vocation once a year.

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LIGHTING AND POWER NOTES.

Aberdeen.—New Sub-Stations.—Two new sub-stations are to be erected in King Street and Jamieson Quay. The Town Council is applying for increased borrowing powers to the extent of £145,000.

Alloa.—Price Increase.—The Town Council is increasing the present charges for electricity in the burgh by 20 per cent.

Ammanford.—Electricity Supply.—The proprietor of the supply system has offered to sell the undertaking to the Council for £15,000. Failing purchase, he intends to apply for power to increase charges by 100 per cent.

Bewdley.—Price Increase.—The Electric Light Co. has informed the Town Council that the price for electricity is to be increased to 7d. per unit as from last September.

Birstall.—Breakdown.—Considerable inconvenience and loss to business people were caused by a breakdown at the transformer house at the works of Messrs. Henry Longbottom and Co., through which the locality is supplied. The supply to Birstall was not resumed until the following day.

Blackburn.—New Station.—It is stated that the demands for supply from the new generating station now being erected at Whitebirk will completely absorb the output, and the question of additional plant is already under consideration.

Loan.—The Town Council is applying for sanction to borrow £130,000 to be expended chiefly in extension of the area of distribution.

Bootle.—Loan.—The Bootle Corporation is applying to the Ministry of Health for the loan of nearly £8,000 for the erection of new offices, workshops, and stores, at the Marsh Lane electricity works.

Chepstow.—Tidal Power.—The construction of dams to enable the rise and fall of the tide to be utilised for the generation of electricity, is being considered. The rise of the tide at Chepstow is stated to be the second largest in the world—40 ft.

Chorley Wood.—Time Extension.—The Urban District Council has protested against the continued extension of time for laying distributing mains under the Rickmansworth and Chorley Wood Electric Lighting Order. A further six months has been granted from January 31st last.

Crieff.—Town Lighting.—An expert has been called in by the Council to report upon the cost and practicability of the installation of a lighting scheme, &c.

Dewsbury.—Loan.—The Town Council proposes to apply for a loan of £22,120—£8,500 for the purchase of the necessary plant in connection with a bulk supply from the Yorkshire Electric Power Co., and £13,620 for mains and distribution extensions.

Dundalk.—Inquiry into Prices.—The Council has received sanction to increase the maximum charge for lighting to 10d. per unit. The increase, however, is not yet being imposed, as it is stated that electricity for power is being sold at a loss, and consequently it would be inequitable to recoup the loss by an extra charge for lighting. A Committee has accordingly been appointed to investigate and report upon the subject.

Grantham.—Price Increases.—The Town Council has been notified by the Urban Electric Supply Co., Ltd., that charges for electricity will be advanced as follows, commencing from the December meter readings :—Power, first 100 units per quarter, 7d. per unit; next 3,000, 3½d.; and beyond, 2½d. Heating, first 100 units, 3½d.; and beyond, 2½d. per unit. The company is seeking to raise the maximum to 1s. 2d. per unit, and the Council is opposing.

Grimsby.—Loan.—The Town Council has decided to make application for an amount of £10,000 in addition to the loan of £100,000 already sanctioned. Consumers are to be charged 8s. per annum meter rent, payable in advance.

Kilkenny.—Lighting Scheme.—Applications from consulting engineers are being invited in connection with the formulation of a lighting scheme for the town.

Kirkcaldy.—Supply Undertaking.—Although the demands for electricity exceed the output of the generating station, the Electricity Commissioners will not sanction extensions, and the Town Council is, therefore, contemplating taking a bulk supply from the Fife Electric Power Co., as an auxiliary to the town supply. The Commissioners, however, apparently desire the Council to dispose of its generating station, and receive a supply from the Fife Electric Power Co. only.

Littlehampton.—Town Lighting.—The Urban District Council has given consent to Mr. Prior, of Burgess Hill, to carry out an electric lighting scheme for the town by means of an overhead system.

Liverpool.—Committees.—The City Council has been considering a proposal to appoint separate committees to deal with matters concerning the electricity and tramway departments. At present the two undertakings are combined. An alternative suggestion is that the existing Committee should hold separate meetings for each department.

London.—Hackney.—The report of the Electricity and Finance Committee of the Borough Council for the year ended March 31st, 1919, gives the total income and expenditure as £115,883 and £67,805 respectively, leaving a gross balance of £48,078. The deduction of loan charges, insurance, and other expenses resulted in a net profit of £8,618. The figure for the previous period was £10,763.

Manchester.—Sewage Works.—The Rivers Committee recommends the substitution of electric power for the present steam plant at the Withington Sewage Works. The cost of the installation will be £3,500, and the annual working expenses £1,600, as against the present annual cost of £2,640.

Middlesbrough.—Extensions.—In accordance with the electrical engineer's recommendations, the Town Council has decided to apply for a loan of £69,000. This includes over £20,000 for extension of mains and distributors, £406 for boosters, and £6,000 for a rotary converter.

Plymouth.—Extensions.—The Town Council is applying for sanction to a loan of £54,000 for cable extensions.

Ramsgate.—Proposed Price Increase.—The local Electric Light Co. has submitted for the Council's consideration the draft of a Bill authorising the increase of the present maximum price (8d. per unit) to 1s. 2d. The Town Council will oppose this in conjunction with other public bodies.

Rathmines (Co. Dublin).—Loan.—An inquiry is being made into the circumstances attending the Council's application for power to borrow £10,000. This amount is required for the extension of the electricity undertaking, and to cover work already completed.

Stafford.—Extensions.—The Town Council is applying for sanction to borrow £2,000 for mains extensions, &c. Electricity for shop lighting is to be supplied at the charge of 5d. per unit, subject to a minimum of three lights per shop and a payment of 15s. for the installation of a time-switch.

Stretford.—Plant Purchase.—The Urban District Council has recently purchased the undertaking of the Trafford Power and Light Supply (1902), Ltd.

Sunderland.—Proposed Extensions.—Proposals for the extension of the electricity works, at a total cost of over £127,000, were submitted to the Corporation last week. Among the items put forward are two new boilers, coal-handling machinery, a cooling tower, switchgear, a rotary converter, and the erection of an additional sub-station. The engineer states that the additions will effect a considerable saving. The Electricity Committee asked for time to consider the scheme, and a special meeting is to be called to deal with the matter.

Swansea.—Finance.—The deputy borough treasurer on February 12th sought the approval of the Finance Committee for the utilisation of two sums of £8,000 and £3,000 out of the sinking fund of the electricity undertaking for capital purposes. He said there was a great advantage in applying moneys in this way, inasmuch as if they borrowed money they would have to pay considerably more than by this method. The Committee agreed to this proposal.

Tredegar.—Proposed Electricity Works.—A Parliamentary Bill is being promoted by the Urban District Council, which will enable it, *inter alia*, to erect a power station and commence a supply within two years. The maximum price is fixed at 8d. per unit, subject to an agreed minimum of 13s. 4d. per quarter.

Walkden.—Sub-Stations.—The Lancashire Electric Power Co. has erected a sub-station in Brackley Street in order to cope with increasing demands. Messrs. E. Lane & Sons, cotton manufacturers, have built a private sub-station.

Whitby.—Loan.—The U.D.C. has applied for a loan of £9,000 for electricity purposes, in addition to £21,000 previously sought.

Whitehaven.—Extensions.—The Town Council is applying for a further loan of £4,800, principally for the purpose of mains extensions.

TRAMWAY AND RAILWAY NOTES.

Ayr.—Extensions.—The Town Council has decided to double the track to Prestwick at an estimated cost of £14,400. £30,000 is to be spent on track renewals in the centre of the town.

Bradford.—Slipper Contract.—An invention of the tramway manager, Mr. R. H. Wilkinson, a double-jointed slipper contact, has recently been introduced on the Bradford cars.

Burnley.—Report on Accident.—On December 3rd last, one of the Corporation's cars was ascending the Briercliffe New Road hill, and at a point about 180 yards from the foot of the hill it commenced to run back, eventually overturning on a curve. Five persons were injured, but neither driver nor conductor was hurt. In his report upon this accident, Major G. L. Hall, R.E., states that, upon examination of the damaged car, he found that the

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positive lead of one of the motors had been broken off, which must have resulted in a loss of power, rendering the driver's attempt to apply power by means of the "series notches" ineffectual. Major Hall blamed both driver and conductor for the accident. The former did not use his hand-brake properly, or the car could have been held back; and the latter did not have the track-brake near the rails, in accordance with instructions, as in his evidence he admitted that he had to give the wheel "about 15 three-quarter turns."

Chatham.—YEAR'S WORKING.—The accounts of the Chatham and District Light Railway Co. for the year ended December 31st, 1919, show a gross balance of £26,225, the total revenue and expenditure being £78,840 and £52,615 respectively. After the deduction of rents, interest, &c., the result was a net balance of £14,259.

Dublin.—EMPLOYES' WAGES.—The employés of the Dublin Tramways Co. have accepted the company's offer to increase the wages of men by 5s. a week and boys by 2s. 6d. a week, retrospective as from January 1st last.

Jamaica.—TRAMWAY STRIKE.—The Conciliation Board formed to deal with the tramway dispute has settled the matter by granting substantial increases to both motormen and conductors.

Lancashire.—RAILWAY ELECTRIFICATION.—Referring to the proposed electrical extensions on the Lancashire and Yorkshire Railway Co.'s line at the annual meeting of the shareholders, the chairman said the directors were satisfied with the results of the electrification of the line, and they now favoured an extension of the electrification between Manchester and Oldham, and on to Shaw and Royton. The proposed extension formed part of a complete scheme which was prepared some time ago. As to the suggestion that the line should be electrified as far as Rochdale, that would be considered when they had carried out the scheme as far as Royton, but nothing definite could be done at present.

Leyton.—OPPOSITION TO BILLS.—A meeting to decide the question of opposing the Tramway Bills of the London and Middlesex County Councils is being held on February 24th.

London.—Owing to the failure of a signal, delay was caused on the Piccadilly and Brompton tube on Wednesday last week. On the same day tramcars were held up in the Old Kent Road through a plough jamming.

Surplus stock at the tramcar depôts was disposed of by the London County Council for £11,840.

PARLIAMENTARY BILLS.—The Bills relating to tramway extensions deposited at the House of Commons by the London County Council and the Middlesex County Council have been referred to the Standing Orders Committee for its decision regarding non-compliance with the Standing Order, which stipulates that the consent of local authorities affected by such Bills must be first obtained.

WORKMEN'S FARES.—Referring to the proposed abolition of workmen's fares, Lord Ashfield recently stated that these were merely an old tradition—a form of charity—and wages should now be such as to permit the payment of full fares by the working classes.

HACKNEY.—The London County Council Finance Committee recommends that sanction be given to the Borough Council for the borrowing of £7,300 for the provision of electrically-propelled refuse vehicles and incidental expenses.

Plymouth.—EXTENSIONS.—Among recent proposals adopted by the Town Council were items of £28,000 for the provision of new cars, £30,000 for the establishment of a motor-omnibus service, and £5,000 for plant extensions.

Pontypridd.—EMPLOYES' WAGES.—The Council received a letter last week from the Tramwaymen's Union, asking that the wages of the employés should be brought up to at least the figure now being paid to labourers and scavengers. The engineer and manager (Mr. J. E. Teasdel) supported the suggested increase, but in view of the fact that the tramwaymen were represented on the Tramways Joint District Council, recommended that any action taken should be a concerted one. He added that the wages at present amounted to £26,285 per annum, and the increase suggested would mean a further expenditure of £1,300. This, he thought, would involve a revision of the fares. The manager's recommendation as to concerted action was agreed to.

Prestwich.—OPPOSITION TO BILL.—On the ground that the Salford Corporation is not offering to contribute sufficient towards the maintenance of the roads it will use, the Prestwich and Whitefield District Councils, together with other authorities, have decided to formally oppose the Salford Bill by which it is sought (*inter alia*) to run motor-buses, and extend tramway routes in localities adjacent to the borough. The amount offered by the Salford Corporation is three-eighths of 1d. per car-mile.

Transport Workers' Wages.—Following the application for a wage increase for commercial road vehicle workers, it is reported that the National Transport Workers' Federation has applied for an increase for all tramway and omnibus workers, to bring the wages up to 44s. per week above pre-war rates. The case for the tramway workers will come before the Joint Industrial Council for the tramway industry on February 26th.

Yorkshire.—STORM DAMAGE.—During recent storms the overflowing of the river Aire flooded several tramway routes in the Calder Valley, and caused a great deal of damage. Overhead wires were also torn down.

TELEGRAPH AND TELEPHONE NOTES.

Australia.—The Marconi Co. announces that ordinary telegrams, routed "*viâ* Marconi and Pacific," may be accepted on and from February 16th for Admiralty Island, Australia (including Flinders Island, King Island, and Woodlark Island), Bougainville Island, British New Guinea, Cook or Hervey Islands, Fanning Island, Fiji Islands, Marshall Islands, New Britain, New Hebrides, New Ireland, New Zealand, Norfolk Island, Ocean Island, Samoa, Solomon Islands, Tahiti and Tulagi. The charges for messages so addressed are 2d. less per word than the cable rates specified in Column 2 of the relative pages of the Post Office Guide. These messages may be handed in at Marconi House, Strand, W.C. 2, and 1A, Fenchurch Street, E.C.; or any post office in the United Kingdom.

Bolivia.—Four of the six new lines which are to be added to the telegraph system are now under construction. A wireless station has been installed at Cobija, with offices in Brazil, whereby the north-eastern part of the country is placed in direct communication with the other parts of the Republic.

Denmark.—The Conciliation Commissioner's mediation proposals have been rejected by the Danish telephone workers who remain on strike. It is stated that the proposals differed very slightly from the offers made by the companies.—*Economic Review.*

The strike came to an end during the week-end, the workers having failed to secure the big rise in wages which they demanded six weeks ago.

The Danish Budget for the financial year 1920-21 contains a proposal to construct new telegraph routes, including lines from Copenhagen to Hellerup, Gilleleje, Kallundborg, and Skodsburg.

High-Speed Wireless Transmission.—When, probably in the not very distant future, it has become the normal practice to receive wireless messages much in the same way as ordinary line telegraph messages are nowadays received—that is, in the form of paper-strip inked in the Morse code or printed in Roman character, or when it has also become customary to transfer a wireless message automatically and immediately to land-line instruments, and perform these operations at the same speeds as those now possible in line telegraphy—it will be interesting to have it on record that some of the pioneer work in these directions has been carried out by officers of the Royal Engineers and other workers attached to them. For some time experiments have been in progress at the Signals Experimental Establishment, at Woolwich Common, and it is now found to be quite practicable to handle traffic by wireless telegraphy at speeds of 100 words per minute, using the standard Post Office type of Wheatstone transmitter with punched tape for transmission and the standard Wheatstone inker for reception. It is obvious that a message which can be made to operate an inker, can also be employed to actuate a printer receiver of the Creed or other well-known type, or to operate a line transmitter, and so translate the wireless message direct on to land lines. The first practical tests of this method were carried out between Woolwich and Bedford in July, 1919, when a speed of 62 words a minute was reached. After other trials, with gradually improved instruments, a prolonged test was made between Woolwich and Weymouth, using quite moderate power. The apparatus was not tried at much over 100 words per minute, but perfect records were obtained at the following speeds:—2,017 words in 30 minutes; 901 words in 8 minutes; 379 words in 4 minutes. Those accustomed to handling wireless traffic will readily realise the value of being able thus to receive at speed on a standard inker, and will appreciate the value of this experimental work. It may be added that there would not appear to be very much difficulty from the electrical point of view in attaining very much higher speeds. The only limit is that set by the exigencies of mechanical design.

Iceland.—At the end of 1918 the telegraph and telephone systems comprised 1,402 miles of pole line, 4,139 miles of wire, 140 stations, 1,877 telephone instruments, and 12 telegraph installations. In Reykjavik there were 752 telephone subscribers; in Akureyri, 139; and in Vestmannaeyja, 79.

New Telephone Exchange.—A new public telephone exchange, called Broadway, was to be opened at Jupp Road, Stratford East, on Saturday. The exchange is a temporary one, designed to relieve the Stratford area, and will open with the transfer of 225 subscribers' lines from the exchange. Broadway will be the second new exchange opened since the new year for the relief of existing exchanges, the first being Latchmere, in the Battersea area. A third exchange, to be called Clerkenwell, is nearing completion.

Spain.—A Royal Decree was published on January 18th describing the measures to be adopted in Spain in respect of wireless telegraph and telephone installations. According to the *Board of Trade Journal*, permanent installations are still to be controlled by the Decree of February 8th, 1917, and temporary installations are permitted for a limited period under certain reservations stated in the new Decree, which may be inspected at the Department of Overseas Trade, 35, Old Queen Street, Westminster, S.W. 1.

United States.—According to the report about to be issued showing the result of the census of telephones covering the year 1917, there are 53,234 separate telephone systems and lines, which operated 28,827,188 miles of wire in the United States, and connected 11,716,520 telephones, and 21,175 public exchanges. The

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messages aggregated 21,845,722,335. Figured on the estimated population of the country in 1917, this gives 211 messages per annum to every man, woman, and child. The industry in 1917 gave employment to 262,629 persons, of whom over 65 per cent. were women. The sum paid out in salaries and wages amounted to $175,670,449. These employés operated plant and equipment valued at $1,492,329,015, which yielded operating and non-operating revenues of $391,499,531. The report discusses the development of the telephone industry, telephone equipment and traffic; offers interesting comparisons between the Bell and other systems, and between the telephone system as a whole and the telegraph system; and gives important financial statistics of the industry. The dominating part that the Bell system plays in the industry may be illustrated by the fact that of all the other systems reported, 96·1 per cent. reported annual incomes of less than $5,000. During the decade 1907-1917 wire mileage increased 129 per cent., the number of telephones 102·8 per cent., the number of messages 90·5 per cent. for systems having incomes of $5,000 or more. While the revenue has more than doubled during the decade, the expenses have increased at an even more rapid rate. Salaries and wages paid, advanced from 47·4 per cent. of the total expenses in 1912, to 54·2 per cent. in 1917. For systems reporting annual incomes of more than $5,000 in 1917, the average total revenue per telephone was $38.41, average net income per telephone $6.13, and average surplus per telephone $1.46. This report of the telephone industry is part of the "Census of Electrical Industries" which was taken in 1918, covering the operations of the fiscal year 1917.—*T. & T. Age.*

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the ELECTRICAL REVIEW *in which the "Official Notice" appeared.)*

OPEN.

Aberdare.—Urban District Council. Electricity and Tramways Department. Stores for 12 months, including cables, meters, joint boxes, electric lamps, &c. (February 6th.)

Australia.—MELBOURNE.—March 30th. City Council. 12,000 metal filament incandescent lamps. (February 6th.)

April 12th. City Council. Two 2,000-KW. rotary converters; H.T. switchgear, 6,600 V.; D.C. switchgear, 600 V. (January 30th.)

Bedford.—February 21st. Electricity Department. E.H.T. cable and transformers, E.H.T. switchgear. (February 6th.)

Belfast.—March 10th. Electricity Department. Stores, including meters, cables, electrical accessories, lamps, carbon brushes, &c. (See this issue.)

Belgium.—February 27th. Municipal authorities of Villers-le-Peuplier (Province of Liege) are inviting tenders for the concession for the supply of electrical energy for lighting and power purposes in the district.

Bedwas (Mon.).—March 4th. Bedwas Navigation Colliery Co., Ltd. Six months' supply of stores, including electrical goods, &c. (February 6th.)

Belfast.—March 22nd. Electricity Department. Coal-handling plant. (See this issue.)

Bristol.—February 23rd. Electricity Department. One 2,000-KW., single-phase, 2,200-V. turbo-generator, complete with condenser and auxiliaries. (February 6th.)

Broughton (nr. Chester).—February 25th. Hawarden Union. Installation of electric light at the institution. The Clerk, Union Offices, Broughton, nr. Chester.

Chester-le-Street (Co. Durham).—March 3rd. Urban District Council. Underground mains and all equipment for lighting district by electricity. F. J. Gray, Clerk, Council Offices.

Doncaster.—March 2nd. Electricity Department. Two 3,000-KW., three-phase turbo-generators, with condensing plants. (See this issue.)

Dundee.—February 23rd. Town Council. Electric lighting work at City Hall Buildings. Mr. J. Thomson, City Architect, Muncipal Offices.

Farnworth.—February 25th. Urban District Council. One 750-KW. rotary converter, transformer, switchgear and instruments, cables, &c. (February 13th.)

France.—March 5th. French State Railway authorities, 43, Rue de Rome, Paris. Tenders for an electric lighting and power installation at the new railway works at Sotteville Quatre-Mares, near Rouen.

Gillingham.—February 28th. Electric Light and Power Department. Two 700 to 800-B.H.P. combined Diesel engines and alternators. (See this issue.)

Hammersmith.—March 3rd. Electricity Committee. Stores for 12 months, including electric light sundries, insulated wire, meters, jointing compound, &c. (February 13th.)

Lincoln.—March 2nd. Electricity Department. One automatic battery, for St. Swithin's Power Station. (February 6th.)

London.—Great Central Railway. March 17th. Stores for 12 months, including electrical line construction, electrical apparatus, wires, cables, lamps, &c. Specifications from Mr. W. Williams, Stores Superintendent, G.C.R., Gorton, Manchester.

H.M. Office of Works. February 26th. 12 months' supply of fuseboards, switches, &c. Controller of Supplies, King Charles Street, Westminster, S.W. 1.

Madagascar.—TAMATAVE.—March 1st. Paris, Ministère des Colonies (Service Administratif Colonial). Construction of water and electric supply services in the City of Tamatave, including development of the Volobefalls, and supply of electrical machinery, &c.

Manchester.—February 24th. Tramways Committee. Permanent-way points, tongues and centres; tramway-type amp.-hour meters and general stores, including motor parts, resistances, lamps, cable, &c. J. M. McElroy, General Manager, 55, Piccadilly.

Merthyr Tydfil.—March 9th. Board of Guardians. Electrical fittings for six months. The Workhouse Master.

New Zealand.—DUNEDIN.—April 26th. The Imperial Trade Correspondent at Dunedin has forwarded a copy of the specifications and plans in connection with a call for tenders by the Dunedin City Council for (*a*) electric car bodies; (*b*) car trucks; and (*c*) car equipment. These documents may be consulted by British firms interested, at the Department of Overseas Trade (Development and Intelligence), 35, Old Queen Street, S.W. 1 (Room 49). Copies of the specifications and plans can be obtained from the Town Clerk, Dunedin, on payment of a fee of £1 (returnable as usual).

Salford.—February 23rd. Electricity Department. Two water-tube boilers, with stokers, mechanical-draught plant, &c. (February 13th.)

Uruguay.—February 27th. General Administration of the Electric Power Station of the State. 97,500 electric metal-filament lamps. A copy of the conditions can be seen at the Department of Overseas Trade in London.

The Post Office authorities have decided that public tenders shall be called for the construction of a new national system of telephones for the city and department of Montevideo.—*Review of the River Plate.*

CLOSED.

Bradford.—Tramways Committee:—

Power cables for new cars, at £60 per car.—English Electric Co., Ltd.

Electricity Committee:—

Induced-draught fan and accessories.—Musgrave & Co., Ltd.
Ten motors.—Electromotors, Ltd.
Steelwork at Valley Road Works.—Redpath, Brown & Co., Ltd.
Battery booster.—Mather & Platt, Ltd.
Two H.T. 300-ampere oil switches.—Metropolitan-Vickers Electrical Co., Ltd.
One electric industrial truck, with side-tipping body.—Electromobile (Leeds), Ltd.
Boiler mountings for three new boilers.—J. Hopkinson & Co., Ltd.
Two self-contained impelled draught stokers.—Underfeed Stoker Co., Ltd.

Grimsby.—Town Council. Accepted:—

Coal-handling plant at the electricity works, £3,688.—Herbert Morris, Ltd

Lowestoft.—Electricity Committee. Accepted:—

Induced-draught fan, £857.—Davidson & Co.
Air and exhaust pumps, &c., £1,766; pipework, &c., £500; feed-water purifier, £600.—Belliss & Morcom, Ltd.

Sheffield.—At its last meeting the City Council had before it a statement showing that the Electric Supply Committee had considered the report of the General Manager giving particulars of tenders which were referred back to the Committee at the January Council meeting on the protest raised by Councillor Graves at the absence of any details. The Committee report, says the *Sheffield Daily Telegraph*, that "in view of the fact that the Finance Consultative Committee, acting on an instruction of the Council, have under consideration, at the present time, a question as to what matter shall be printed on minutes for submission to the Council, the Committee did not deem it advisable to give full details of the tenders referred to. They wish to inform the Council, however, that the total amount involved in the acceptance of such tenders is £104,351 4s. 3d., and they reaffirm their previous decision to accept the tenders, and recommend that the Corporate Common Seal be affixed to the necessary contracts."

Sunderland.—Electricity Committee. Accepted:—

Ressoils, Ltd.—Transformer oil.
Ferguson, Pailin, Ltd.—H.T. switchgear.
Ferranti, Ltd.—Ampere meters.

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London.—STEPNEY.—ELECTRICITY SUPPLY COMMITTEE.—The Council, on December 10th, 1919, decided to advertise for tenders for the supply of a 5,000-KW. turbo-alternator, with condenser, accessories, and switchgear, but contractors were also invited to tender for the largest set which could be accommodated in the space available :—

TURBO-ALTERNATOR, &C., FOR LIMEHOUSE STATION.

Size of set.	Name of tenderer.	Price.	Delivery.	Remarks.
KW.		£		
5,000	Adamson, D. & Co. Ltd.	50,495*	Oct., 1920	—
,,	Ateliers de Construction Oerlikon.	48,775*†	18 mths	—
,,	B.T.H. Co., Ltd.	(a) 48,712* (b) 48,662 (c) 48,642	15 mths	(a) "Grice" air-filter. (b) "Sturtevant" air-filter. (c) "Davidsons" air-filter.
,,	Brush Elec. Eng. Co., Ltd.	48,677	Uncertain	—
,,	Cole, Marchent and Morley, Ltd.	14,900	Oct., 1920	For condensing plant only.
,,	English Electric Co., Ltd.	45,877	6 mths ex site	—
,,	Escher, Wyss & Co., S.A.	(a) 50,569 (b) 52,821†	11 mths ,,	(a) Oerlikon alternator. (b) Brown, Boveri alternator.
,,	Fraser & Chalmers (Prop. G.E. Co.)	47,367*	11 mths	—
,,	Hick, Hargreaves and Co., Ltd.	14,650	10 mths	For condensing plant only.
,,	Metropolitan-Vickers Elec. Co., Ltd.	49,647*	10 mths ex works	—
,,	Mirrlees Watson Co., Ltd.	16,960	Oct., 1920	For condensing plant only.
,,	Parsons, C. A., & Co., Ltd.	47,850	Uncertain	Set quoted for since "sold."
,,	Reyrolle & Co., Ltd.	(a) 9,027 (b) 9,733	Oct., 1920 ,,	(a) As per existing board. (b) For stronger tanks and double-breaking capacity of switches. For switchgear only.
,,	Richardsons, Westgarth, Ltd.	(a) 47,334* (b) 47,494	7 to 8 mths ex works	(a) Two-jet air-pump. (b) Rotary air-pump.
6,000	Parsons, C. A., & Co., Ltd.	52,450	10 mths	—
6,500	English Electric Co., Ltd.	47,999	10 mths ex site	—
10,000	Fraser & Chalmers ..	69,008*	11 mths	—
,,	Parsons, C. A., & Co., Ltd.	61,050	12 mths	—
10,000	Cole, Marchent and Morley, Ltd.	24,857	Oct., 1920	Condensing plant only.
,,	Escher, Wyss & Co....	(a) 79,204† (b) 82,634†	13 mths ,,	(a) Oerlikon alternator. (b) Brown, Boveri alternator. If with Mirrlees Watson ejector air pump, price reduced £915.
,,	Hick, Hargreaves and Co., Ltd.	25,850	10 mths	For condensing plant only.
,,	**Metropolitan-Vickers Elec. Co., Ltd.**	**72,156*** (Recommended)	12 mths ex works	For an extra £1,750 a reduction of ·3 lb. in steam consumption will be guaranteed.

† Price calculated at 19 fr. = £1 sterling. To vary with rate of exchange.

* Tenders marked thus were sent in incomplete, and have been completed by adding in the figures of other tenderers, which is an arrangement agreed between the members of the British Electrical and Allied Manufacturers' Association.

The Committee recommends that the tender of the Metropolitan-Vickers Electrical Co., Ltd., for a 10,000-KW. turbo-alternator be accepted at £72,156 plus an extra £1,750 in order to secure a guarantee of a reduction of ·3 lb. per unit in steam consumption from the figure set out in the main tender.

Two water-tube boilers (recom.) .. **£43,914 Babcock & Wilcox, Ltd.**

1½ miles of conduits, and 2½ miles of troughs and covers.

Sutton & Co. (recom.)	**£1,875**
Henley's Telegraph Works Co., Ltd.	2,078
Siemens Bros. & Co., Ltd...	2,104

House service cable.

Henley's Telegraph Works Co., Ltd. (recom.) ..	**£558**
B.I. & Helsby Cables	571
W. T. Glover & Co.	585

FORTHCOMING EVENTS.

Birmingham and District Electric Club.—Saturday, February 21st. At the Grand Hotel, Colmore Row. At 7 p.m. Paper on "Electric Vehicles," by Major R. V. C. Brook.

Liverpool Engineering Society.—Monday, February 23rd. At the University, Liverpool. At 5.30 p.m. Lecture on "Aviation: the Past, the Present, and the Future," by Major-General Sir Frederick Sykes.

British Industries Fairs.—Monday, February 23rd to Friday, March 5th. At the Crystal Palace and the Castle Bromwich Aerodrome, Birmingham.

Institution of Civil Engineers.—Tuesday, February 24th. At Gt. George Street, S.W. At 5.30 p.m. Ordinary meeting.

Royal Institution of Great Britain.—Tuesday, February 24th. At Albemarle Street, W. At 3 p.m. Lecture on "Magnetic Susceptibility," by Prof. E. Wilson.

Friday, February 27th. At 9 p.m. Lecture on "Problems of Lubrication," by Mr. W. B. Hardy, F.R.S.

Illuminating Engineering Society.—Tuesday, February 24th. At the Royal Society of Arts, John Street, Adelphi, W.C. At 8 p.m. Discussion on Lighting Conditions in Mines," to be opened by Dr. T. Lister Llewellyn.

Paisley Association of Electrical Engineers.—Wednesday, February 25th. At the Y.M.C.A., 25, High Street. At 7.30 p.m. Paper on "The Historical Development of the Design of Generators," by Mr. A. McCrorie.

Edinburgh Electrical Society.—Wednesday, February 25th. At the Philosophical Institution. At 7.30 p.m. Paper on "Electrical Projectors and some of their Uses," by Mr. A. Ogilvie.

Institution of Electrical Engineers.—Joint meeting with the Röntgen Society and the Electro-Therapeutic Section of the Royal Society of Medicine. Thursday, February 26th. At the Royal Society of Medicine, Wimpole Street. At 5.45 and 8.15 p.m. Papers on "The Efficiency of High-tension Transformers as used for X-Ray Purposes," by Dr. R. Morton; "The Problem of Interrupted and Fluctuating Currents," by Major C. E. S. Phillips; and "High-tension Transformers," by Mr. R. S. Wright.

(North-Eastern Centre).—Monday, February 23rd. At the Armstrong College, Newcastle. At 7.15 p.m. Lecture on "Some Magnetic Problems," by Mr. L. H. A. Carr.

(North-Western Centre).—Tuesday, February 24th. At the Engineers' Club. At 7 p.m. Informal discussion on "Electricity Supply Tariffs."

(North Midland Centre.)—Friday, February 27th. At the Queen's Hotel, Leeds. Annual dinner. Reception 6.30 p.m.; dinner 6.45 p.m.

(South Midland Centre).—Wednesday, February 25th. At the Library, Margaret Street, Birmingham. At 7.30 p.m. Paper on "Transformers for Electric Furnaces," by Mr. J. L. Thompson.

Junior Institution of Engineers.—Thursday, February 26th. At 6.30 p.m. Visit to the Works of the British Oxygen Co., Ltd., at East Greenwich.

Friday, February 27th. At 89, Victoria Street, S.W. Lecturette on "Defects Found on Inspection of Boilers," by Mr. R. H. Kenyon.

Wireless Society of London.—Friday, February 27th. At the Royal Society of Arts, John Street, Adelphi, W.C. At 8 p.m. Lecture on "Some Wireless Wonders," by Mr. Alan A. Campbell Swinton.

Association of Engineering and Shipbuilding Draughtsmen.—Thursday, February 27th. At 7.30 p.m. At the Engineering Lecture Theatre, Liverpool University. Lecture by Prof. E. W. Marchant, D.Sc., on "Wireless Telegraphy."

NOTES.

Another American Turbine Failure.—Damage to the extent of $100,000 was caused at the Regina, Sask., city power station on January 8th, says the *Engineer*, when the rotor of one of the large steam turbines burst and completely wrecked the set. As a result, the tramway system was temporarily at a standstill.

Electric Vehicle Progress.—The provision of plant for a charging station for electric vehicles for refuse collection has been considered by the Hackney Borough Council. The tenders for the motor-generator (250 amperes, 110 volts) included the following :—Lancashire Dynamo and Motor Co. (780 B.P.M.), £475, and (1,000 B.P.M.), £445 ; J. H. Holmes (900 B.P.M.), £445 ; Electromotors, Ltd. (710 B.P.M.), £432 12s. ; British Thomson-Houston Co. (815 B.P.M.), £415 ; Electric Construction Co. (1,300 B.P.M.), £280 and (1,000 B.P.M.), £330. For the charging switchgear the quotations were :—Lancashire Dynamo and Motor Co. £629 ; J. H. Holmes, £480 ; and Igranic Electric Co., £433 10s. The Public Health Committee recommended the acceptance of the tender of the Electric Construction Co. for the supply of the motor-generator for £330, and of the Igranic Electric Co. for the provision of the charging switchgear for £433 10s. The first four electric vehicles will be supplied by Ransomes, Sims & Jefferies, the contract price being £5,118 for two 2-tonners and two 3½-tonners, fitted with side-tipping arrangements. The Harwich Town Council is applying for permission to borrow £3,000 for the purchase of two electric vehicles. The Works Committee of the Ilford Urban Council has recommended the acceptance of a tender by Ransomes, Sims & Jefferies, for the supply of six "Orwell" electric vehicles, required for refuse collection purposes. The London Metropolitan Asylums Board has entered into further agreements with the Tudor Accumulator Co. for the maintenance for a year of the electric batteries of two vehicles at a cost of 2½d. per mile run. The Pontypridd Urban Council is to obtain another Edison accumulator electric vehicle for the sanitary services.—*The Electric Vehicle.*

A large British engineering firm has definitely decided to take up the manufacture of electric battery vehicles. This development, which is important in itself, is also an indication of the trend of events in electric vehicle production. There is a very large unsatisfied demand for battery vehicles of all kinds, and existing makers are seriously preoccupied with the difficulties of delivery.

Searchlight Officers.—All officers who commanded searchlight sections in France are requested to send their names and addresses to Major A. W. Mawby, O.B.E., R.E., 47, Penywern Road, Earl's Court, S.W. 5. This request is not with a view to immediate re-mobilisation, but in order that he may furnish as complete a list as possible to Captain K. M. Locke, M.C., who is organising an annual dinner of all anti-aircraft officers, later in the year, at which searchlight officers will be welcome; and also to enable Major Mawby to keep a record for the purpose of a regular annual reunion dinner of Overseas Searchlight Officers. The first Overseas Searchlight Officers' Dinner, to which Major Mawby invited all with whom he was able to get in touch, was held at the Trocadero Restaurant on January 30th. The following were present :—Major T. Rich, O.B.E. (in the chair), Major Mawby, Captain Ffrench-Mullen, Captain A. W. Sproule, Messrs. L. C. Baldwin, Baumann, Bazalgette, Bodkin, Cox, Crosley, Done, Duckworth, Foulger, Hort, Myles, Raphael, Rawlings, Reed, Staunton, Wadham, K. L. Wood, and Voss. The speeches were of an informal character, and the gathering was a great success. Most of those present had not met one another since they had been in France, and many reminiscences were exchanged.

Direct United States Cable Co., Ltd., v. Western Union Telegraph Co., Ltd.—This action was before Mr. Justice Peterson in the Chancery Division on February 16th and 17th, and was adjourned until Monday next.

Freemasonry.—An emergency meeting of the Kelvin Lodge will be held at the Mark Masons Hall, Great Queen Street, London, W.C., on Friday, 27th inst., at 4.45 p.m. The secretary is Mr. H. W. S. Rentell, 36, Maiden Lane, W.C. 2. (Telephone : Gerrard 2460.)

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Worse to Follow!—The following letter was reproduced in facsimile in the *E.T.Z.* of December 18th, under the heading, "The Reply of a 'Gentleman.'" An explanatory paragraph stated that the Dutch branch of the Siemens-Schuckert Co. had received a telegram from Bombay in August last year, of which the contents were not intelligible. It was thought that the message came from the Bombay representative of Siemens Brothers Dynamo Works, who was politely asked for enlightenment. After saying that the reply is characteristic of the culture and disposition of the writer, the *E.T.Z.* remarks that comment is unnecessary.

We fear the "Germhuns" will begin to think we don't like them, if they receive many more letters of this kind :—

SIEMENS BROTHERS DYNAMO WORKS, LTD.
Rampart Row, Bombay.
Siemens-Schuckertwerke 3—10—1919.
8, Gravenhage, Huygenspark 39 C.

We have received your letter No. 26 A R dated September 2nd, 1919. Your statement that we sent you a cablegram about August 24th last is a rotten lie—worthy of a Hun.

We do not know what the purpose of your letter is, but if it is an endeavour to start correspondence with us, with a view to business, we can tell you straight that during the writer's lifetime he will not touch anything German again, as it stinks, like your name.

We also do not want your friendly greetings—from Germhuns!

We do not want our customers to know that we have received letters from Germhuns, so do not write us again—if you do we will write you back a really nasty letter.

It is, of course, difficult to express in words what an ordinary decent-minded Britisher thinks of the German Huns, but you may be able to guess from the foregoing.

SIEMENS BROS. DYNAMO WORKS, LTD.,
(Signed) GEO. BARNES, *Manager*.

Appointments Vacant.—Telegraph inspectors (£200 + £65) for the Posts and Telegraphs Department in the Tanganyika Territory; executive engineer (£750) for the Nigerian Government Public Works Department; lectureship in electrical engineering for the Birmingham Municipal Technical School; draughtsman for the City of Leicester electricity department; electrician and electrical fitter for the Londonderry Corporation electricity department; charge engineer (90s.) for the Corporation of Stafford electricity department; switchboard attendant (37s. 6d. + 38s. 6d. + 12½ per cent.) for the City of Chester electricity department; sub-station attendant (82s. 8d.) for the Stoke Newington Borough Council electric light station; control engineer for the Yorkshire Electric Power Co.; mains assistant (£240) for the Borough of Aylesbury electricity department; shift engineer (£300 + £120) for the Electric Light Department of the Government of Nigeria. See our advertisement pages to-day.

Fatalities.—An inquiry was held at Bradford, last week, relative to the death of Thomas Beaumont, labourer, who was killed whilst manipulating an electric drill at the works of Messrs. Croft, Ltd., engineers, Empire Works, Thornbury, Bradford. The evidence showed that the man had been previously employed on similar work. Mr. Lewis Jessop, electrical engineer, Bradford, said, in his opinion, the flexible wire attached to the drill had been fractured, as the result of its having come into contact with, and been wound round the twist drill. The ends of the live wire and the casing of the drill coming into contact would cause the casing to become "alive." It would be safest for an earth wire to be attached when a portable drill of that kind was being used, but there was insufficient proof that even an earth wire would have prevented the accident. Verdict, "Accidental death."

At Wakefield, a verdict of "Death from misadventure" was returned at an inquest held on the body of a railway guard, named H. Riley, who was killed while on his way home from his work on the morning of January 29th, when a violent storm was raging. In going to the assistance of a fellow workman, who had got entangled in some telephone wires which had blown down, he himself also became entangled, and was killed through the wires coming into contact with the "live" tramway overhead wires. It was stated that at this particular point there were no guard wires over the trolley wires, and this was because the tramway company had been unable to procure a supply of guard wire. Before the war the tramway system of the Yorkshire (W.R.) Electric Tramways Co., Ltd., had been efficiently equipped with protective wires at all points.

An inquest was opened on 11th inst. into the death of Harold B. Hill, aged 30, an engineer, who was found dead with his hands badly burned, at the Islington electricity works at Upper Street. F. A. Jones, charge engineer, said that Hill relieved him at 11 p.m. on the previous Saturday. The medical evidence showed that both hands were burnt, and that there was a cleaning rag under deceased's thigh; there were blisters on the wrists and hands. Death was due to heart failure consequent upon shock. The inquiry was adjourned.

Oersted Centenary.—In honour of Oersted, the discoverer of electromagnetism, it is intended to hold an international centennial congress this year at Copenhagen, from August 31st to September 4th. In view of the many-sided influences of Oersted's discovery, the scope of the congress will be widened to include physics and chemistry, the congress being divided into three sections, represented as under:—Electrotechnical—Prof. P. O. Pedersen, chairman; Mr. Povl Vinding, engineer; and Mr. Aage Hassel, manufacturer. Physical—Prof. Dr. Martin Knudsen, chairman; Madame Dr. Kirstine Meyer; and Prof. K. Prytz. Chemical—Prof. Dr. S. P. L. Sorensen, chairman; Mr. Paul Bergsoe, engineer; and Prof. Dr. Einar Bellmann. The complete programme of the business of the congresses has not yet been drawn up. Prof. Dr. Martin Knudsen is the chairman of the Organising Committee.

Ships' Lights Committee.—The President of the Board of Trade has appointed a committee, under the chairmanship of Mr. Clifford C. Paterson, O.B.E., M.I.E.E., to consider the question of laying down standards for ships' lights to comply with the requirements of the International Collision Regulations.—*The Times.*

Educational.—Glasgow University has accepted an offer of £5,000 to establish a lectureship in electrical diagnosis and therapeutics at the Western Infirmary.—*The Times.*

INSTITUTION NOTES.

Institution of Electrical Engineers.—At the meeting last week, the President announced that the Council had decided to reimpose the condition, as from February 29th, that those seeking election as Associate Members must pass the Institution examination or one of the exempting examinations. In the case of a man being 35 years of age or over, the examination might be dispensed with, at the discretion of the Council. Another long list of candidates for election was approved; there were 215 names, including 54 Associate Members and 141 Students. This brings the membership up to 8,505.

Applications for tickets for the annual dinner at the Connaught Rooms, Great Queen Street, W.C., on March 4th, 1920, should be made to the Secretary of the Institution, No. 1, Albemarle Street, W. 1. not later than Saturday, February 28th.

INFORMAL MEETING.—On Monday, Mr. A. B. Eason read a short lecture on "Automatic Telephony for Private Branch Exchanges," before a full attendance. Explaining that he was concerned only with private exchanges which were not connected to the public telephone system, the author briefly outlined the principles of working of the chief types of apparatus, and discussed their advantages in comparison with private manual exchanges and intercommunication telephone installations. At the conclusion of the lecture, leaflets giving many references to books, articles, and papers dealing with the subject of automatic telephony were distributed. A discussion followed, in the course of which many questions were put to, and answered by, the author. The chairman reminded the meeting of the "Informal Social Evening" to be held on March 29th.

NORTH-WESTERN CENTRE.—At the meeting held on February 10th, Lieut.-Colonel F. C. Aldous and Mr. A. E. L. Scanes delivered a lecture on the electric power supply in the Rhine Valley, a report of which will be published later.

SOUTH MIDLAND CENTRE.—An interesting "full dress" debate on "The Uses of Gas and Electricity for Heating and Power," took place at the University of Birmingham on February 5th, and was attended by 350 gas and electrical engineers, industrial chemists, metallurgists and mechanical engineers. The occasion was a joint meeting of the Midland Junior Gas Association and the South Midland Centre of the Institution, and the chair was occupied by Mr. Councillor E. C. R. Marks, M.I.Mech.E. Very general interest was taken in the proceedings in gas and electrical engineering circles. A report of the proceedings will appear in a later number of the ELECTRICAL REVIEW.

SCOTTISH CENTRE.—It is reported that the sum of about £200—the surplus of the fund collected by the Institution and the Electrical Contractors' Association, for the formation of a signal company of the City of Glasgow Royal Engineers during the latter years of the war—has been handed over to the Benevolent Fund of the Institution.

Roentgen Society.—The "Silvanus Thompson Memorial" lecture will be delivered by Prof. W. H. Bragg, C.B.E., F.R.S., on March 2nd. The subject chosen is "Analysis by X-rays."

Institution of Engineers (India).—The offer of the I.E.E. (London) of a £20 premium annually for five years, to be awarded to the author of the best paper on an electrical subject read before the above new Institution, has been accepted. The Institution has taken temporary premises at D/5, Clive Buildings, Clive Street, Calcutta, where all communications should be addressed.

The Wireless Society of London.—The next meeting of this society will take place on Friday, February 27th, at 8 p.m., in the lecture hall of the Royal Society of Arts. The President, Mr. Alan A. Campbell Swinton, F.R.S., will deliver his address, the subject of which will be "Some Wireless Wonders." The address will be illustrated by experiments. In the afternoon of the same day a conference of Provincial Wireless Societies, which have recently become affiliated to the Wireless Society of London, will be held at 3 p.m., also at the Royal Society of Arts. Intending new members may apply for particulars of the Wireless Society of London, to the hon. secretary, Mr. L. McMichael, 32, Quex Road, West Hampstead, N.W. 6.

Edinburgh Electrical Society.—A lecture on "The History and Development of X-Ray Apparatus" was delivered by Mr. W. Law at the meeting on February 11th. The author dealt in a thorough manner with the evolution from the crude vacuum tubes first used,

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to the highly efficient adjustable tubes now employed for examination and curative applications of X-rays. Various interrupters were illustrated, and their special qualities discussed in detail. Equipments of the portable and hospital types were shown. The next meeting will take place in the Philosophical Institute on February 25th, when Colonel Ogilvie will lecture on "Projectors."

Faraday House.—The annual dinner will in all probability be held during the second or third week of April, and in view of the large membership, now over 500, a record attendance of members and friends is expected.

Colonel Hubert Sparks, C.M.G., &c., M.I.E.E., M.I.Mech.E. (F.H. 1891-92), has been elected a Governor.

Diesel Engine Users' Association.—At the February meeting a considerable amount of interest was evinced in the discussion which took place after the reading of Mr. Geoffrey Porter's paper on "Wear of Diesel Engines." The author stated that liner wear was chiefly influenced by the percentage of ash content in the fuel oil and its variable nature according to the class of fuel used, the lubrication, the fit of pistons and piston rings, &c., and pointed to the deleterious effect of excessive cylinder lubrication, which resulted in the formation of carbon deposits on the piston. Mr. G. W. F. Horner, referring to the wear of fuel-pump plungers, stated that he had found no appreciable difference since using tar oil fuel as compared with petroleum. Mr. A. N. Rye had not noticed that the use of tar oil fuel had been detrimental to cylinder liners, but it had a marked effect on valves and other portions of the engine gear. He referred to the effect of granite dust in the air in the case of some engines situated near a granite quarry. The abrasive effect of the granite dust introduced into the power house when the wind was in certain quarters had caused a considerable amount of trouble in the cylinders until air-filters had been introduced.

Institute of Metals.—The annual general meeting of the Institute will be held on March 11th and 12th, at the Institution of Mechanical Engineers, when, among other papers, the following are to be read:—"Fifth Report to the Corrosion Research Committee," "The Effect of Progressive Drawing upon Some Physical Properties of Commercially Pure Copper," "The Influence of Cold Rolling on the Physical Properties of Copper," and "The Study of Thermal Electromotive Force as an Aid to the Investigation of the Constitution of Alloy Systems." The annual dinner is to be held at the Criterion Restaurant on March 12th, at 8 p.m. It is also announced that the next gathering of members will not take place on May 5th, as previously stated, but on June 10th, when a lecture on "Recent Progress in Thermo-Electricity" will be given by Prof. Carl A. F. Benedicks, Ph.D., of Stockholm.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

The salary of Mr. J. HUTCHINSON, electrical engineer to the Farnworth District Council, has been advanced by £100 per annum.

Mr. THOMAS A. EDISON celebrated his 73rd birthday on February 11th, and in connection with this event the Edison Pioneers arranged to have their annual luncheon with Mr. Edison at his laboratory, Orange, New Jersey, on that date. During the war he devoted his time to the Naval Consulting Board of the Navy Department, U.S.A., and paid the expenses of a large staff of experts. An interesting feature of the celebration is that "73" is the symbol used by telegraphers in expressing greeting.

The salary of Mr. J. DOWNIE, chief clerk of the electricity department, has been increased by the Aberdeen T.C. to £350.

Mr. H. H. PARKER is resigning his position as War Department superintendent electrical engineer, South Irish District, and is taking up the appointment of engineer and manager of the Holmfirth U.D.C. electricity undertaking, having been selected from among 127 applicants.

A correspondent is anxious to get into touch with Mr. Henry Stafford Hatfield, and would like to know his address.

Mr. W. INNES, formerly deputy electrical engineer to the Borough of Poplar, and latterly a partner in the late firm of Towler & Innes, engineers, London, has joined the board of the Westminster Engineering Co., Willesden, and has been appointed joint managing director.

At the last meeting of the Railway Telegraph and Electrical Engineers' Conference, Mr. W. WOOD, electrical engineer of the North British Railway, was elected president.

Lieutenant H. G. Ross, Devon Fortress Engineers (Electric Lights), has relinquished his commission owing to ill health contracted on active service.

Dublin Corporation Lighting Committee has elected Mr. J. FARREN, representing the Labour Party, to the chairmanship.

The *Times* announces that the First Commissioner of His Majesty's Works and Public Buildings has appointed Mr. H. BAINES, O.B.E., to be chief engineer to H.M. Office of Works, to succeed Mr. H. A. McFerran, O.B.E., who has retired.

Stoke Newington B.C. Electricity Committee has appointed Mr. E. P. LOVELL (an ex-soldier) business representative to canvass the borough for new consumers of electricity, at £4 per week, plus 10s. war bonus, and a commission of 2s. 6d. per KW. connected at his instance.

Mr. N. B. ROSHER, O.B.E., M.I.E.E., &c., has resigned his appointment with the Ministry of Munitions in order to rejoin his firm, Messrs. Moffett & Rosher, consulting and inspecting engineers, of 63, Temple Row, Birmingham.

Mr. J. S. BUCKLEY, late of the County of London Electric Supply Co., Ltd., leaves Liverpool on the s.s. *Oriana* on February 21st to take up a position with the Chilian Electric Tramway and Lighting Co., Ltd., as engineer in charge of laboratory and instrument testing.

Obituary.—MR. C. M. DORMAN.—We regret to learn that Mr. Charles Mark Dorman, managing director of Messrs. Dorman & Smith, Ltd., passed away suddenly at Llandudno on Thursday, February 12th. Mr. Dorman showed signs of illness just before Christmas, and his heart was causing anxiety to his friends. It was hoped that a few weeks' holiday at Llandudno would have been beneficial. Unfortunately his condition became very serious whilst staying at Llandudno, until he became too ill to be moved. He was a well-known pioneer of electrical work, and some of the switchgear designs originated by him in the 'eighties are still good practice at the present time. Born at Northampton in 1861, he was educated at Birkhampstead and the Yorkshire College, and afterwards served an apprenticeship in the works and drawing office of the Hunslet Engine Co., where he did much valuable work in the way of locomotive design. In the year 1881 he and Mr. R. A. Smith, who later became his partner, deserted locomotive engineering and joined the late Mr. J. S. Raworth as his assistants. Mr. Dorman carried out some of the very earliest electrical installations on board ship, and was responsible for many of the early designs of switchgear and other electrical apparatus. When Mr. Raworth left Manchester Mr. Dorman and Mr. Smith took over the small works which he had established, and have since gradually developed the important business which is now carried on as Dorman & Smith, Ltd. Mr. Dorman was of an extremely genial and hospitable disposition, and will be much missed by his many friends. His health appeared to be fairly good until a few months ago. The end came rather suddenly through heart failure. It is probable that the death of his only child, a very promising young student, who accidentally lost his life while training for military service, has been the primary cause of his comparatively early decease.

LIEUTENANT W. CHEETHAM.—Lieut. William Cheetham, of Blackpool, who recently passed away, was prior to the war employed at the Blackpool Electricity Works.

MR. G. J. T. ALDER.—The death occurred on February 9th of Mr. G. J. Thornton Alder, electrical engineer and contractor, of 53, Victoria Street, S.W. 1. Mr. G. W. Alder will continue the business.

MR. A. PRATT.—The death occurred on February 5th, after a brief illness, of Mr. Arthur Pratt, who had for 22 years carried on business as an electrical engineer at Hornsey.

NEW COMPANIES REGISTERED.

Sydney Anderson, Ltd. (163,783).—Private company. Registered February 6th. Capital, £1,000 in £1 shares. To carry on the business of electricians, motor and mechanical engineers, &c. The subscribers (each with one share) are: S. Anderson, 58a, Sydenham Road North, Croydon, engineer; P. T. Silcott, 46, Kidderminster Road, West Croydon, mechanic; W. A. S. Hellyar, 28, Park Lane, Croydon, solicitor. The first directors are not named. Registered office: Wellesley Works, Wellesley Court Road, Croydon.

Symington (Lanarkshire) Electric Supply Co., Ltd. (10,948).—Private company. Registered in Edinburgh February 5th. Capital, £2,000 in £1 shares. To carry on the business of electrical engineers, electricians, practical engineers and contractors, manufacturers of electrical apparatus, &c. The subscribers (each with one share) are: J. Cassels, Silverwells, Hamilton, solicitor; D. A. Hay, 105, St. Vincent Street, Glasgow, C.A. The first directors are: J. Cassels, D. A. Hay, T. Duncan, J. C. Jarrat, and J. W. McDonald. Qualification, 50 shares. Secretary: D. A. Hay. Registered office: 105, St. Vincent Street, Glasgow.

Hubert D. Carter (Bangor), Ltd. (163,797).—Private company. Registered February 7th. Capital, £5,000 in £1 shares (2,000 preference). To carry on the business of electrical, motor, hot water and mechanical engineers and consultants, dealers in electrical and other plant and appliances and mechanical toys, &c., as formerly carried on by H. D. Carter at Faraday House, 249, High Street, Bangor. The first directors are: H. D. Carter (governing director), Glenhurst, Colwyn Bay, electrical engineer; E. P. Carter, Glenhurst, Colwyn Bay, electrical engineer. Solicitor: A. F. Brookes, Public Hall, Colwyn Bay.

Telephone Installations (London), Ltd. (163,690).—Private company. Registered February 4th. Capital, £2,000 in £1 shares. To carry on the business of manufacturers and installers of private telephone systems, &c. The subscribers (each with one share) are: G. H. Hanson, 102, Gravelly Hill, Birmingham, telephone engineer; A. H. Hanson, 9, Beaufort Road, Gravelly Hill, telephone engineer. Table "A" mainly applies. Solicitors: Cochrane and Cripwell, 119, Finsbury Pavement, E.C. Registered office: 14, Snow Hill, Birmingham.

Stoneycroft Electrical Works, Ltd. (163,831).—Private company. Registered February 16th. Capital, £3,000 in £1 shares. To take over the business of a general electrical and engineering contractor carried on by F. S. Ormonde at 20, St. Anne Street, Islington, Liverpool, as the "Stoneycroft Electrical Works." The first directors are: F. S. Ormonde, 50, Inigo Road, Stoneycroft, Liverpool, electrical engineer; E. C. Day, 42, Oriel Road, Bootle, Liverpool, marine engineer; A. Huntington, 219, Edge Lane, Liverpool. Solicitors: Reynolds and Reynolds, 15, Lord Street, Liverpool.

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Hackbridge Electric Construction Co., Ltd. (163,753).—Private company. Registered February 6th. Capital, £25,000 in £1 shares. To carry on the business of electrical, mechanical and general engineers, manufacturers of and dealers in transformers, radiators, dynamos, motors and all kinds of electric lighting, power and transmission plant, &c. The subscribers (each with one share) are: C. W. Bloomfield, Highlands, Foxley Lane, Purley, Surrey, engineer; R. L. Morris, 6, Eastcombe Avenue, Charlton, S.E.7, engineer. C. W. Bloomfield is permanent governing director. Solicitor: F. W. Simmonds, Broad Street House, E.C. Registered office: London Road, Hackbridge, Surrey.

Lloyd's Electro-plating Works, Ltd. (163,925).—Private company. Registered February 11th. Capital, £1,000 in £1 shares. Objects: To take over the business of electro platers, lacquerers and oxydisers of metals, &c., carried on by J. W. Lloyd, and recently by R. J. Weston (as trustee under deed of assignment) at 39, Castle Street, Derby. The first directors are: J. W. Lloyd (managing director), 39, Castle Street, Derby, electro plater; A. Green, M.P., The Knoll, Normanton, Derby; D. Sibbald, Keddleston Road, Derby, C.A. Registered office: 39, Castle Street, Derby.

Aladdin (Lancashire and Yorkshire), Ltd. (163,949).—Private company. Registered February 11th. Capital, £50,000 in £1 shares. Objects: To acquire exclusive licences for the working in the Counties of Lancashire and Yorkshire the patents belonging to the Aladdin Renew Electric Lamp Corporation, Ltd., and to enter into agreements (1) with E. J. McWilliam and (2) with J. G. McIntosh. The subscribers (each with one share) are: R. E. Ellis, 70, Madeley Road, Ealing, W.5, engineer; W. J. Underwood, 51, Creffield Road, Acton, W.3, electrical engineer. Permanent directors: E. J. McWilliam and J. C. McIntosh. Solicitor: C. B. Ellis, 70, Chancery Lane, W.C.

United Arc Welding Co., Ltd. (163,039).—Private company. Registered February 11th. Capital, £5,000 in £1 shares. To carry on business as indicated by the title. The first directors are: W. E. Groves, 76, Roman Road, South Shields, electrical engineer; H. C. Lumsden, 48, Rothwell Road, Gosforth, boiler inspector; R. Winskell, 6, Flavia Terrace, South Shields, solicitor. Secretary: C. L. Dobson. Registered office: Ferry Street, South Shields.

Mayfair Light and Power Co., Ltd. (163,836).—Private company. Registered February 9th. Capital, £1,000 in £1 shares. To carry on the business of electrical engineers and contractors, electricians, suppliers of electricity for light, heat and power, &c., and to adopt an agreement with H. Meekhonik. The first directors are: H. Meekhonik, Ambleside, Brighton Road, Purley; A. Meekhonik, 14, Pepys Road, New Cross, S.E.; H. M. Williams, Aberdeen Lodge, Powys Villas, Brighton. Solicitor: P. G. Averill, 135, Edgware Road, W. Registered office: 135, Edgware Road, W.

W. G. Perry & Co., Ltd. (163,943).—Private company. Registered February 11th. Capital, £5,000 in 4,000 ordinary shares of 6d. each and 4,900 preference shares of £1 each. To carry on the business of electrical engineers, dealers in machinery, plant and accessories, &c., and to adopt an agreement with W. G. Perry. The first directors are: W. G. Perry, 37, Birchwood Road, Wandsworth, S.W.; F. W. Cook, 155, Upper Kennington Lane, S.E.; A. Perry, 155, Upper Kennington Lane, S.E. Solicitor: J. A. Davies, Colonial House, London, Bridge. Registered office: 199, Westminster Bridge Road, S.E.

Mechanical Products, Ltd. (163,927).—Private company. Registered February 11th. Capital, £10,000 in £1 shares. To carry on the business of electrical and mechanical engineers, metal stampers, manufacturers of electrical and mechanical plant and accessories, &c. The first directors are: T. Thompson, Allbury House, Surbiton, Surrey; H. H. Oxley, Hill Top, Crowhurst, Sussex. Solicitor: H. M. Veitch, Norfolk House, Norfolk Street, Victoria Embankment, W.C. Registered office: 60-61, Blackfriars Road, S.E.1.

Stainsped, Ltd. (163,925).—Private company. Registered February 11th. Capital, £20,000 in £1 shares. To take over three contracts relating to the manufacture of and licences to work patents relating to "Pedrail" trains (1) between Pedrail Transport, Ltd., and Staines Projectile Co., Ltd.; (2) between the said Pedrail Transport, Ltd., R. H. Brackenburg, J. G. W. Lowe and Staines Projectile Co., Ltd.; and (3) contained in correspondence between the liquidator of the said Staines Projectile Co., Ltd., and Pedrail Transport, Ltd. The subscribers (each with one share) are: E. J. Almond, 119, Finsbury Pavement, E.C., secretary; R. J. Rawlinson, 184, Windsor Road, Ilford, Essex, clerk. The subscribers are to appoint the first directors. Solicitor: R. H. Parratt, 18 and 19, Pall Mall, S.W.

H. T. Baker & Co., Ltd. (163,967).—Private company. Registered February 11th. Capital, £2,000 in £1 shares. To take over the business carried on by H. T. Baker at 117, Albert Road, Stechford, as "H. T. Baker & Co.," and to carry on the business of electrical, mechanical, cycle, motor, sanitary, civil and general engineers, &c. The permanent directors are: H. T. Baker, 117, Albert Road, Stechford; H. E. Thomas, Services Club, Stratford Place, W. Qualification, £50. Secretary, W. T. Hurtt. Registered office: 125, Edmund Street, Birmingham.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Aluminium Corporation, Ltd.—Mortgage on premises and cottage, &c., at Mienan, Carnarvon, registered January 19th, 1920, to secure £1,800. Holder: Sir A. H. Walker, Kt., 2, Marsfield Gardens, Hampstead.

Electro-Medical Treatment, Ltd.—Particulars filed January 21st, 1920, of £2,000 debentures, charged on the company's undertaking and property, present and future, including uncalled capital, amount for present issue being £1,250.

Siemens Brothers & Co., Ltd.—Satisfaction registered January 14th, 1920, to the extent of £22,400, of charge for £1,330,000, registered January 21st, 1918.

Vickers, Ltd.—Satisfaction registered January 17th, 1920, of charge for £1,000,000, registered February 20th, 1903.

Taranto Tramways & Electric Supply Co., Ltd.—Mortgage on certain concessions, &c., and the company's undertaking and property, present and future, including uncalled capital, registered January 14th, 1920, to secure £72,600. Holders: Commercial Bank of Scotland, Ltd.

CITY NOTES.

Westminster Electric Supply Corporation, Ltd.

During the year 1919 the total lamps, motors, &c., connected increased from 50,166 KW. to 52,457 KW. After allowing for depreciation, sinking fund, and other charges, and paying the dividend on the 4½ per cent. preference shares, a final dividend at the rate of 13 per cent., less income tax, is to be paid on the ordinary shares, making 10 per cent. for the year, and £15,473 is to be carried forward. The directors make the following reference to the Electricity Supply Bill:—

The Electricity (Supply) Bill introduced by the Government last year has now become law. This Bill, owing to the strong opposition in the House of Lords, directed specially against its financial proposals was considerably modified in both Houses of Parliament. Eventually all its compulsory provisions were withdrawn, and the valuable proposals, relating to the appointment of Commissioners and the control and advice which they are enabled by the Act to give in connection with the development of electricity in the country, were retained.

The Act now enables the different companies and authorities and others in a district to combine to form a joint electricity authority for the district, and the leading London companies have already associated themselves for this purpose. It is hoped that by the formation of such an authority arrangements may be put in force whereby the best and most efficient use will be made of the resources and experience of the different undertakers which will result in electricity being produced and sold at the cheapest possible rate, while at the same time the rights and interests of the shareholders will be duly safeguarded.

Units generated, 27,867,237; total utilised, 25,543,795; expended in distribution, 1,651,031.

Melbourne Electric Supply Co., Ltd.

At the annual meeting on Monday, Mr. J. B. Braithwaite said that including the sums now being issued they would have increased the capital by £300,000 since that time last year, and as the ordinary shares were being issued at a premium of 25 per cent., they would really get £325,000 additional capital. Some might think they were issuing capital too fast, but they were only raising money when they could see an immediate profitable return on it. They had transferred £20,501 from profit and loss and £4,999 from premium account to the general reserve, raising that fund to £140,000. For technical reasons the auditors stated in their report that "no specific reserve has been made against depreciation." When a company was liable to be bought up at a certain time, it was very unwise to admit in their balance sheet that they required to make a provision which in their case amounted to £140,000, for depreciation. They did not require it, and therefore they had carefully avoided putting the sum to depreciation reserve, but he could assure them they were making ample reserves in that direction. In spite of drawbacks they had had to contend with, they were nearly £20,000 to the good on their net earnings. The improvement was shown all round. Private supply yielded £165,688, as against £144,218, an improvement of £21,000; power, heating, &c., yielded £83,476, against £79,878; public supply showed a slight increase, being £12,408, as against £11,746, and the supply to the tramways had yielded £50,970, as compared with £48,940. Bulk supply showed the most satisfactory percentage of increase—the receipts having increased from £8,160 to £9,848. The meter rents yielded £15,091, a small increase. As to Geelong, there again they could not boast of any large increase, but the balance carried to profit and loss was £13,087, as against £12,988, so that the actual results there were not unsatisfactory when they remembered that they had had to contend against three rather serious strikes during the year. The seamen's strike had the effect of putting them in considerable difficulty in regard to their coal supply, and it was only due to the foresight and energy of their staff in Melbourne that they did not have some serious interruptions in their supply. As it was they managed to pull through fairly well on the whole. Had it not been for those strikes their increased profit of £20,000 would have been materially larger. He could only hope that the country would be free from such visitations this year. They had had rather an important increase in their area during the year—22 per cent., with an increase in population of about 11 per cent. They were now serving a district which had a population of 407,000, and they had increased the street mileage during the year by 36, bringing up their total to 660 miles of streets in which they were now giving a supply. That accounted for some of the large capital expenditure they had had to incur. They were also engaged in somewhat extensive capital expenditure at Geelong, which they hoped would prove profitable in future years; at one time they thought Geelong would be quite a small station. Last year at Melbourne they had added 5,560 consumers, which was a record for the whole period of their existence, and 18 per cent. better than the previous 12 months. If they reckoned their consumers in districts where they were giving a bulk supply, it would be seen that they were supplying about 51,000 consumers. Taking the population into account, those figures were in excess of anything that had been achieved by any English company. The outlook for the current year was extremely satisfactory. Up to date they were considerably better off in net profits than they were for the same period a year ago, and that their consumers seemed to be multiplying if anything at an accelerated rate. The number connected during the last month of which they had the record was between 800 and 900. If the increase should be maintained in anything like the same ratio it would show an extremely good result for the year, as last year the increase was at the rate of about 500 per month. They had started the year under good auspices, and if they were spared a recurrence of strikes and other labour troubles, he thought they had every reason to anticipate a successful year. The people who really earned their money for them lived 12,000 miles away, and they owed a great deal of the prosperity and success of the company to Mr. Clements, the managing director, and the local board in Melbourne.

In reply to a shareholder, the chairman said that most of the company's concessions expired in 1925, but he doubted very much whether anybody in Australia had got the money to buy them out, even if they wished to. They must bear

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in mind that in recent years particularly they had been giving a bulk supply to an increasing number of municipalities, and he did not think they would find any advantage in purchasing them, even if they had the money. The terms of purchase were more satisfactory than they were under the English Electric Lighting Acts.

A vote of thanks was passed to the local board in Australia and the staff.

Yorkshire Electric Power Co.

At the annual meeting, on the 17th inst., Mr. A. G. Lupton, who presided, said that an increase of revenue of over 30 per cent. was satisfactory, especially for a year of reconstruction. The general adoption of a shorter working week in the early part of the year, and the various labour disputes including the Yorkshire miners' strike, the railway strike, and the moulders' strike, all had their effect in retarding development. Working costs had been heavy owing to the price of coal, stores, and wages. The reduction of working hours had necessitated an increase in the number of the company's employés, and in addition the rates of wages paid had been increased. The salaries and wages paid by the company in 1913 were 27 per cent. of the total expenditure. In 1919 this had increased to 40 per cent. The extra costs had been met by the increase of revenue. The capital account showed the assets of the company standing at over one million pounds. Due to the large increase in the cost of machinery and mains which had taken place as a result of the war, a valuation of the plant would show the present value to be largely in excess of the book figures. It was satisfactory that all classes of power users were realising the advantages of co-operating through the agency of the company, and are not only using its supply but were subscribing a proportion of the capital. The Electricity Supply Act recognised and endorsed the principles by which this company had always stood—that of generation in large central stations and distribution throughout large areas, and it was now the duty of this company to respond to the call made upon it, and take its full share in developing the area committed to it. The value of economies in the use of coal and capital on which the company's business depended had been largely increased by the higher cost of coal and machinery, and the advantages to the user were therefore proportionately greater. These high costs, and the scarcity of labour, were rendering manufacturers daily more disposed to devote themselves to their own proper business, and to look to this company to provide their motive power as and when they required it. As a consequence, demands for current were pressing from every side, and fully justified the large extensions for which they were now asking them to provide the capital. A company with an area such as theirs could not stand still; it was like a river which gathered volume as it flowed. Not only was the demand for power increasing more rapidly, but the smaller electricity supply undertakings were deciding to purchase in bulk from the company rather than to continue to generate electricity in small and relatively inefficient stations. Out of the 55 electricity supply undertakings in the company's area arrangements had been made in 41 cases for bulk supply or joint working, so that the unification of supply over the whole of the company's area was within measurable distance of completion. Agreements had been made with some of the larger municipalities for interchange of supply in the spirit of the Coal Conservation Report, which had already been mutually advantageous. They hoped to carry these a good deal further. They had now nearly 400 miles of mains bringing in good revenue, and the time had come when the company must take another great step forward. They therefore asked the meeting in the first place to consolidate the company's finance by authorising an issue of debentures to repay loans from the bankers and the Government, which had been spent on plant and mains already earning good revenue for the company, and secondly, to take part in the issue of further ordinary shares. They would offer the debentures, a 5¼ per cent. security, at a price which would bring a return to investors of 6¼ per cent. The development of the new station at Ferrybridge had been held up. The station was urgently required, and it was grievous that so much delay had been forced upon them by legislative uncertainties, and that it was only now possible to go forward with the preparation of plans for what was so urgently required. These plans would take time to prepare, and when complete would require considerable additions of capital, but the funds now asked for would enable extensions to be made, and would widen the basis of the company, and enable it to carry on and to earn revenue which would justify the further advances as they became necessary. The chairman alluded to the energy and devotion of the engineer and manager, Mr. Woodhouse, and his competent staff.

London Underground Electric Railway Companies.

Central London Railway Co.—Report for 1919. Total net income £186,917, a decrease of £40,656. Brought forward, £17,484. Interest, rentals, &c., absorb £46,039; to reserve, £20,000; preference dividend, £21,600. Available balance £116,762, a decrease of £20,723. After paying the dividends mentioned in our last issue, £11,762 is to be carried forward. Capital expended during 1919, £7,409. The gross revenue of the five companies contributing to the common fund was increased by £2,497,018, or 32 per cent. during the year; operating expenses and interest and reserves by £2,632,321, or 37 per cent. The amount available for dividends and further reserves decreased £135,303 or 21 per cent. The full effect of the increased cost of wages, fuel, and other supplies was not felt in 1919. The working costs are to-day at an even higher ratio to earnings than during 1919. If sufficient revenue is to be obtained to meet the working expenses to provide for adequate depreciation and renewals, and to obtain a reasonable return on capital, fares must be increased, and a Bill has been introduced seeking authority. Works in connection with the electrification of the Ealing and Shepherd's Bush railway of the G.W.R. are rapidly approaching completion, and it is hoped that Central London trains will be running at an early date between the city and Ealing Broadway station. Baron Ashfield, of Southwell, having resigned from the presidency of the Board of Trade, has been elected chairman and managing director.

London Electric Railway Co.—Report for 1919. Total net income £611,601, a decrease of £39,003. Brought forward, £23,605. Interest, rentals, &c., absorb £290,738; to reserve, £45,000; preference dividend £126,947. Available balance, £172,521, a decrease of £47,643. After paying the dividends mentioned last week, £20,942 is to be carried forward. Capital expended during the year, £6,898. The report contains observations similar to those quoted above in the Central London reference, respecting the revenue, &c., of the five companies, and action respecting future fares.

Metropolitan District Railway Co.—Report for 1919. Total net income, £565,611, a decrease of £18,091. Brought forward, £21,332. Interest, rentals, &c., £336,115; to reserve, £45,000; dividends on guaranteed and first preference stocks, £124,930. Available balance, £80,898, a decrease of £23,933. After paying dividends mentioned here last week, £22,098 is to be carried forward. Capital expenditure of the year £1,499. Orders have been placed for a large number of additional carriages of an improved type. The above remarks regarding revenue, expenses, fares, &c., also apply in this case.

City and South London Railway Co.—Report for 1919. Total net income £144,486, a decrease of £7,918. Balance brought forward £24,567. Interest, rentals, &c., £47,203; to reserve £25,000; preference dividend, £42,500. Available balance, £54,350, a decrease of £4,817. After paying dividends already announced a further £5,000 is put to reserve, and £19,750 is to be carried forward. Capital expended during the year, £10,800. Experimental work in connection with the enlargement of the tunnels is being carried out with the object of determining the most efficient method of reconstructing the railway. The above remarks regarding revenue, expenses, fares, &c., apply in this case also.

The following table shows the operating expenses of the above four companies and the L.G.O. Co., comparing 1919 with 1918 :—

	1919. £	Inc. or dec. £
Traffic receipts	9,110,469	+2,156,078
Government compensation (after providing for adjustments)	566,370	+ 263,751
Total	9,676,839	+2,419,829
Operating expenses	8,179,598	+2,645,983
Net receipts	1,497,241	— 226,154
Miscellaneous receipts (net)	563,630	+ 77,189
Net income...	2,060,871	— 148,965
Interest, rentals and other fixed charges	828.507	— 33,662
Balance	1,232,364	— 115,303
Reserve for contingencies and renewals.	420,000	+ 20,000
Balance	812,364	— 135,303
Dividends on guaranteed and preference stocks, excluding M.D.R. second preference stock	315,977	—
Surplus paid into or deficit met out of common fund	496,387	— 135,303
Amount received from common fund ...	496,387	— 135,303
Per cent.	100%	—
Add balances from last year's accounts...	147,918	+ 17,273
Total amount available for dividends and further reserves	644,305	— 118,030

The following table shows the passengers carried, average fare per passenger, and the number of car miles run in 1919 compared with 1918 and 1913 : :—

	1919.	1918. Inc. or dec.	1913. Inc. or dec.
Passengers carried :			
Ordinary	956,696,890	+163,207,971	+197,532,168
Workmen	68,503,288	+ 6,066,590	+ 21,472,001
Season	48,192,370	+ 1,235,571	+ 24,254,169
Total... ...	1,073,392,548	+170,510,132	+243,258,338
Average fare per passenger	d. 1·99	d. +·19	d. +·54
Car miles run ...	130,977,237	+ 18,790,138	— 7,201,770

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Metropolitan Railway Co.—Speaking at the annual meeting, Lord Aberconway, P.C., said that so long as the control continued the position would necessarily remain as it was, and very little, if any, variation in dividend could be looked for. They had an excellent property, with an increasing earning capacity, but the heavy increase in the cost of working, brought about mainly by the concessions made to the staff by the Government, had for the time being turned their profit into a loss, in spite of the largely increased turnover of business. The position must be adjusted in the same way as was being done in every other business concern, namely, by raising the price of the commodity they had to sell. The whole matter was before the Ministry of Transport at the present time, and very soon something would be done. They would not reap any immediate benefit from such increased fares, as the extra revenue would only go to reduce the amount payable to them by the Government under their guarantee, but it was necessary that the fares should be put upon a satisfactory basis in view of the time when the subsidy from the Government would cease. The traffic not only on their line but on the other London lines had already outgrown the facilities, and the expenditure of large amounts of capital was necessary if the transport accommodation was to keep up with the growth of the population. The housing question and the necessity for improving the conditions of life of the people employed in their big centres were totally bound up with the question of transport, and if the capital required for the necessary extension was to be forthcoming the companies would have to be in a much sounder commercial position.

Llandudno & Colwyn Bay Electric Railway, Ltd.—The annual meeting was held on February 11th. The chairman said that the financial result was disappointing when taken in conjunction with the increase in traffic receipts. It was due to increased operating expenses, repairs, and maintenance. The work of overhauling the rolling stock was greater than was anticipated, and repairs and maintenance charges—permanent way and overhead lines—would be heavy for some little time. Power expenses were heavier, due to the increased charge, and there could be little relief on this item during the current year. The Old Colwyn extension still proved a valuable addition to the line; if this had not been built they would have been incurring a heavy loss in operating the tramways outside of the holiday season. They hoped shortly to place an order for additional cars, but their ability in this connection was limited by their financial resources and the increased cost of cars. Traffics were showing a slight increase as compared to a year ago, but the costs continued to increase, and further demands from labour might have to be met to some extent. They hoped, however, that the increase in traffic receipts would suffice to overcome the increase in operating expenses.

General Electric Co., Ltd.—At meetings of the company's shareholders held last Saturday, approval was given to a proposal to issue new capital in the form of 7½ per cent B cumulative preference shares and partly in the form of ordinary shares. Mr Hirst said that considerable progress had been made with the programme to which he referred at the annual meeting for proceeding with developments and increasing the capital to £6,000,000. Those developments had been proceeding with the assistance of the bankers, but the issue of further capital was now necessary, though it could not be done on the same conditions as the last increase. Resolutions were passed under which the 1,655,790 issued preference shares and 144,210 of the unissued preference shares will be called "A" preference shares; the 1,800,000 unissued preference shares will be converted into 7½ per cent. "B" cumulative preference shares.

Prospectus.—The Still Engine Co., Ltd.—This company, which was formed last year to acquire from the Engine Development Co., Ltd., and other vendors, the patents for the Still engine (with the exception of the Japanese patents which had been disposed of), has been offering 75,000 shares of £1 each for subscription at par. The list was to close on Wednesday. The nominal capital is £300,000. 145,000 shares are being issued as fully paid, and £10,000 cash consideration is also to be paid out of the proceeds of the present public issue, the balance being for working capital. A number of agreements for licences have been entered into with well-known firms in this country and in France, and other negotiations are in progress. The objects of the company are to sell further licences, to continue research work on the Still engine for the benefit of its licensees, and to deal with the foreign patents.

Electrical Distribution of Yorkshire, Ltd.—In their report for 1919 the directors state that the net profit was £4,354, against £3,168 for 1918, and £3,693 for 1917. £886 was brought forward. After paying 6 per cent., free of tax, on the ordinary shares, £1,000 is added to reserve, and £1,279 is to be carried forward. The manner in which the company has passed through the war period has demonstrated the soundness and stability of the business.

Restrictions on the use of electricity were not completely withdrawn until the latter part of the year and, due to industrial disturbances throughout the country, the delivery of material was greatly delayed so that the growth of the company's business has been retarded. Applications for the company's supply have been received in large numbers and with the restoration of normal industrial conditions a rapid expansion of the company's business is assured. This will require the issue of further capital, and shareholders are recommended to apply for further shares.

Tyneside Tramways & Tramroads Co.—At the meeting held in Newcastle on 10th inst, Dr. J. T. Merz said that the revenue for the year had increased by more than £7,000, but so far from increasing their earnings, they were lower, for the increased costs had been more than double the increase of the revenue. As a consequence, they had some £7,200 less to deal with. The outlay upon repairs, materials, and wages was much greater than it had been. They had to deal with £11,120, to which they had added £3,000 out of the special reserve which was put aside to meet repairs which should have been carried out in former years. They proposed to pay the same dividend as in the previous year. As to prospects, the traffic return showed some increase, but that should not mislead them, as it was probable that the costs would increase at a greater rate than did the revenue. They hoped that their income would be improved by the acquisition of three new cars which they had ordered. The trade in the district had been very much interfered with, especially by the moulders' strike, which threw many men idle and affected the traffic.

Dublin United (Electric) Tramways Co., Ltd.—The Right Hon. L. A. Waldron, P.C., who presided at the recent meeting, said that on the whole they had had a prosperous year. The services were now nearly normal again, coal shortage and other difficulties that arose in wartime being less acute, though the coal supply was again causing considerable anxiety. The introduction of an 8-hour day for their men had entailed the employment of an extra 200 in the traffic department. The advance in wages over pre-war rates now stood at 28s., and a further demand was being made. They had heavy track renewals before them. The running of the power station had been very satisfactory, and the cost of generating the unit came to .979d. A new sub-station now in operation at College Street would help towards economy and add to the efficiency of distribution. They proposed to build covers on the upper decks for all cars except those which had to pass under railway bridges.

Paisley District Tramways Co.—Revenue during 1919, £126,530; expenses, £100,238. General interest requires £130, income tax £5,766, debenture interest £3,200, debenture sinking fund £1,500. Including £6,072 brought forward the balance is £21,767. £6,000 has been put to reserve, 5 per cent. has been paid on the preference shares, and £2,000 put to preference share sinking fund; £6,267 is to be carried forward. Traffic receipts increased by £5,454, but expenditure increased by £20,418, due to rises in wages, shorter hours, and a further great rise in the cost of materials. The full effect of these increased charges on a complete year's working has still to be borne. Increases in fares were sanctioned, and came into force in November, but it is not anticipated that in the current year the relief obtained by these altered fares will cover the increased costs, and it may be necessary to make application for further modifications.

Chloride Electrical Storage Co., Ltd.—The directors have put forward a proposal for the capitalisation of £73,250 out of the reserves and undivided profits, and the distribution of this sum in the form of bonus shares to ordinary shareholders in the proportion of one new £1 share to every two shares now held. It was only three years ago—in March, 1917—that the then ordinary share capital of £73,250 was doubled by the distribution of bonus shares of £1 each on a share per share basis. The present proposal would increase the ordinary share capital to £219,750, of which £146,500 would have been provided by the payment of bonus shares. In 1912-13 there was also a bonus of 7s. 6d. per share, which was met by an allotment of fully-paid ordinary shares.—*Daily Dispatch*.

Lanarkshire Tramways Co.—Revenue for 1919 £199,868, expenses £148,060, leaving £51,808. Contributions to local authorities, £4,001; debenture interest, £650; interest accounts, £4,182; depreciation reserve, £12,000; maintenance reserve, £5,000. Adding £5,912 brought forward, the balance is £31,888. After paying 7½ per cent. for the year on the shares, and £883 to directors, £5,280 is carried forward. Revenue increase, £7,338; expenses increase £22,010. Expenditure of £7,816 on deferred repairs has been charged against maintenance reserve account. The deferred repair work was not completed at December 31st. The strike of traffic employés in April and May caused a loss of £10,000 in traffic revenue. Passengers carried, 1918, 31,695,400; 1919, 31,521,049.

South Metropolitan Electric Light & Power Co., Ltd.—Credit balance for 1919 £70,109, plus £12,857 brought forward, also 10 per cent. dividend on holding in West Kent Electric Co., Ltd., £1,002; total £83,968. Debenture and other interest £15,355; 7 per cent. dividend on cumulative first preference shares and 6 per cent. on the second; £21,500 to depreciation; £10,000 to reserve; 6 per cent. dividend on the ordinary shares, less income tax, £9,000; to be carried forward £12,323. The general business has been well maintained, notwithstanding a large but it is hoped temporary, reduction in bulk supply demand. Mr. H. W. Bowden has resigned as a director and engineer-in-chief, but he will act as the consulting engineer.

Oxford Electric Co., Ltd.—Dividend 5 per cent. on ordinary shares.

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Stock Exchange Notice.—The Committee has specially allowed dealings in the following under temporary regulation 4 (3):—

English Electric Co., Ltd.—148,004 preference shares of £1 each, fully paid, Nos. 404,525 to 552,528; 33,973 ordinary shares of £1 each, fully paid, Nos. 1,397,537 to 1,431,509.

National Electric Supply Co., Ltd.—The directors report that the extensions to the generating plant could not be completed for this winter's load owing to strikes, &c. There is put to depreciation £5,000, to reserve £3,000, dividend 5s. per ordinary share, making 7s. 6d. for the year, dividend 27s. 2d. per founders' share, carried forward £1,036.

Central Electric Supply Co., Ltd.—The report states that energy has been supplied to the Westminster Electric Supply Corporation, the St. James' and Pall Mall Co., and the Chelsea Electricity Supply Co. to an amount of 36,096,110 units.

National Boiler & General Insurance Co., Ltd.—Final dividend of 18s. per share, less tax, in addition to 12s. interim dividend. To investment reserve £6,410. Carried forward £4,347.

Bournemouth & Poole Electricity Supply Co., Ltd.—Final dividend on the ordinary shares at the rate of 7 per cent. per annum, less tax, making 6 per cent. for the year.

London Electric Supply Corporation, Ltd.—Dividend 2½ per cent. for 1919; £12,500 to reserve; £5,000 to contingencies; £11,500 carried forward.

Crossley Bros., Ltd.—Dividend at the rate of 10 per cent. per annum on the ordinary shares for the half-year, making 8 per cent. for the year.

STOCKS AND SHARES.

Tuesday Evening.

The Stock Exchange acknowledges a distinct tendency on the part of its market to lapse into quietude. This spells lower prices, as a matter of course. Business is the reverse from exciting. Buoyancy and bullish enthusiasm are superseded by a critical attitude in the investor and the speculator. New issues are lavishly offered, and divert attention from the existing securities with which they come into competition. The Stock Exchange enters upon the Lenten season with a befitting decorum.

General Electrics stand out with noticeable strength. Details of the new issue of ordinary shares began to leak out generally a few days back. They were stated here a fortnight ago. One new ordinary share at 27s. 6d. for every three shares at present held was the forecast here, and although no official confirmation is forthcoming up to this evening, the matter will doubtless be made public very soon. An issue of 7 per cent. "B" preference may be expected, with the present 6½ per cents. turned into "A" shares. A comprehensive scheme, and one that is likely to arouse public interest. Other shares in the manufacturing group are somewhat featureless. British Aluminium are 1-32 higher and Siemens a florin up. Automatic Telephones dropped to 17s. 6d., rallied to 23s. 6d., and, at the moment, are easier again at 22s. 6d. Indignation is expressed at the directors' proposals, but unless a leader steps forward to focus the opposition, it may be that the scheme will be passed. One of the extraordinary points about the business is the fact that the scheme requires for its operation the assent of only 51 per cent. of the shares. The board could hardly have asked for a more slender majority than this. Without further opportunity of voicing their dissatisfaction, some of the shareholders declare that they will not send in their acquiescence.

The Home Railway market is better in places, and, though Districts have fallen to 19 and Central London ordinary to 55¼, Underground Electric "A" shares are better at 7s., and the £10 shares at 2¾. There has been a slight spring during the last day or two in the heavier railway stocks, and this has encouraged the improvement in the issues of the Underground Electric Co. The attention of the speculative investor might be usefully turned to the prospects of East London 4 per cent. "B" debenture stock.

Electricity supply shares are quiet. Metropolitans rose ⅛ to 3¼, and Charing Cross preference recovered the dividend of 2s. 3d. There is not much business doing, but inquiries for shares find little floating supply with which to satisfy their demands. In the foreign list, Madras Electric are better at 18s. 6d. Canadian General Common have risen to 128½, and most of the dollar securities show adavnces, in consequence of the movements in the American rate of exchange. Rises and falls are out of all proportion to the amount of trade transacted, and, as a rule, the alterations are made simply in order to bring London quotations into line with those current in New York and Montreal.

Brazilian Tractions have again given way this time to 54. The Mexican group is heavy. Mexico Trams 5 per cent. bonds at 42½ are 3½ points down, and the 6 per cent. bonds at 32½ show a drop of 2. Meanwhile, it is said that the Commission which came to London to see what could be done in order to improve matters in connection with Mexican finance, is still working with a view to straightening out the chaotic condition of Mexican matters. But apparently no particular progress has been made in this direction, and the boomlet which took place in all Mexican securities some four or five weeks ago has proved to be premature. At the same time, it would appear to be indiscreet to sell Mexicans at the present time, when any day might bring a revulsion of feeling in favour of the stocks. Bombay Electric preference at 17 are another 30s. higher. Anglo-Argentine second preference at 3⅜ are 10s. down, which is natural enough, in view of the fact that last week these shares were quoted higher than the first preference. Potteries Electric Tractions have gone back to 13s. British Electric Traction 5 per cent. debenture stock is lower at 82.

Marconis hold their firmness at 4 3-16. Great Northern Telegraphs are down £3 in consequence of the exchange rate.

Eastern Extensions have recovered to 20, but there is no particular change otherwise in the Eastern group. Chile Telephones are a sixteenth up at 6 7-16. Our attention has been courteously called to the fact that this company paid a dividend last year of 6 per cent., and, although for 1917 and 1918, as stated in our lists, the dividend was 8 per cent., the yield should be worked out on the basis of 6 per cent., which was paid free of tax. Oriental Telephones are 1-16 up. West India and Panama shares are equally higher at 1¼. Automatic Telephones have settled down to the neighbourhood of 22s. 6d., as already mentioned. The rubber market is quiet, owing to the price of the raw material remaining at a shade under 2s. 9d. per lb., but the shares of the leading companies are in demand, on expectations, some of them already fulfilled, of reorganisation of capitals. Business amongst base metal shares is meagre, and in the iron and steel group the investor holds his hand, pending the next developments in connection with nationalisation.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1917.	Dividend 1918.	Price Feb. 17, 1920.	Rise or fall.	Yield p.c.
Home Electricity Companies.					
Brompton Ordinary	10	8	6½	—	£6 7 0
Charing Cross Ordinary	4	4	3⅜	—	5 6 8
do. do. do 4½ Pref.	4½	4½	2⅜xd	+ ⅜	8 8 8
Chelsea	5	8	3½	—	4 12 4
City of London	8	8	1⅜	—	5 16 4
do. do. 6 per cent. Pref.	6	6	9⅜	—	6 4 8
County of London	7	7	8⅜	—	7 3 7
do do. 6 per cent. Pref.	6	6	9	—	6 13 4
Kensington Ordinary	7	6	5½	—	5 14 3
London Electric	Nil	Nil	1⅜	—	
do. do. 6 per cent. Pref.	5	6	8½	—	8 11 6
Metropolitan	4	5	3⅞	+ ⅛	6 9 0
do. 4½ per cent. Pref.	4½	4½	2⅞	—	7 16 6
St. James' and Pall Mall	9	10	6½	—	7 13 10
South London	5	5	2⅝	—	7 12 8
South Metropolitan Pref.	7	7	1	—	7 0 0
Westminster Ordinary	9	8	6	—	7 10 0
Telegraphs and Telephones.					
Anglo-Am. Tel. Pref.	6	6	92½	+1	6 9 9
do. Def.	1½	88/6	21	— ½	7 1 2
Chile Telephone	8	8	6	+ 1/16	*1 13 3
Cuba Sub. Ord.	7	7	10½	—	*6 18 4
Eastern Extension	8	8	20	+ ½	*5 0 0
Eastern Tel. Ord.	8	8	195	—	*5 2 7
Globe Tel. and T. Ord.	7	8	20	—	*4 18 6
do. do. Pref.	6	6	92	+ ½	6 4 8
Great Northern Tel.	22	22	23½	—8	8 17 6
Indo-European	18	18	48½	—	6 18 4
Marconi	20	25	4 3/16	—	6 0 0
Oriental Telephone Ord.	15	10	2	—	4 16 0
United R. Plate Tel.	8	8	8	+ 1/16	*4 19 3
West India and Panama	1/8	1/8	1¼	+ 1/16	5 11 1
Western Telegraph	8	8	20½	—	*4 17 7
Home Rails.					
Central London Ord. Assented	4	4	£5½	—3	7 9 7
Metropolitan	1	1½	23	—	5 8 8
do. District	Nil	Nil	19	— 1	Nil
Underground Electric Ordinary	Nil	Nil	2⅜	+ ⅛	Nil
do. do. "A"	Nil	Nil	7/-	+1/-	Nil
do. do. Income	4	5	78	—	—
Foreign Trams, &c.					
Adelaide Sup. 6 per cent. Pref.	6	6	87	—	7 14 10
Anglo-Arg. Trams. First Pref.	5½	Nil	38	—	—
do. do. 2nd Pref.	—	—	8⅜	— ½	—
do. do. 5 Deb.	5	5	63½	—1	7 15 0
Brazil Tractions	—	—	54	—1	—
Bombay Electric Pref.	6	6	17	+1½	3 10 7
British Columbia Elec. Rly. Pfce.	5	5	64	—	7 15 0
do. do. Preferrred	Nil	2½	56xd	—	8 18 6
do. do. Deferred	Nil	Nil	48xd	—	6 10 5
do. do. Deb.	4½	4½	64	—	6 15
Mexico Trams 5 per cent. Bonds	Nil	Nil	42½	—3½	Nil
do. 6 per cent. Bonds	Nil	Nil	33½	—2	Nil
Mexican Light Common	Nil	Nil	22½	—	Nil
do. Pref.	Nil	Nil	35	—	Nil
do. 1st Bonds	Nil	Nil	52½	—	—
Manufacturing Companies.					
Babcock & Wilcox	15	15	38	—	*4 2 9
British Aluminium Ord.	10	10	1 3/32	+ 1/32	5 14 8
British Insulated Ord.	25	12½	2 1/16	—	5 14 2
Callenders	25	25	2⅝	—	6 9 10
,, 6½ Pref.	5	6½	4⅜	+ ⅛	6 16 10
Castner Kellner	25	20	4	—	—
Crompton Ord.	7	10	22/6	—	8 17 10
Edison-Swan, "A"	—	10	1½	—	8 0 0
do. do. 5 per cent. Deb.	4	5	79½	—	6 5 9
Electric Construction	10	10	1½	—	8 0 0
Gen. Elec. Pref.	6	6½	19/6	—	6 13 4
do. Ord.	10	10	2½	+4/-	*4 9 0
Henley	25	25	2 3/16	—	5 14 2
do. 4½ Pref.	4½	4½	3⅜	—	6 4 2
India-Rubber	10	10	15½	—	*6 9 0
Met.-Vickers Pref.	—	—	3 1/16	—	5 0 4
Siemens Ord.	—	10	30/-	+2/-	*6 13 4
Telegraph Cop.	20	20	29½	+1	*4 1 4

* Dividends paid free of Income Tax.

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THE PROTECTION OF A.C. SYSTEMS WITHOUT THE USE OF SPECIAL CONDUCTORS.

By Major KENELM EDGCUMBE, R.E.(T.), M.I.E.E.

(*Abstract of paper read before the* Institution of Electrical Engineers.)

Under present conditions, almost every network consists of a collection of cables laid at various dates, so that no system of protection which involves duplicate cores, pilot leads, conducting sheaths, or the like, can be regarded as a general solution of the problem. The methods adopted must be such as can readily be applied to the various sections of an existing system as well as to any future extensions. The author believes the four cardinal points of a protective system to be: (1) The maintenance of continuity of supply. (2) Simplicity of the apparatus involved. (3) Adaptability to existing gear with minimum alterations, and flexibility as regards future extensions. (4) Economy in its true sense, having regard to the capital sunk in cables, &c. The present paper is an attempt to show how these ideals can be obtained by simple means and with well-tried apparatus, without recourse to special conductors which, however desirable in themselves, are, more often than not, quite out of the question.

Whatever advantages may, at one time, have been claimed for the insulated neutral, it is now fully recognised that the advantages are all in favour of earthing, and the protection

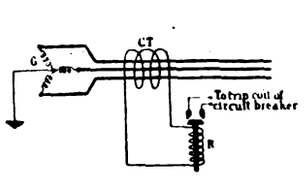

Fig. 1.—Leakage Protection of Feeder.

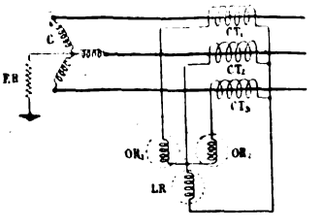

Fig. 2.—Leakage and Overload Protection of Feeder.

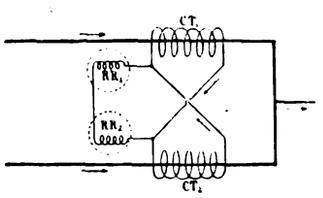

Fig. 5.—Differential Reverse Relay Protection of a Pair of Parallel Feeders.

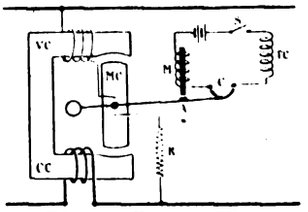

Fig. 6.—Reverse Relay Compensated for Voltage.

branches, as shown in fig. 2, and under these circumstances one at least of the relays will act under all possible fault conditions. One of the principal advantages of such an arrangement lies in the smaller current with which the circuit breakers are called upon to deal; the earth current can best be limited by an earthing resistance connected between the generator neutral and "earth" (E R in fig. 2). Discriminating action can be obtained by giving the various relays different time-lags. The time interval between the operation of successive relays in series must not be less than that required for the opening of the breaker after the closing of the relay contacts, or the second breaker may commence to act before the first has isolated the fault. Modern switchgear may be relied upon to open the circuit within about one-fifth of a second or even less, but older gear will probably take considerably longer. To this time must be added that required for the relay to operate, as well as a margin for contingencies. It may be assumed in general that intervals of ½ second should be sufficient for quick-acting gear or ¾ second with less efficient patterns.

Such graded time-lags, when applied to overload relays, against over-pressures (whether due to atmospheric effects or to intermittent earths), which is afforded by the damping effect of a resistance in the earth circuit, is seen to be so important that both American and Continental practice are fast following the lead given by this country. In the present paper, earthed systems alone are dealt with since, in the author's opinion, the first step towards the attainment of satisfactory protection is to earth the system through a resistance. At the same time, many of the arrangements recommended are also applicable to insulated systems.

Apart altogether from the value of earthing through a resistance as a protection against over-pressures, it affords a means whereby the majority of faults can be cleared in their initial stages as single-phase leakages to earth, instead of being left on the system until they have developed into short-circuits between phases.

Fig. 1 illustrates the application of the leakage protection principle to a circuit breaker. The three-phase generator G, with earthed neutral, is connected to a feeder, the three cores of which are surrounded by the iron circuit of a current transformer C T having a single secondary winding, connected to a relay R. Under normal conditions, no matter how much the load may be out of balance, the sum of the three currents is zero, and the resultant flux in the transformer core will be negligibly small. An earth fault on any phase, however, will upset the balance in the three lines and induce a current in the secondary of the transformer, causing the relay to operate and the breaker to open the circuit. Fig. 2 shows a similar arrangement, but in this case three separate current transformers are connected in star and the leakage relay L R is included in the common return. An objection to leakage protection when used by itself is that, should the fault either start as, or immediately develop into, a short-circuit between phases, there will be no out-of-balance current and, consequently, the leakage relay will not act. To obviate this, overload relays O R_1 and O R_2 can be included in two of the branches, as shown in fig. 2, and under these circumstances one at least of the relays will act under all possible fault conditions.

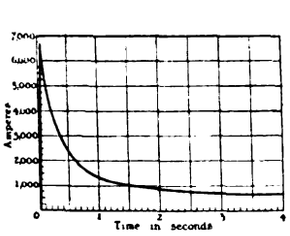

Fig. 3.—Short-circuit Current of 4,000-kw. Turbo-Alternator.

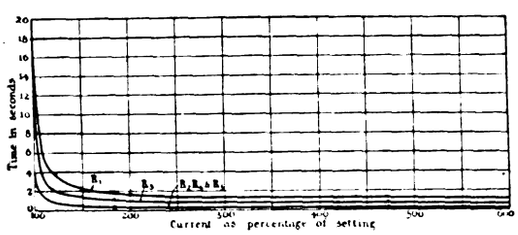

Fig. 4.—Time Curves of Induction Type Inverse-time-lag Overload Relays.

One of the principal advantages of such an arrangement lies in the smaller current with which the circuit breakers are called upon to deal; the earth current can best be limited by an earthing resistance connected between the generator neutral and "earth" (E R in fig. 2). Discriminating action can be obtained by giving the various relays different time-lags. The time interval between the operation of successive relays in series must not be less than that required for the opening of the breaker after the closing of the relay contacts, or the second breaker may commence to act before the first has isolated the fault. Modern switchgear may be relied upon to open the circuit within about one-fifth of a second or even less, but older gear will probably take considerably longer. To this time must be added that required for the relay to operate, as well as a margin for contingencies. It may be assumed in general that intervals of ½ second should be sufficient for quick-acting gear or ¾ second with less efficient patterns.

Such graded time-lags, when applied to overload relays, have a further very important advantage which does not seem to have received the attention it deserves. Although the short-circuit current of a modern alternator is comparatively small, probably not more than twice to three times its full-load current, yet the momentary current flowing into a short-circuit may be ten times as great as the steady value. This is due to the fact that, whilst the steady short-circuit current is limited by a weakening of the field owing to armature reaction, this field necessarily dies away but slowly, and during the interval the current is limited by resistance and inductance alone. Fig. 3 is a typical curve indicating the way in which the current rises to a maximum and then gradually falls to its steady value. Now in the case of a dead short-circuit occurring close to the generating station, if the breaker were to open instantly it would have to break a current nearly seven times as heavy as if it opened after 1½ seconds, as would be the case with the settings proposed. The further from the generating station a fault occurs the more the short-circuit current will be reduced by the impedance of the intervening feeders, so that shorter time-lags can safely be given to the relays.

More interruptions of supply are caused by opening circuits prematurely than by leaving a fault on the system for too long a time. An interval of two seconds should probably be regarded, however, as the upper limit, and for sub-stations containing synchronous machinery this figure must be considerably reduced. If fixed time-lags are employed they must be made sufficiently short to deal adequately with short-circuits; and, as a result, cables may be disconnected unnecessarily on the occurrence of small momentary overloads. For these reasons inverse time-lags are in every way to be preferred.

Fig. 4 gives the relative time curves of inverse time-lag overload relays of the induction type, set to operate with three different times. For currents exceeding five times those for which the relays are set the time lags reach an almost steady value, and it is this figure which should be taken as the criterion and not the point at which the curve cuts the vertical axis, which is necessarily somewhat indefinite and, moreover, only applies to very small overloads. For this reason relays should invariably be scaled both in overload and short-circuit time-lags. It may be added that no relay can be considered satisfactory unless its time curve becomes practically horizontal at a moderate overload, otherwise the intervals between the operation of successive relays may become too short to allow of one breaker opening the circuit before that next behind it commences to act. It is also essential that the

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curves corresponding to different settings should follow one another closely throughout. In both these respects the induction relay is much to be preferred to the fuse-shunted solenoid pattern. The only case in which long time-lags are objectionable is when a fault occurs close to the generating station. Should such a fault develop into a dead short-circuit between phases, it is essential to clear it with the least possible delay, the criterion of urgency being the extent to which the voltage is pulled down. A convenient means of applying this principle consists in arranging the tripping mechanism of the relays at the generating station, so that should the voltage fall to, say, 70 per cent. of the normal, the time-lag is automatically shortened to perhaps half a second in each case.

The foregoing remarks refer more especially to the overload relays (O R_1 and O R_2 in fig. 2), but much the same considerations apply to the leakage relays L R, except that, owing to the leakage current being definitely limited by the earthing resistance, there is no great advantage in reducing the time-lag to a minimum. With leakage relays, likewise, there is nothing to be gained by the adoption of a fixed time-lag, although the objections to it may be less strong than in the case of overload relays.

This combination of leakage and overload relays has the important advantage that it is sufficient in itself to deal with faults at any and every point of the system, including the sub-station busbars, whereas many other methods such as the Merz-Price or the "split conductor," whilst excellent in themselves, only control individual sections of the feeders and afford no protection whatever to the sub-station busbars. Moreover, should one of the relays or circuit breakers fail to act, there is absolutely no second line of defence and overload protection by means of fuses is usually advocated in addition, whereby simplicity is sacrificed, and the instantaneous action which is generally put forward as a great feature of such systems is entirely lost.

The leakage relay (L R in fig. 2) takes the place of one of the three overload relays which would otherwise be required for pure overload protection, so that the adoption of leakage tripping does not involve any extra gear. Although too much reliance must not be placed upon the grading of the current-settings as a means of discrimination, it has an important bearing upon the question. The time curve of a relay should become nearly horizontal for currents exceeding, say, four times the setting (see fig. 4). Consequently, if the short-circuit current exceeds this value in the case of all the relays through which it passes in series, each one will operate after the same lapse of time. On most systems, however, such a state of things is very unlikely. Whilst, however, the minimum time necessary for the operation of the breakers should form the basis in arriving at the time intervals between the settings of the relays, nevertheless, a considerable reduction is nearly always possible owing to the discriminating effect of the current settings.

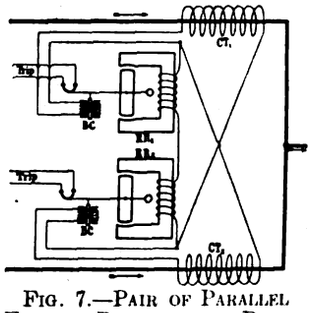

FIG. 7.—PAIR OF PARALLEL FEEDERS PROTECTED BY BIASED DIFFERENTIAL REVERSE RELAYS.

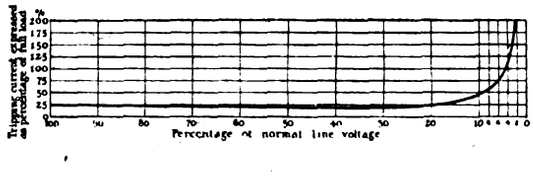

FIG. 8.—CURRENT REQUIRED TO OPERATE RELAY FIG. 6 UNDER LOW-VOLTAGE CONDITIONS.

With two parallel feeders, unless the current to earth exceeds the load current at the moment, reversal can not take place, and with three or more feeders the required excess will be still greater. This condition necessitates the installation of a larger earthing resistance than would otherwise be necessary, thus throwing an undue strain upon all parts of the system owing to the heavier fault current.

This difficulty can be overcome by the use of differential reverse relays, the current connections for which are shown in fig. 5, the pressure windings being omitted for the sake of clearness. C T_1 and C T_2 are two current transformers, cross-connected in such a way that a flow of current in the direction indicated by the arrows merely causes a circulation of current in the secondaries, and none flows through the relays R R_1 and R R_2 which are connected in series between equipotential points. On the occurrence of a fault, the currents in the two feeders are no longer equal and the difference current flows through the reverse relays which are so arranged that one or the other operates, according to the direction of the current through them, and thus isolates the faulty feeder alone.

Since the relays operate with a given difference current, it is immaterial whether there is actual reversal or not. A further important advantage is that a surge producing a simultaneous reversal of current in both feeders will not cause either relay to operate.

In the case of four or six parallel feeders, they can be very simply arranged in pairs.

At their outgoing ends, parallel feeders present much the same problem as a single feeder, and may be similarly dealt with by means of combined overload and leakage trips, a group of relays as shown in fig. 2 being applied to each feeder. Graded time-lags must be applied to both the overload and leakage relays. If the fault occurs close to the sub-station the fault current may divide itself almost equally between the two feeders, and there is a risk of the sound feeder coming out instead of the faulty one. Moreover, after the latter has been isolated at the generating station end the fault current will still flow into the sound feeder and may cause its relay to operate. For these reasons it is preferable to install differential reverse relays (fig. 5) at the outgoing end as well as at the other. At the sub-station end the fault current flows in opposite directions through the two current transformers so that the effect upon the relays is doubled, and for this reason the settings may be low, with the corresponding advantages of leakage protection.

If the relays at the outgoing end have isolated the faulty feeder before those at the sub-station the fault current will flow into the sound feeder, and as it then forms the out-of-balance circuit it will operate the relay and isolate the sound feeder as well. To prevent this, the circuit breaker on each feeder should be fitted with an auxiliary contact which, in coming out, renders inoperative the relay on the opposite feeder. At the sub-station end this is unnecessary.

Apart from the fact that a reversal will cause its relay to act, the sound feeder is left without protection. To remedy this, overload relays may be added or the reverse relays can be rendered operative on a heavy forward current. The relay shown in fig. 6 can be arranged to act with such a current if the pressure circuit is opened, which can readily be done by means of an auxiliary switch operated by the circuit breaker as already described. It must not be forgotten that the whole load current now forms the out of balance, and it is, therefore, essential that the relay windings should be capable of carrying this current without overheating. Failing this, the relays must be cut out of circuit by the auxiliary switch, separate overload protection being provided at the outgoing end.

If there are a number of parallel feeders in series perfect discrimination is afforded by the arrangement described.

Various methods have been suggested for giving the necessary "bias" to the relays of fig. 5. What is required is that the bias should increase with the current in the feeders, *i.e.*, should represent a definite percentage of the current flowing. A method of carrying this into effect is shown diagrammatically in fig. 7. R R_1 and R R_2 are a pair of reverse relays, fed by current transformers C T_1 and C T_2, cross-connected as in fig. 5. Besides the usual fixed control, which gives a definite current setting to each of the relays, a biasing coil, B C, applies an additional control which is proportional to the current flowing in the feeders. If this auxiliary control is such as to give a bias of 5 per cent., or at most 10 per cent., it will cover all likely contingencies as regards want of balance. It is usually desirable that the bias should increase rather more than in proportion to the current.

It is of fundamental importance that reverse relays should operate with certainty even if the voltage of the system is pulled down to a small fraction of the normal. The only true solution is to render the reverse relays as far as possible independent of a fall in voltage, and the working principle of a well-known form of such relay is shown in fig. 6. It is a moving-coil instrument having an iron circuit carrying two fixed windings, a current coil C C, and a volt coil V C, so connected as to assist one another with a forward current and to oppose one another with a reversal. The moving coil M C is connected in series with V C and a non-inductive resistance R between phases or to the neutral point, according to circumstances. The windings V C and C C being in opposition under operating (reverse) conditions, the flux in the air-gap for a given current increases rapidly as the pressure falls, and thus largely compensates for the reduced current flowing through the moving-coil winding.

Fig. 8 shows how successfully this result is accomplished. A relay set to operate at 25 per cent. of full load, under normal voltage conditions, will only require twice full-load current to actuate it, even should the voltage of the system fall to 2 per cent. of the normal. Such a result puts the reverse relay upon an entirely different footing, and removes the objection which was at one time so often raised. This form of relay, moreover, can be designed to operate with an exceptionally heavy forward current (say, 20 times the setting) at zero voltage.

(To be concluded.)

DISCUSSION IN LONDON.

MR. E. B. WEDMORE explained that several new devices, which had not been discussed before, were incorporated in the paper, but some of them had not been sufficiently fully described. For example, the biased differential reverse relay,

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fig. 7, were extremely sensitive in spite of the unbalance in transformers, &c., and it was a very good example of this form of protection. With regard to the protection of a system of two generating stations and four sub-stations, the author's fig. 16, he was not sure that it would do all that might be asked of it. Under certain conditions the generating station relays might operate when the fault was in the sub-stations themselves or in the feeders beyond them. The author's fig. 17 showed a novel arrangement which, however, involved the earthing of the neutral of the H.T. transformers. The author's explanation of the normal voltage triangle and that resulting from a severe short circuit between phases was novel. There was a clear reason why relays which appeared to be good from a theoretical point of view often failed in practice, but he had rarely seen the reason properly explained, and even the author had failed to do so. Compensated differential reverse relays as described by the author, had proved very satisfactory in practice; on a certain overhead system there had been as many as 22 faults in three months, and in every case adequate protection was afforded.

MR. J. R. COWIE agreed with many of the points put forward in the paper; there were, however, some with which he could not agree. For instance, he thought that it was quite futile to try and obtain discriminating action by giving the various relays different short time-lags. The Merz-Price and "split conductor" systems were preferred by many, yet the last line of defence was often an overload relay at the power station. He personally had a leaning towards the solenoid type of relay on account of its simplicity. This country led the world in the use of protective devices, for which they all owed a debt of gratitude to such men as the author.

MAJOR A. M. TAYLOR thought the relay shown in fig. 6 had a very excellent feature in the low voltage at which it would operate. With regard to the interruption of large currents, and particularly fig. 3, he had recently been applying the equations established by Steinmetz (in his book on "Transient Phenomena"), to both the case of interrupting the full load current of the station and to that of interrupting the short circuit current. He (the speaker) had introduced into these equations constants more in conformity with the conditions obtaining in this country than were those assessed by Steinmetz, and the equations showed that under bad conditions of feeder arrangement, it was possible, even when breaking the circuit where the current passed through zero, to get voltage oscillations up to double or treble the normal voltage, while if breaking it when the current was at its maximum, they might get anything up to ten, or even twenty times the normal. It, therefore, appeared that two points should urgently be striven for, viz., (1) the use of as many trunk feeders as possible in parallel, when approaching the main station, each absolutely independent of the other (split-conductor protection preferred), so that even a group of feeders might momentarily be thrown out without the main generator circuit being broken; and (2) the use of core-balance, or most delicate protection obtainable, in order to cut out every feeder before the leak to earth had time to develop into even a mild short-circuit between phases. He found himself quite at issue with the author on the question of time-lags; the intervals given were altogether too short. He would like to ask the author how he would protect, with differential reverse relays, a group of six feeders in parallel, some of which were 80 per cent. longer than others, and some of which were fed through reactances, while some were direct on the busbars. With reference to the suggestion that combined leakage and overload protection should be applied to the outgoing feeders, unless very coarsely set the leakage relays would bring out both the sound and the unsound feeders. Speaking generally, combined overload and leakage protection were all right for the outskirts of a large system, and for dealing with existing mains—in the absence of anything better; but they were not, in his opinion, suitable for the heavier feeders. In support of the possibility of the short circuit being opened at some time other than when the current was passing through its zero value, it should be considered that the oscillating E.M.F. was at its maximum when the current wave was approaching or leaving zero, and the insulation might, therefore, break down just at that moment, followed by an immediate rush of current, which the forward motion of the breaker must interrupt, at once giving the most dangerous conditions.

MR. G. W. PARTRIDGE agreed that more interruptions of supply were caused by opening circuits prematurely than by leaving a fault on the system for too long a time. It was his opinion that the later the switch acted the better, provided that when it did act it did so quickly. It was quite impossible to interrupt short-circuit currents with an oil switch except at the zero line. From the point of view of speed of action it was preferable to use as small a number of relays as possible; it was not uncommon to go into a station and find all the relays fastened up with string to prevent them acting, or again when they were allowed to act, for them all to come out at once and cause general confusion. A drawback was the failure of relay action owing to the fall in pressure, and in his opinion it would probably be preferable to make use of some device which lowered the short-circuit pressure until the fault could be cleared. With reference to the Brazil resistances, he had one installed some time ago, and it had worked well ever since; he found them perfectly satisfactory.

MR. H. W. CLOTHIER was of the opinion that the switchgear should be made as simple as possible; such devices as were advocated by the author might find a useful field in the smaller systems or in the less important sections of the larger ones. The method of leakage protection had not been given a chance, the imposing of a time limit cut out every virtue of the thing. It was his opinion that faults should not be allowed to hang on to the system, relays should operate instantaneously. The air-dashpot was more unreliable than the time-limit fuse. With regard to the author's method of bridging the primary winding of the transformer by a non-inductive resistance to form a by-pass for the surge, he thought it would be much more advisable to make a good job of the insulation than to rely on such a method of relieving the strain between the turns of the winding.

MR. H. BRAZIL thought the paper an important one, as it not only emphasised this method of protection, but also the placing of the protective devices in their correct positions. In this country protective devices were often placed quite wrongly. The inductive type of relay worked well in practice, and had given good results; he was in favour of the use of inverse time-lag. With regard to earthing through a reactance, he thought the practice was entirely wrong.

MAJOR K. EDGCUMBE, in reply, said that the question of earthing the mid-point was looked at from quite a different standpoint to-day, and no very serious objections could be taken to doing so. With regard to the solenoid type of relay, it made quite a satisfactory fixed time relay, but it was useless when an inverse time limit was to be made use of. It was true that they led the world in the use of protective devices, and it was most interesting to follow the work now being done in America and Germany, where the same difficulties were being experienced to-day that had been overcome in this country years ago. With reference to pressure regulators, they were not looked upon as part of the protective gear, and the suggested use of two relays in series was not, in his opinion, advisable.

THE GERMAN ALUMINIUM INDUSTRY.

DURING the course of the past four years an aluminium producing industry has been created in Germany, partly by the investment of private capital, but mostly with the assistance of considerable funds provided by the Government. Although the industry has not yet become of great economic importance it is claimed to be exercising to some extent a favourable effect on the commercial balance of the country, inasmuch as it affords an opportunity for dispensing with imports of metal manufactures of the most varied kinds, and at the same time permits of the carrying on of a remunerative export trade in manufactures of aluminium. In this connection a German newspaper * gives the following information concerning the industry.

As the utilisation of water power for the production of cheap energy had been neglected, the Government departments concerned with the supply of metals were confronted with great difficulties when the requirements in aluminium enormously increased, and foreign sources of supply were stopped in part. Under these circumstances, attention was first directed to the electricity produced in the lignite districts as being the most readily available, and a basis was first found in the existing works at Bitterfeld and Horrem; next at the coalfields on the Elster, then at the Erft hydro-electric works, and finally at a second water-power installation on the Inn. Apart from an installation at Berlin, which has already been discontinued, four centres of production have been completed and set in operation, all these using alumina which has been previously subject to preparatory treatment. The works are completely organised commercially in private companies, and are joint economic undertakings principally financed by the Government. The works are:—

1. Ver. Aluminium Werke A.G., which was originally formed jointly by the Griesheim-Elektron Co., and the Metall Bank of Frankfort-on-Main. The capital was nominally 50,000,000 marks, but the credit granted by the Government were very considerably greater. The works and estimated capacity are: Lauta, 12,000 tons; Horrem, 3,000 tons; and Bitterfeld, 3,000 tons.

2. Erft Werke A.G., which was constituted by Giolini and the Rhenish-Westphalian Electricity Works Co., with a nominal capital of 15,000,000 marks, and considerably greater expenditure in the form of credits. The estimated productive capacity is 12,000 tons.

3. The Inn Werk A.G., which was established by the A.E.G. and Siemens-Schuckert Works, Giolini, and the Government of the State, the capital being 13,200,000 marks.

The works of the first two (Nos. 1 and 2) companies are in operation, although by no means at their full capacity, whilst the third is apparently not yet producing aluminium. It will be seen that preparations have been made for an annual output of 30,000 tons, but the actual production has not and does not reach these figures. In order to give some idea on this question, it is mentioned that the peace-time imports of

* *Frankfurter Zeitung.*

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crude and scrap aluminium ranged from 15,000 to 18,000 tons per annum, representing a former value of 25,000,000 marks, but which would not be far short of 500,000,000 marks at present prices, and taking into account the depreciation of the mark. The production of the works from the beginning of 1916 amounted to 600 tons per month, and in 1917 and 1918 it reached about 2,000 to 2,500 tons monthly, but these quantities were insufficient for the war requirements. After the end of the war the output greatly declined partly in consequence of "strangulation," and partly owing to the general scarcity of coal. A recovery, however, is now proceeding, and technical men estimate the monthly production at present at 1,000 tons or slightly more. The whole of the output is said to be passing into works producing articles of peace—the rolling mills of Stinnes, the electrical industry, and the great metal ware manufacturing industry in Westphalia and Central Germany. The sales organisation of the works—the so-called "Imperial Works"—lies in the hands of the Metall Gesellschaft, of Frankfort-on-Main, but during the war the distribution of aluminium was controlled by the War Metal Co. A comparison of the course of prices per kilogramme is shown below.

German aluminium prices in marks per kilogramme :—

1914 (peace price), 1.50 marks; 1918 to November 18th, War Metal Co.'s price, 5.50 marks; 1918, War Metal Co.'s price on November 19th, 7.00 marks; 1919 to September, 10.00 to 15.00 marks; 1919, November 11th, 22.50 marks; 1919, December 2nd, 27.00 marks; 1920, January 16th, 35.00 marks.

It is difficult to ascertain whether the works have obtained the maximum prices during this period of bounding prices. Sales are said to have been made with which it was impossible for the production to keep pace, so that sometimes—and it is asserted also at present—the deliveries were only carried out at a time when the costs of production and the market prices had already again advanced. It is therefore considered that very little consolation can be assumed from the past as to the remunerativeness of the works, especially as the period was one of construction.

A year ago a very pessimistic opinion prevailed as to the economy of the works, owing to the growth in the working expenses, the rapidly swollen costs of construction which specially exceeded the estimate in the case of the Lauta Works near Hoyerswerda, and the great rise in local wages, whilst the technical-economic efficiency of the Lauta Works failed to come up to expectations. In the meantime, however, the collapse of the exchange has come as an additional burden; the mark which had fallen to one-half of parity in Switzerland at the end of 1918 now stands at one-twelfth. Moreover, the world price for copper, after transitory convulsions, has fairly well maintained its wartime level, at least in London. But the vitality of the inland production of aluminium depends extraordinarily upon both the mark and the price of copper. Every rise in the Swiss franc constitutes a still greater sacrifice in procuring aluminium from Neuhausen, and every mark added to the costs of copper imported or available in the country compels engineers to make use of native aluminium instead of foreign copper, where it is possible to do so, particularly with overhead transmission lines and other products of the electrical industry.

Another factor which cannot be left out of consideration is the fact that pure alumina is required for the production of the metal, and this was for the most part formerly procured from the bauxites in the South of France, Hungary, and the Adria. Considerable quantities were assured, but they will come to an end, and the economy of the industry would again be jeopardised if new foreign raw materials had to be imported. Under these circumstances efforts must be put forth in the direction of finding raw materials for the purpose in Germany, and the basis of the industry will only be firmly established when success has been obtained in this respect.

SCIENTIFIC MANAGEMENT.

At a meeting of the North-Eastern Centre of the Institution of Electrical Engineers, on January 12th, Capt. J. M. Scott-Maxwell read a summary of his paper on "Scientific Management." An abstract of the paper appeared in our issues of December 19th and 26th, 1919. In the subsequent discussion Mr. Arthur Parsons (Messrs. C. A. Parsons and Co.) referred to a system which the firm with which he was connected had adopted, and which had been working for a considerable time. It was devised for a factory where the work was specialised, and where there was not much repetition work. Even before the order was received the planning department got into operation. They could ascertain exactly what was the position of the works, and when they could deliver the goods. Then the tender was submitted, and when it was accepted the planning department planned it out. In illustration of his remarks, Mr. Parsons submitted a diagram, which showed the progress of an order through the works. It was assumed that the order was received on January 1st, and that it had to be out by the end of June. The actual work on the job was shown by a blue line, which also represented a given period of time; yellow lines represented the time allowed for the getting in of the raw materials, mauve lines the time allowed for the making of patterns, &c., and a red line the balance of time. The lines were divided into portions each indicating a given stage in the work. Each portion of a job had to be done by a certain date, and these dates were supplied to each department, and the work of the department was reported on weekly cards. The chief aim of such a system was to get all the work duly to the assembling department. The men worked infinitely better if they had the materials to hand, and the work went much smoother. He agreed that the only way for payment was payment by results. If they could get some suitable method of doing that, arrange their factories on a more scientific method of management, and increase productive capacity, there was a great future for this country.

Sir Thomas Oliver, M.D., said if they were going to carry out scientific management there would arise questions of a psychological character which medical men would have to face, and they could only face the question along with the experts. Mr. Maxwell had referred to boards for research into matters connected with fatigue, and he would like to see workers and the employers associated, so that the experts should have their attention drawn to those matters upon which enlightenment was needed. There were two kinds of fatigue—subjective, which concerned the working man, and objective, which was seen in the character of the man's work. As to subjective, formerly it was thought the seat of fatigue was in the muscles, now it was known that it was not so much in the muscles as in the nervous system. Not only the muscles, but, perhaps, even the heart, was affected slightly in fatigue. Speaking of Taylorism, Sir Thomas said the trade unions did not want to find out how much a man could do. Man's capacity for work varied, as his capacity for fatigue. One man was more easily tired than another, and they did not want that exposed. Taylorism had special advantages, and men made more money with less fatigue under Taylorism than under any other method. What had impressed him upon the question of fatigue was the cry for shorter hours, and the hours became far too low, more than the condition of the body called for. It seemed to him that the question of hours should not be uniform at all, there were certain industries where shorter hours might be introduced, but that did not apply to other industries where liability to fatigue was not so great.

Mr. T. Carter asked how far inspection should actually go, whether one should make a point of inspecting every single thing, or should only go so far as seemed necessary and extend when difficulties occurred? The help of both employers and workmen was very necessary in the problems that had to be faced, and simple suggestions made by employés might have extremely important results. He had in mind one case where a suggestion of keeping records of machines in a particular way made by one of the clerical staff, led, by its subsequent development, to the recording of twenty times as many machines as previously, with only double the staff. The speaker suggested that problems and their proposed solutions should be explained to individuals rather than to masses of men. He also suggested that the staff could probably be used in many ways. The fact that they were able by their position to see both sides made them peculiarly fitted to bring to one side the views of the other in an intelligent way.

Mr. Ranft questioned the figures as to the time taken in handling of tools, which was put down at 75 per cent. of the total time, the handling of the machine, 15 per cent., and the job itself only required 10 per cent. of the total time. Nor did he agree that it was a comparatively easy thing to draw up a plan of work as the paper suggested. He thought the vital thing in all these matters was co-ordination and co-operation.

Mr. Bedworth said he thought that anything that was to succeed must receive the approval of labour, and anything to get the approval of labour must give not only some slight financial gain, but also some mental and physical advantage. He asked, was that system of scientific management, as laid down, going to improve the worker mentally? Everything was cut out for him, everything was thought out for him. There was an elaborate system of timing, was that to increase his mental vision? They knew the time for every operation, for every portion of the job. He did not think the worker would benefit financially. His idea of scientific management was applied common sense.

Prof. Hallsworth looked at the question as a student of economics as likely to give very valuable results. It was likely to lead to the discovery of the most efficient way of doing a thing. He also thought that the system might throw light on the whole question of fatigue. These advantages were so great that they should carry labour with them. But this system must not interfere with collective bargaining, nor lead to the cutting of piece rates. Neither must it reduce the workman to an automaton.

Capt. Scott-Maxwell briefly replied.

Patent Application in Sweden.—A Royal Decree of December 19th, 1919, extends until July 1st, 1920, the time for lodging an application for a patent in Sweden, with priority of date, in respect of any invention for which a patent has been applied for in a foreign State on or after July 31st, 1913.—*Illustrated Official Journal (Patents).*

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CONFERENCE OF MANUFACTURERS.

At the Kingsway Hall, Kingsway, London, on Tuesday and Wednesday, February 10th and 11th, a National Conference of Manufacturers and Producers was held under the auspices of the Federation of British Industries. Mr. Peter Rylands, President of the Federation, was in the chair, and in addition to 69 affiliated associations, there were represented nine other organisations and ten research associations. Those represented included the British Electrical Federation, the Provincial Electric Supply Committee of the United Kingdom, and the British Scientific Instrument Research Association.

The President's Address.

Mr. Peter Rylands, in his opening address, dealt at some length with the economic conditions, as the war has left them in Germany, Great Britain, and the United States. At the present time Germany was an extreme case of a country consuming more than it produced. The conditions prevailing in Germany to-day would seem to make it almost impossible for German industry to make a fresh start. The two alternatives seemed to be national bankruptcy and an absolutely fresh start—a solution which would seem to be imposed by the ordinary operation of economic laws—or the intervention of artificial assistance. The danger of this latter was that it might have the effect of giving temporary relief, and healing rather than curing the disease. Moreover, it might not seem surprising that proposals to assist Germany should be viewed with suspicion and even disfavour if only for the reason that if Germany was rehabilitated she might ultimately work out a policy directed to revenge. On the other hand, there were considerations founded upon our own interest which told heavily on the other side, for a social and economic catastrophe in Germany might have far-reaching consequences.

On the other hand, the United States was suffering because she had too many goods for export, and the rate of exchange was such that it was not to the advantage of other countries to buy more than they were obliged to buy. That position might prove of assistance to Great Britain in finding a solution for her troubles arising out of the fall in the value of the sovereign. This position was discussed at some length, and the view was expressed that any serious development in the export trade of the United States in the near future was not probable, and there might not be such an immense competition from America as we might be inclined to think. One factor which would aid in the adjustment of the rate of exchange was that America should import more goods—although that did not seem likely immediately—and another factor was that American capital should find an outlet in foreign countries instead of all of it being used, as now, for the extension of the home trade. This latter would come in time, when the rate of interest on money employed at home would fall owing to there being less demand for it. Then it would be found to be more profitable to use it abroad.

Discussing Great Britain's position, Mr. Rylands thought we could congratulate ourselves on having borne the shock of the war so well. The great remedy for our troubles was to bring our national expenditure into line with our revenue. The Government was still borrowing at the rate of 1½ millions per day, and it was an essential first step that Government borrowing should cease. Secondly, there must be increased production, because there was no doubt that prices would remain high whatever was done now, owing to the continued excess of demand over the supply. At the same time, manufacturers must always bear in mind that the higher prices reached, the more disastrous might be the fall, which must inevitably come. Therefore, it was necessary that manufacturers should increase their reserves out of profits as much as possible, in order to provide against the day of depression which experience taught was almost inevitable. The duty of manufacturers now was to do all they could to assist increased production, and not even grudge the return of Germany as a world producer; at the same time, they must see to it that the British manufacturers secured the largest possible share in the supply of the world's requirements. The public always believed that combination among manufacturers tended to inflate prices, but he was satisfied that that was a mistaken impression. In times like the present the influence of public opinion was very great, and when a large combination was settling a price policy, public opinion could not be absent from their minds. Where, however, no price organisation existed, and each manufacturer in an industry was pursuing an independent price policy, there was no such restraining effect.

The economic conditions of the United States, Great Britain, and Germany gave ground for anxiety, but no good ground for dismay. He believed it would be wise to restrict importation from the United States to essentials, and to prohibit the import of luxuries and non-essentials. Artificial interference with economic conditions was generally objectionable, and usually brought retribution in its train, but it was not easy to see that a policy of restricting certain imports could have any objectionable consequences, and such a policy could be altered when warranted by a change in the position. The high cost of living in this country was a matter for the most serious concern, and unquestionably could not be controlled by the State by any method which was not economically unsound. Coke was an instance of this. The home fixed price of coke was 20s. per ton, but it was fetching £5 per ton for export. The consequence was that all coke producers who were not steel makers were sending their coke abroad, and whereas many of our blast-furnaces were only turning out half their output because of the shortage of coke, the ports were crowded with coke awaiting export. That was an example of ill-judged interference with economic laws. He asked that artificial interference with private enterprise should cease, and referred to the Whitley Council and Works Committee as likely to bring about a better understanding between capital and labour.

The agenda contained a series of resolutions, which were dealt with seriatim. The first one, which was in two parts, related to

Export Trade and Foreign Exchanges.

Sir Arthur Steel Maitland, M.P., late chief of the Department of Overseas Trade, proposed the first part of the first resolution, and in doing so, called special attention to developing certain markets abroad which have not yet been touched to anything like the extent possible. The greatest of such countries, provided a decent Government could be obtained, was the South-Eastern portion of Russia, and that part of the country on either side of the Urals. Next to that, apart from the rather remote speculative possibilities of China, was South America, the surface of the trade of which had scarcely been scratched. The consuming population in South America, which had been cut off from British goods during the war, were not altogether satisfied with the substitutes which they had obtained, and the demand for British goods was extraordinary. After urging the abolition of all control of industry, and the replacement of it by Government assistance in a proper form, Sir Arthur Steel Maitland referred to the impossibility of British manufacturers accepting all orders that were offered them, and pointed out that one of the shrewdest business men had suggested that orders should be placed by British manufacturers with firms in allied countries to be completed on commission. That would help us, and also assist the other countries to get going again.

Mr. de F. Pennefather, M.P. (Association of British Chambers of Commerce), seconded the resolution, which was finally passed in the following form:—

"That as an improvement in the exchange value of the pound sterling is of the utmost importance to this country and can be greatly assisted by the expansion of the export trade, this conference urges upon manufacturers the desirability of setting aside some proportion of their output for export purposes, more particularly articles unessential for home consumption, and adjures the Government to give all possible assistance to production both of our factories and soil, and to the export trade of the country."

Mr. Harry Allcock (British Engineers' Association) supported the resolution, and spoke strongly in favour of the adoption of the metric system. He asked that some reference to the metric system should be made in the resolution.

The President thought that the question was too controversial, and suggested that the proposed addition to the resolution should be withdrawn.

Mr. Allcock agreed to this.

The second part of the resolution, which was proposed by Hon. R. H. Brand, a banker, and seconded by Mr. A. M. Samuel, M.P., was finally passed in the following form, the original draft being altered in the important particulars that the assistance proposed should be in raw materials and not financial assistance:—

(1) That the present economic situation of the world is a danger to civilisation, and that immediate international action is urgently required if adequate steps are to be taken to avert chaos throughout Europe.

(2) That an essential preliminary to such action should be the acceptance of the principle that a decrease of excessive consumption and an increase of production and taxation must be rigorously imposed by all countries who will require assistance in order to arrest and counteract the continuous growth in the volume of outstanding money and of Government obligations and its concomitant, the constant increase of prices, and to ensure that the expenditure of the various countries concerned may be brought within their taxable capacity.

(3) That measures should be taken to assist in the reconstruction of Europe by assistance to those countries whose rehabilitation would otherwise be indefinitely postponed.

(4) That this assistance should take the form of the supply of essential raw materials on terms to be arranged, and which should be supplied by those countries where the trade balance and the exchanges are favourable; it should be restricted to the lowest limit of necessity, and should be devoted only to the restoration of productive processes.

Sir William Peat moved a resolution in the following terms:—

(1) That this conference urges that Government borrowing must cease forthwith, and the consideration of grandiose and expensive schemes must be postponed. Taxation must be

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reduced as soon as possible so as to diminish the tendency of capital and enterprise to seek development in foreign countries.

(2) That this conference is emphatically of opinion that a levy on capital is opposed to the best interests of the country, since it would discourage thrift and the investing of capital in productive enterprise; this conference further considers that any such levy must operate inequitably and be highly dangerous to financial stability, and could yield the Exchequer only an unknown proportion of the true value of the property when realised, owing to the universal fall in value which such widespread realisation would produce.

(3) That this conference considers that the taxation of war fortunes cannot be carried out without gross injustice to those whose wealth has increased as the legitimate result of thrift, extra effort, or the normal development of business, and has already contributed its full share in taxation, more especially through excess profits duty and income tax.

(4) That this conference welcomes the abolition of excess profits duty, which was never scientific or equitable, and is now out of date, urges that any tax which it may be found necessary for revenue purposes to introduce in its place shall be designed to inflict the minimum possible hindrance to the development of industry and requests His Majesty's Government to consult manufacturers as fully and freely as possible before deciding on the nature of such a tax.

MR. THOMAS TAGGART (Scottish Association of Controlled Establishments) seconded the resolution, and it was agreed to.

(To be concluded.)

THE ELECTRICAL WHOLESALERS' FEDERATION, LTD.

THIS very practical and businesslike body held its annual meeting on Wednesday last week at the Hotel Russell, London. Delegates were present from the London, Lancashire, Yorkshire, Northern, Midlands, Scotland and South Wales districts. The morning and afternoon deliberations were conducted behind closed doors, but to the luncheon which came between the technical Press was admitted.

What happened at the meeting is not for us to say, but that it was all very interesting goes without saying. So far as the luncheon atmosphere was concerned it was highly charged with a 15 per cent. spirit; precisely what that means members alone may tell to other wholesale factoring firms who wish to join the select and highly prosperous circle. Whether it was due to the present state of the industry or to the benefits of co-operative action under the Federation wing, those present appeared to have very good reason to be pleased with themselves. They did not conceal evidences of deep conviction that they had done a very satisfactory thing in establishing the E.W.F., and were equally convinced that it was going to have a great future. We could not help recalling our tours of the provinces made several years before the war when one had only to tap a factor lightly and floods of grievances as to the state of the trade gushed forth. Association has undoubtedly been a good thing for the wholesalers as it has for the manufacturers. Mr. W. Donovan, who was in the chair, proposed the toast "Success to the Federation," and said that they were making progress in spite of the difficulties of the times through which they had passed. They were rapidly becoming recognised as part of the necessary organisation for the distribution of electrical apparatus throughout the Empire. Born in January, 1914, with twelve members, the Federation now had 53, and they anticipated that very shortly this number would be very greatly increased by the accession of firms who were entirely eligible for membership because they fully complied with the organisation's very rigid specification of a "" factor." They took the view that membership of the Association should be the hall mark of a genuine factor, and they had had to ask some firms to excuse them from admitting them. The agreements that they had been able to make with various groups of manufacturers indicated that manufacturers themselves were realising more to-day than hitherto the necessity for the factor, and were abandoning the attitude which many of them had adopted for the exclusion of the factor. Mr. Donovan mentioned an article that had appeared in the *Times* on the Organisation of the Electrical Industry, in which the name of the Federation was coupled with that of the B.E.A.M.A. and the E.D.A. as part of the necessary machinery for distributing the products of the electrical factories throughout the Empire. They had secured attention and recognition—though not the measure of recognition that they desired—from the manufacturer, and they had secured the attention of the Press, and their clients who had known them for so many years knew quite well that they were a necessity and could render very valuable service. It was the Federation's business to see that the manufacturer realised more every day, owing to honest and efficient service rendered, that it was in his interests to grant the preferential terms that they desired, and for clients to continue to extend their business with federated members.

Mr. Donovan said that the future of the factor was a bright one; business was good; and without the factor the system of distribution could not be efficient. The future of the Federation was also bright, because without the organisation which it provided the factor would not be able to command the attention and consideration which his position warranted.

A happy incident was provided when the secretary, who has been responsible for so much of the success of the E.W.F. (Mr. A. G. Beaver), was presented with a cheque. Mr. Beaver, after briefly and appropriately responding, moved the toast of the "Technical Press," and after it had been "drunk with enthusiasm," as they say, the emission of brilliant flashes of humour by an always good-humoured and veritable veteran pressman from Maiden Lane was the signal for all to retire for a ten minutes' interval so that the factors might prepare to resume their profound deliberations.

THE ELECTRICAL TRADE OF SPAIN.

ATTENTION has frequently been called in these columns to the industrial development which has been witnessed in Spain during the past five years, and the resultant opportunities for the introduction of electrical machinery and appliances. Conditions are ripe for the further exploitation of Spain's mineral wealth, the utilisation of its water power for the generation of electric current, the electrification of railways, &c. The Americans are keeping in close touch with all these possibilities, and one of their Trade Commissioners recently gave an interesting account of the methods by which Germany succeeded in gaining such a strong hold on the market. That country did the greater part of the business in machinery and installation material, including small industrial motors. Wires and cables, cotton and rubber insulated, and underground cables have long been manufactured in the country. Latterly quite an extension has taken place in Spain's production of motors and transformers.

As regards lamps, there also existed, before the war, the following factories: Compañía General de Electricidad "Metal T," with a production of 5,000 lamps daily; The Sociedad Española de Lámparas Z, producing more than 4,000 lamps daily; and three other small factories. In all, these did not supply more than a third of the local consumption of lamps with metallic filaments. The Siemens-Schuckert Co. owned some construction shops in Cornella (near Barcelona), in which it gave employment to some 500 workmen, and manufactured motors for alternating and direct currents up to 150 H.P., and transformers of all capacities. The Sociedad "La Electricidad," of Sabadell had 300 workmen making motors, transformers, alternators, and centrifugal pumps of moderate capacity. There were also two or three shops of very little importance, among which was one of the Allgemeine Elektricitäts-Gesellschaft-Thomson Houston Ibérica doing small repair work. This was the state of the market in 1913 and until the middle of 1914.

The domination of the German industry was absolute, due almost exclusively to commercial methods, which were very much in harmony with the financial condition of Spain at that time, and above all to the customs and inclinations of the majority of the national merchants.

There stands out among these methods the consigning of stocks of motors and other machines to large and accredited resale agents in the provincial capitals, and the extension to them of very appreciable facilities for making payments. These facilities were also extended to the purchaser and to central stations of the second class, even to those which in certain articles (such as meters, for example) enjoyed the privilege of paying in 10, 12, 16, and up to 20 months, in graduated instalments, by means of accepted drafts.

Their travelling salesmen and order takers were almost exclusively Spaniards, as they were received in business houses with greater sympathy than were foreigners, and, being more familiar with the character and peculiarities of each region were able to derive more profit from the business.

During the war the German houses were obliged to overcome great difficulties; but, in spite of all, they conserved a large part of their domination of the market. The Allgemeine Elektricitäts-Gesellschaft received material from Germany via Italy until that country joined the Allies. It also received large shipments from the United States until she entered the war. Since then the company has enlarged its shops, in which to-day it employs some 200 workmen constructing small motors and transformers. Siemens-Schuckert amplified and intensified the production of its shops in Cornella, and has very materially bettered its situation in the market, as far as the possibility of supplying small machinery from its factory is concerned.

Neither of these houses could do anything with large apparatus, and advantage of this fact has been taken by the Brown-Boveri Oerlikon and Allmanna Svenska companies.

From Italy many small motors (up to 5 H.P.) have been imported, and a few in sizes as large as 100 H.P.

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NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

An Improved Earthing Device.

MR. S. LEES, 89, Green Street, Middleton, Lancs., has invented a device to render the earthing of a conduit installation more efficient. This consists of a lug or extension piece

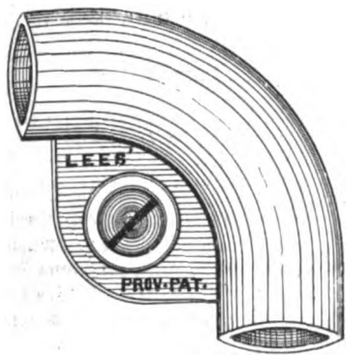

FIG. 1.—IMPROVED EARTHING DEVICE.

forming a part of the tubing (fig. 1). This lug is fitted with a bolt, nut, and washer, by which the earthing wire is clamped. All bends and joints can by this means be securely earthed.

The Peerless Electric Car Lighting and Starting Set.

A new electric lighting and engine starting set for use on petrol motor cars has lately been put on the market by the PEERLESS ENGINFERING CO., of Cote Hill, Halifax. The lighting dynamo, fig. 2, which is made in three sizes, of respectively 45, 90, and 120 watts, and 6, 12, and 12 volts capacity, is of the constant-current type, and of cylindrical form. The armature is substantially made, and runs on ball bearings, the maximum speed being 1,500 R.P.M. Three brushes are provided, these being accessibly placed inside the commutator end. The brush gear and commutator housing is enclosed by a steel band which clips over the housing and automatically secures itself in position. The regulation of output is effected electrically within the dynamo, partly by the special armature construction, and partly by the third brush circuit, the result being that the field, after a pre-determined speed has

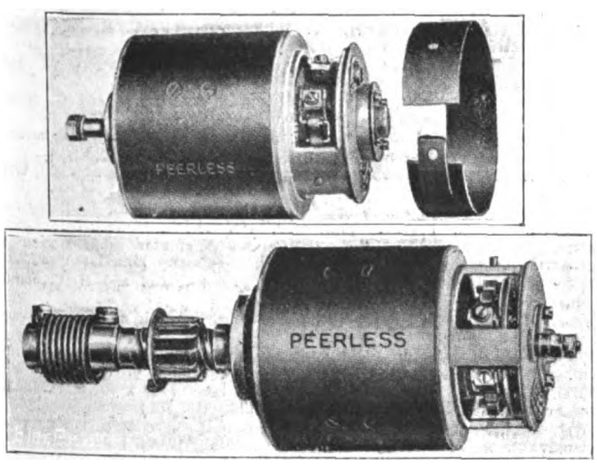

FIG. 2.—PEERLESS MOTOR-CAR LIGHTING (ABOVE) AND STARTING (BELOW) EQUIPMENT.

been attained, is to some extent demagnetised. The dynamo cable is anchored by a neat and secure device so arranged as to ensure both a good electrical connection and a waterproof joint for cables of varying diameters.

The cut-out is a separate fitting containing a fuse for protecting the field winding. A triple cable connects the dynamo and switchboard with the cut-out, the arrangement being such as to facilitate the wiring and to avoid joints and the necessity for a junction box. The battery supplied with the equipment consists of 2-volt unit cells built up to give 6 or 12 volts as required, the accumulators being supplied in either celluloid or ebonite cases.

The engine starter, fig. 2, which is of the four-pole type, is designed on the same general lines as the dynamo; the armature runs on ball bearings, and the windings are of the series type designed for producing a powerful torque. The engaging mechanism is of the standard inertia pinion pattern, a strong spiral spring being embodied to take up any shock on the engagement of the pinion with the toothed flywheel of the engine. Three sizes of the starter are being made, intended for engines of respectively 12, 25, and 50 H.P. The starter is operated by a pedal switch of neat and simple design, and arranged to be fixed under the driver's footboard, only the pedal projecting through.

New "Falco" Cooker.

The accompanying illustration relates to one of the "Falco" domestic or household ranges, made by the FALKIRK IRON CO., LTD., Falkirk, which was remodelled about seven months ago, and has since then been subjected to prolonged tests with very satisfactory results. Fig. 3 shows the new model, which is complete with switches and fuses mounted upon it, the main terminal box being at the back; this, besides being cheaper than the models with separate switchboards, makes the cooker more portable and more easily installed. The range itself is constructed of cast iron and mild steel plate, and the overall dimensions are 43 in. by 27 in. by 40 in. high, the oven having an available cooking space of 12 in. by 15 in. by 14 in. high, and the hot cupboard being 18 in. by 19 in. by 5 in. high.

The oven bottom is raised 8 in. from the floor, and a trivet of cast iron, ground and polished, is fitted flush with it, making the equipment very convenient for working. A clear space is left underneath the oven to facilitate washing and cleaning of the floor. The heating elements in the oven are fitted in the sides, are interchangeable, and are arranged for various degrees of heat regulation; they are protected by strong guards carrying the runners, whilst a thick lagging of heat-insulating material separates the inner and outer cases. Over the oven is mounted a hob enclosing the hot chamber, which is warmed by borrowed heat from the hot plates and grill. As is usual with this type of "Falco" cooker, the hot plates are cast solid with the hob, forming two intensified heat sections, the remainder of the surface being also heated to varying temperatures according to position. Various cook-

FIG. 3.—"FALCO" COOKER, OPENED.

ing operations can therefore be carried out over the whole surface of the hob, as well as grilling or toasting on the grill, which throws the heat downwards.

Fig. 3 gives a general view of the hob opened out for inspection, an operation that can be performed instantly, as it is not fixed except by the hinge pins. A loose enamelled crown plate fits underneath the hob, and a shallow skirting at the back. The equipment of the cooker consists of a

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strong grill pan and grid, with close and perforated shelves for the oven. The whole of the electrical parts and heating elements can be opened out for inspection without the aid of a screw driver or tool of any sort, the accessibility of these parts being one of the chief features. The main terminal box at the back opens out, and all the wiring can be exposed at a moment's notice. The leads are of bare solid wire where there is the slightest suggestion of heat, but from the main terminal box to the switch boxes at the sides, Association cable is drawn through standard conduit, and as this conduit is heat insulated with slag wool, and the linings of the oven stand ½ in. off the body, the cables are quite cool.

The loadings of the various elements are as follows: Oven, 2 KW.; grill, 1 KW.; hot plates, 1.5 KW. each; total, 6 KW.

We are informed that the company has received orders for a very large number of these cookers, which can be delivered from stock.

NEW PATENTS APPLIED FOR 1920.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. Sefton-Jones, O'Dell and Stephens (successors to W. P. Thompson & Co., of London), Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

3,090. "Luminous current-indicating apparatus for electric irons, &c." H. J. Furse. February 2nd.
3,121. "Electric reciprocating engine." H. Pearse. February 2nd.
3,132. "Continuous-current generator for constant intensity of current." H. Fritze. February 2nd. (Germany, May 6th, 1919.)
3,156. "Electric fires." H. H. Berry. February 2nd.
3,162. "Spark plug." W. C. Rollins. February 2nd.
3,186. "Electric induction apparatus." British Thomson-Houston Co. (General Electric Co., U.S.A.). February 2nd.
3,197. "Electric generators or motors." F. R. F. Ramsay. February 2nd.
3,217. "Electric furnaces." L. Tagliaferri. February 2nd.
3,218. "Reception of continuous waves in wireless telegraphy." W. A. Appleton and A. K. Macrorie. February 2nd.
3,219. "Wireless telegraphy and telephony." G. A. Irving and A. K. Macrorie. February 2nd.
3,220. "Electric relays for electric valve sets in wireless telegraphy and telephony." A. K. Macrorie and G. Shearing. February 2nd.
3,221. "Detection of high-frequency currents for wireless telegraphy and telephony." W. A. Appleton, S. H. Long and A. K. Macrorei. February 2nd.
3,222. "Low-frequency amplification in electrical circuits for wireless telegraphy and telephony." S. H. Long and A. K. Macrorie. February 2nd.
3,223. "Holders for electric valves in wireless telegraphy." H. M. Airey and A. K. Macrorie. February 2nd.
3,224. "Thermionic valves and their circuits for wireless telegraphy and telephony." H. M. Airey and A. K. Macrorie. February 2nd.
3,231. "Distribution in single-phase and two-phase alternating-current systems." A. M. Taylor. February 3rd.
3,248. "Leading-in wires and filaments for electric lamps." S. O. Cowper-Coles. February 3rd.
3,272. "Sparking plugs." A. H. Smith and A. Wigmore. February 3rd.
3,286. "Incandescent electric lamps, &c." J. T. Callaway. February 3rd.
3,292. "Insulators for electrolytic systems." A. S. Gush. February 3rd.
3,305. "Cooling-devices for electrical apparatus." British Thomson-Houston Co. (General Electric Co., U.S.A.). February 3rd.
3,307. "Electrically-driven machines." E. J. Harman and E. Le Bas. February 3rd.
3,312. "Electrodes for electric arc welding and metal cutting." W. H. Boorne. February 3rd.
3,313. "Magnetic valve-operating mechanism." W. C. Harrigan and R. A. Nye. February 3rd.
3,336. "Alternating-current electric machines." Aktieselskabet Jydsk Elektro. February 3rd. (Denmark, April 12th, 1919.)
3,347. "Electric incandescent lamps, &c." A. Woosnam. (Naamlooze Vennootschap Metaaldraadlampenfabriek, Holland.) February 3rd.
3,348. "Electric valve or lamp relay and intervalve transformer." G. A. Mathieu. February 3rd.
3,350. "Electric incandescent lamps." S. Waldner. February 3rd.
3,353. "Telephones." R. L. Murray and Telephone Manufacturing Co. February 3rd.
3,358. "Transmitters for wireless telephony." G. A. Irving and A. K. Macrorie. February 3rd.
3,360. "Internal-combustion engines and self-contained electric lighting units." Boulton & Paul and G. E. Ffiske. February 4th.
3,375. "Method of producing tungsten incandescent lamps." Deutsche Gasglühlicht Akt. Ges. February 4th. (Germany, February 17th, 1919.)
3,407. "Sparking plugs." T. Bradford. February 4th.
3,413. "Electric switches." P. B. Handley. February 4th.
3,428. "Reception of telegraphic signals." H. J. Hinks. February 4th.
3,446. "Alternating-current electric machines." Aktieselskabet Jydsk Elektro. February 4th.
3,465. "Safety fuses for electric circuits." E. Antinoro. February 4th.
3,471. "Regulating systems for electric circuits." British Thomson-Houston Co. (General Electric Co., U.S.A.). February 4th.
3,491. "Method of evacuating bulbs of electric incandescent lamps, &c." Deutsche Gasglühlicht Akt. Ges. February 4th. (Germany, May 18th, 1918.)
3,492. "Electric current-interrupters." F. S. Enrich and C. P. Serrano. February 4th.
3,498. "Electrical transformers." F. E. Berry. February 4th.
3,504. "Low-tension wiring system for Ford engines." P. W. Corless. February 4th.
3,517. "Driving dynamos." S. H. van Abbott, E. W. Scammell and Scammell & Abbott. February 5th.
3,524. "Electro-deposition of iron." S. O. Cowper-Coles. February 5th.
3,565. "Electric-current generators for motor vehicles, &c." E. A. Watson. February 5th.
3,566. "Automatic switches for motor vehicle, &c., electricity systems." C.L.I. Manufacturing Co. and E. A. Watson. February 5th.
3,567. "Electric generators for motor vehicle, &c., lighting and ignition systems." C.L.I. Manufacturing Co. and E. A. Watson. February 5th.
3,568. "Electric gas lamps with glow discharge." J. Pintsch Akt. Ges. February 5th. (Germany, April 26th, 1918.)
3,569. "Electric gas lamp with glow discharge." J. Pintsch Akt. Ges. February 5th. (Germany, October 18th, 1918.)
3,590. "Ignition systems for internal-combustion engines." Dayton Engineering Laboratories Co. February 5th. (United States, November 11th, 1918.)
3,596. "Telephones." R. L. Murray and Telephone Manufacturing Co. February 5th.
3,605. "Lamp-holders for electric incandescent lamps." P. B. Downs. February 6th.
3,606. "Telegraphic, &c., circuits for ionic tubes or valves." W. H. Eccles. February 6th.
3,610. "Electric torches or lamps." W. Berry and H. G. Evans. February 6th.
3,615. "Brush-gear for dynamo-electric machines." J. H. Boyd, Campbell & Isherwood and W. C. Rouse. February 6th.
3,627. "Terminals for electric cables." J. E. Barrows. February 6th.
3,647. "Electrical indicators for railways, &c." J. Gardner. February 6th.
3,650. "Incandescent electric lamps." H. J. Osborn. February 6th.
3,665. "Electrical appliance." S. F. Cannon. February 6th.
3,675. "Radio-sensitive materials." O. Bloch, Ilford, Ltd., F. F. Renwick and B. V. Storr. February 6th.
3,701. "Systems of regulation for electric circuits." British Thomson-Houston Co. (General Electric Co., U.S.A.). February 6th.
3,722. "Dynamo-electric apparatus." W. J. Mellersh-Jackson (Neuland Patents, Ltd.). February 6th.
3,726. "Actuating device for magneto-electric ignition apparatus for explosion engines." R. E. Heerd. February 6th. (Germany, July 10th, 1919.)
3,727. "Magneto-electric ignition apparatus for explosion engines." R. E. Heerd. February 6th.
3,741. "Coil ignition apparatus for internal-combustion engines." D. A. V. Rist. February 6th.
3,750. "Railway signalling systems." Automatic Telephone Manufacturing Co. February 7th.
3,756. "Method of shaping steel, &c., articles by electric heating." W. J. Readett. February 7th.
3,758. "Generation and application of high-frequency sound waves." T. F. Wall. February 7th.
3,776. "Means for connecting electric light and power cables with junction boxes, distributing boards, &c." R. S. Woods. February 7th.
3,783. "Regulating devices for controlling electrical air-heating apparatus." E. P. Dyer. February 7th.
3,790. "Electron discharge devices." British Thomson-Houston Co. and J. Gray. February 7th.
3,797. "Electric coin-freed automatic machines with money-counting and change-delivery devices." R. Bertschinger and J. J. Prinzing. February 7th. (Switzerland, September 16th, 1919.)
3,803. "Electric switch-boxes, &c." W. T. Henley's Telegraph Works Co. and W. H. Nichols. February 7th.
3,810. "Electric cables." F. Jenkins and H. Lucas. February 7th.
3,811. "Spark plugs." A. Oppenheim. February 7th.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1918.

12,567. Electrolytic apparatus. E. O. Benjamin. August 1st, 1917. (137,553.)
21,285. Production of high-frequency electric currents. F. J. Brougham. (M. Deutsch.) December 19th, 1918. (137,564.)

1919.

496. Sparking plugs for internal-combustion engines. L. Macquaire. January 9th, 1918. (122,408.)
893. Electric fuse cartridges. G. A. Conrad. January 13th, 1919. (137,590.)
894. Electric fuse supporting plugs. G. A. Conrad. January 13th, 1919. (137,591.)
910. Electric light sockets. H. H. Melaun. January 13th, 1919. (137,592.)
1,732. Electrolytic cells. H. W. Matheson and F. T. Kaelin. January 23rd, 1919. (167,609.)
1,841. Automatic cut-outs and substitutional resistances. G. E. Tate and F. O. Monkhouse. January 24th, 1919. (137,612.)
2,295. Contact-breakers for magnetos. D. C. Dingley and G. Major. January 30th, 1919. (Cognate application 15,972/19.) (137,622.)
2,458. Electric fusible cut-outs. V. E. Joyce and Park Royal Engineering Works. January 31st, 1919. (137,623.)
2,816. Holders for electric lamp shades. H. Ward. February 5th, 1919. (137,629.)
3,223. Dynamo-electric machines. P. A. H. Mossay, H. C. E. Jacoby and Enclosed Motor Co. February 10th, 1919. (137,635.)
3,372. Apparatus for obtaining continuous or direct current from an alternating current circuit. A. Bopp et Cie. February 15th, 1918. (123,321.)
3,676. Electrical storage cells. Van Raden & Co. and H. C. Smith. February 14th, 1919. (137,641.)
4,469. Electric iron. R. F. Bruce and Portholme Aircraft Co. February 22nd, 1919. (137,652.)
5,639. Electric magnetic rings, bracelets, thimbles, and the like, and the manufacture of the same. R. C. Roden. March 7th, 1919. (137,667.)
6,338. Electrical device intended for use chiefly as a toy. E. L. N. Nelson and E. A. Reynolds. March 13th, 1919. (137,675.)
7,117. Means for actuating electric switches for controlling electrically-driven pumps. A. Dispot. March 21st, 1918. (124,747.)
8,783. Make-and-break devices for magnetos and the like. E. Harrison. April 7th, 1919. (137,704.)
11,538. Dynamo-electric machines. M. Chassin. May 11th, 1918. (126,644.)
12,528. Clip or fastener for connecting electric terminals, wire, or the like. R. Richardson. May 19th, 1919. (137,734.)
12,686. Method of and apparatus for grouping and supporting electric lamps for decorative illumination purposes. F. W. Bundy and H. Bev. May 20th, 1919. (137,736.)
15,132. Electric chain-welding machines. G. J. Armstrong. June 16th, 1919. (137,748.)
16,399. Holders for electric lamps and appliances therefor. G. H. Ide and General Electric Co. June 30th, 1919. (137,754.)
16,788. Electrical connection boxes for electrically-operated cranes or machinery. Siemens Bros & Co. and H. G. Wood. July 4th, 1919. (137,756.)
17,974. Telephone lead and the like couplings for kite balloons and the like. O. S. Stiles. July 18th, 1919. (137,762.)
20,012. Electric cigar lighters, pipe lighters, and the like. M. J. Railing and R. J. H. Hill. August 14th, 1919. (Addition to 119,141.) (137,769.)
22,290. Automatic regulation of the parallel working of variable-speed dynamos and accumulators. F. Mauron. September 10th, 1918. (132,519.)
22,600. Electric lighting fixtures. H. C. Adam. October 8th, 1918. (133,673.)
26,596. Multiple fuses for electric conductors carrying high-voltage currents. O. Cracoanu. May 27th, 1919. (137,793.)

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"THE RIGHT TO WORK."

IT is sometimes stated that the unwillingness of some sections of Labour to work their hardest and increase production is due to their disinclination to increase the wealth of their employers. We can understand, though we do not say justify, that short-sighted attitude. What is less easy to understand, and cannot on any ground be justified, is the action of certain sections of Labour in preventing thousands of other workers from getting not increased wealth, but a living.

In the course of the House of Commons debate on Trade Unionism and unemployed demobilised men, it was stated that there were from 350,000 to 400,000 ex-service men now unemployed in the United Kingdom. The reasons for this are no doubt various, but one of the most deplorable is the obstruction which some Trade Unions place in the way of the training of these men. The engineering trades of the country were never busier, and there is plenty of work ahead, so that there is a capability of absorbing a great volume of additional labour—if suitably trained. In the case of the electrical industry, there is work in prospect for every man who is willing to do it—again, if suitably trained. Of the hundreds of thousands of fighting men who are now idle, a large number are understood to be young men who, while yet youths, were called away from their training to join the Forces and fight for a vital principle, and incidentally for the safety of those who stayed at home—included among their number being a goodly multitude of A.S.E. and E.T.U. men. The soldiers vacated places in industry which were to be awaiting them when they returned, and their training was to be resumed. What do they find to-day? The way to training is blocked—by Trade Union obstruction! and that, notwithstanding that many of them are disabled men, whose disabilities in the ordinary course should alone have evoked consideration. One may criticise a Union as a body without any direct personal application of the criticism, and without eliciting evidence of an individual conscience, but the members of Unions are individuals and have bodies if they have not souls. Who, then, are these men who are preventing their fellows from earning a living? Can it be that there are among them some who earned good money in safety at home while those whom they autocratically condemn to idleness were in the trenches and elsewhere amid all the terrors and horrors of bloody war? Who is the enemy now? The Huns are beaten—can it be that those who defeated them in the field now have to count their own kith and kin as enemies? While they were "over there" they provided them with munitions—now they will not let them earn their daily bread!

There must be some in the ranks of Unionism who have blushed for very shame because of this autocratic oppression. Trade Unionism has been the means of accomplishing great things that nothing else could have accomplished for industrial workers—the pity of it is that it is all put under a cloud of disgrace by the state of affairs which was revealed in the debate of last week. How can the most sympathetic and well-meaning writer refrain from saying hard things? Yet Labour, which uses hard words, is little likely to be moved by such. We might appeal to its reason, but that, we fear, would also fail. Will an appeal, based on the grounds of common humanity and of the inalienable right of every man to do work when there is work waiting to be done, meet with any greater measure of success?

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The electrical and engineering labour organisations know well enough that the industries upon which their members depend give promise of great development and plenty of employment. We deplore along with the more humane sections of those organisations that in the House of Commons debate, these two trades had to be singled out for reference as leading obstructionists. For some time Trade Unionism, as we have latterly known it, has been on its trial. The jury—the general public—has been hearing the arguments and the evidence. Soon it will retire to consider its verdict. Happily not all Trade Unionism has been sinning in the matter under consideration, but there cannot be prodigals in any family without the whole sharing in the loss of prestige or reputation. Trade Unionism must cleanse and purify itself if it is to stand forth a useful and desirable part of the machinery of industrial life.

Pitiless, soulless, despicable, contemptible, and unclean thing is this attitude or plan which prevents fighters who have saved us in our hour of trial, from fitting themselves for settlement again in the ways of industrial peace and freedom. Who can recall the processions of years before the war, with banners waving, claiming "The Right to Work," without viewing with derision the present attempts to deprive one of that right?

The Labour Party repudiates the suggestion that the Trade Unions are callous or indifferent to the claims of the ex-Service men, calls it a "sheer misrepresentation," and describes the whole discussion as a Coalition publicity "stunt" against Labour. Yet it finds it desirable to suggest that the Trade Union Congress should arrange a joint conference between the several Trade Unions concerned and the various ex-Service men's organisations, to inquire into the whole matter, and prepare schemes for absorbing unused labour "without detriment" to "present industrial standards."

British Fairs and Overseas Trade.

Shortly after the war broke out, the Board of Trade organised some very useful exhibitions of German electrical and other goods for the guidance of British manufacturers. We counted it no small privilege to be able to contribute with our specialised information and knowledge to the preliminary work connected with this and other efforts made by Government departments. It was one out of many similar contributions that we made as a national duty toward the effort to ensure the availability of essential supplies for the purpose of the war, and toward the securing of the British trade position after the war. Government officials change, and Government Departments with them, and in reflective mood we sometimes revel in Thomas à Kempis's "testimony of a good conscience" while civil servants and others take the kudos. Much has happened since those early and important exhibitions were held. To-day we have firmly established amongst us the British Industries Fairs held under the auspices of the Board of Trade. The one that is now in full swing in three centres of the United Kingdom is a magnificent affair. Such parts of it as interest our readers we refer to on another page this week. The Birmingham Section is one of great value and importance. The Birmingham Corporation and the Birmingham Chamber of Commerce have, in collaboration with the Board of Trade, brought together a most businesslike collection of British manufactures, and the electrical and allied engineering trades have quite a large representation. At the Crystal Palace also there is quite a considerable proportion of exhibits of electrical apparatus. It is only right and proper that this should be so, and we believe that the firms which have taken advantage of this opportunity will reap due reward immediately if they wish to do so, and certainly later, when they require work more than they do at the moment. Buyers are here from the ends of the earth, and they will return to their different countries knowing far more of British ability than they knew when they came.

If firms refrain from exhibiting their wares or announcing themselves in these days, when all eyes are turned to these islands to see whether we are industrially alert, purely because they have more orders in hand than they can tackle—well, they will have *their* reward, and will deserve it. We congratulate the large number of firms which have adopted what we regard as the right policy by making this present effective demonstration in presence of the overseas buyer. Some of the exhibitors told us as we strolled down the chaotic gangways at Birmingham on Friday last, when the erection and setting out of stands was in progress:—"We have so much work to do that we did not *need* to exhibit, *but*—." We need not continue—the why and wherefore of the action of those busy people is so obvious to far-sighted men.

Lubrication.

To all users of machinery a precise understanding of the qualities of the lubricating oil used should be of the first importance. Whether it is so in fact, is often open to doubt. At any rate, the problem of providing suitable lubricating oil is more often than not left for the lubricating-oil manufacturer to solve, and it cannot but be said that first-class firms do provide a first-class article. That lubricating-oil manufacturers have their heart and soul in the business of improving their oils is seen in the recent important development which has been receiving the attention of some of the more scientific societies, such as the Physical Society and the Society of Chemical Industry, although there is also a considerable backing of practical experience.

It is commonly known to large users of lubricating oils that a pure mineral oil is of little value as a lubricant, and that the essential properties of "oiliness" are provided by mixing varying proportions of a fatty oil with the mineral oil, the percentage of fatty oil reaching up to as much as 20 per cent. For instance, one specification issued by a Government Department, for a lubricating oil for internal-combustion engines, stipulates 10 per cent. of laid oil to 90 per cent. of mineral oil. Another specification, for marine-engine bearing oils, is 80 per cent. mineral oil and 20 per cent. fatty oil, the latter being the general proportion for fast-running machinery under heavy loads. The novelty in the development in lubricating-oil blending to which we have referred is the use of from 0·2 to 2 per cent. of a fatty acid, instead of, say, 20 per cent. of a fatty oil, with the mineral oil, and practical experiments over 18 months, especially in large ships, have proved that a mineral oil with a fractional percentage of fatty acid is capable of doing the same work as an oil containing 20 per cent. of fatty oil.

The patent for this method of blending lubricating oils was applied for on February 5th, 1918, but owing to the war conditions, the publication of the patent was naturally prohibited; but the Admiralty carried out experiments, and the value of the process is testified to by Mr. Arnold Philip, the Admiralty chemist. These tests, and others, have shown conclusively that the substitution of this small percentage of fatty acid does reduce the frictional coefficient of bearings in the same degree, compared with a straight mineral oil, as, say, 20 per cent. of fatty oil. The question at the moment seems to be discussed mainly for the theoretical interest which the new process has in relation to the much discussed problem of "oiliness," but as to the practical result no doubt can be raised.

An interesting point is whether and to what extent this will reduce the cost of lubricating oils. Perhaps to the lubricant manufacturer there will be considerable savings in that he will have his fatty oils for other purposes, but upon the question of cheapening lubricating oils to the user, by the adoption of this new process, called the "Germ" process (for no very conclusive reason, by the way, because no germ enters into the process as might be inferred), nothing has been said. Nor have we yet been told whether the results are merely equivalent to the use of the very much larger percentage of fatty oils. A curious feature noticeable from the figures of tests is that up to 0·5 per cent. of fatty acid, there is a marked reduction of the frictional coefficient, but beyond that and up to 2 per cent., the further reduction is not so pronounced. In any case, this new development is one of considerable interest to all users of machinery.

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A VISIT TO THE CHLORIDE ACCUMULATOR WORKS.

Now that accumulators are used to such a large extent for the propulsion of electric vehicles and industrial trucks, as well as for lighting, starting, and ignition purposes on petrol vehicles, much interest is being shown in their production. One of the most successful makes of accumulators on the market is that produced by the Chloride Electrical Storage Co., Ltd., at whose works at Clifton Junction, near Manchester, we spent a most interesting and instructive day last week.

When, seven years ago, there arose a demand for storage batteries for automobile starting, lighting, and ignition, this company, which was formed in 1889 and commenced operations in 1893, undertook to develop accumulators for this purpose. Extensive additions and alterations have recently been made to the works to enable them to cope with the heavy demand; the works, fig. 1, cover an area of 10 acres, employ over 600 workers, and to-day there are 1,110,000 "Exide" batteries giving satisfaction in motor-car service. In addition to manufacturing, this company is further serving its customers by maintaining an organisation which makes it easy for a car-owner to obtain a battery, or any help, information, renewals, or repairs, when such are necessary.

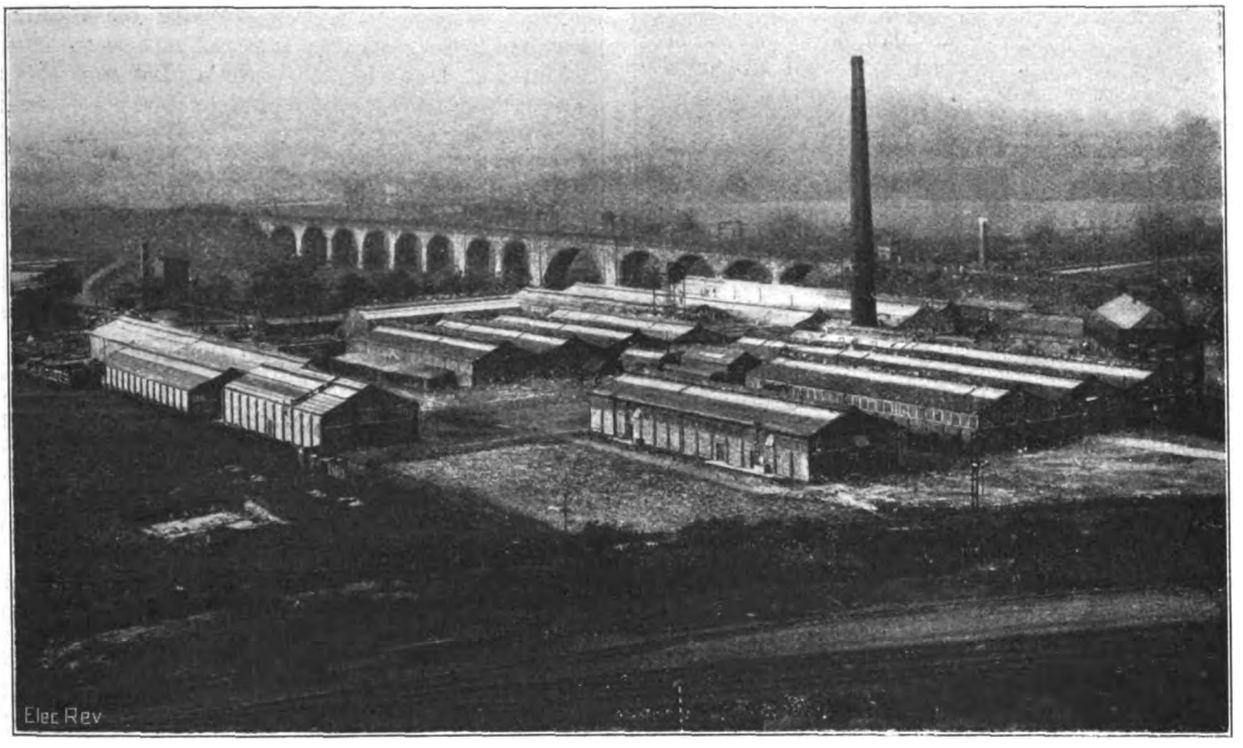

Fig. 1.—The Chloride Accumulator Works at Clifton Junction, near Manchester.

It is not always realised that an "Exide" auto-battery, which measures 12⅝ in. long., 7⅜ in. wide, by 9⅛ in. high, and weighs only 63·5 lb., can deliver over two million foot-pounds of energy, and that when cranking an engine it must often develop power at the rate of over 2 electrical H.P. Further, to be successful, it must do its work unfailingly, and at temperatures ranging from below zero to 100° F.

The positive and negative plates of these batteries are of the same general design as those used in the well-known vehicle batteries. A grid made of a stiff lead alloy (antimony) supports the active material in the form of a series of vertical strips held between the grid bars and locked in place by horizontal surface ribs, which are staggered on the opposite sides. After the grids are cast they are pasted with oxides of lead, made into a paste of special composition, which sets in drying like cement. Figs. 2 and 3 show the interiors of the plate-casting and moulding shops. The plates then go through an electrochemical process, which converts the material of the positives into brown peroxide of lead, and that of the negatives into grey spongy lead. Fig. 4 shows the forming shop where this process is carried out. Both the positive and negative plates are provided with an extension lug, and are so assembled that all the positive lugs come at one side of the jar, and all the negative lugs at the other, thus enabling each set to be burned together with a connecting strap, giving one positive and one negative pole. The burning is done by a hydrogen flame, and all the hydrogen and oxygen used in the works is generated on the premises.

When the positive and negative groups are assembled, the adjoining plates are kept out of contact by means of wood separators ribbed on the side against the positive. The separators are made of tough wood, from which harmful substances are removed by a special treatment. It is found that when wood separators are used, about 10 per cent. greater capacity can be obtained than when glass rods are used. Further, an important point is that the wood absorbs the electrolyte, and therefore, even when the cell is inverted, the circuit is not broken; 50 per cent. of the normal output, or, in other words, the full discharge for half the time, can be obtained when in this position. This is a useful feature in certain cases, as, for instance, in miner's and other hand-lamps.

The cell container is a rubber jar of special composition, which will withstand vibration without breakage. The plates rest on stiff ribs in the bottom of the jar, fig. 6, allowing space for the accumulation of sediment. For railway train lighting batteries special glass boxes have proved to be superior to the old wood boxes lined with lead, which give trouble due to corrosion. With the glass box it is also possible to see what is going on inside without opening up the cell. Ebonite and celluloid boxes are also provided; in the former case nothing but pure water should be added to the electrolyte, but in the latter the acid should be changed about once a year.

A special feature is the method of making a tight seal where the post goes through the cover (fig. 6). The strap post has an alloy collar which supports the jar cover, a soft rubber gasket being placed between. The post is threaded

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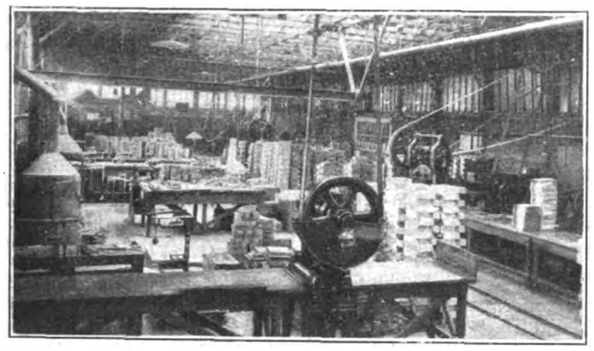
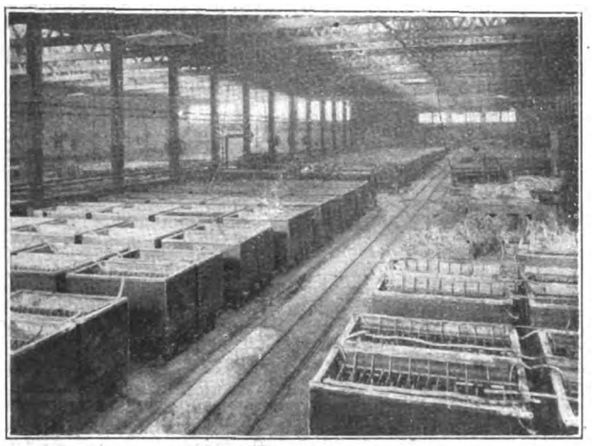
where it comes through the cover, and the sealing nut clamps the cover tight, the rubber gasket making an effective seal.

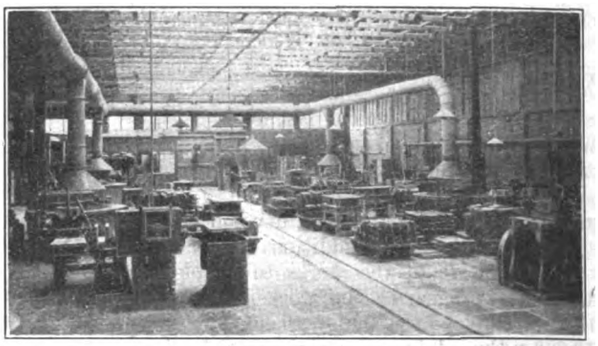
From the illustrations (fig. 7) of the non-flooding vent and filling plug, it will be seen that it provides both a vented stopper (vents F, G, H) and an automatic device for the prevention of over-filling and flooding. In a simple and effective manner, the amount of water that can be put into the cells is limited to the exact amount needed to replace that lost by evaporation. This is accomplished by means of the hard rubber valve (A) within the battery cover and with which the tip of the filling plug (E) engages, as shown in the illustrations. The action of removing the plug (E) turns this valve (A), closing the air passage (B B), and forming an air-tight chamber (C) in the top of the cell. When water is poured in, it cannot rise in this air space (C) so as to fill the cell completely. As soon as the proper level is reached, the water rises in the filling tube (D) and gives a positive indication that sufficient water has been added. Should, however, the filling be continued, the excess will be pure water only, not acid. On replacing the plug (E), the valve (A) is automatically turned, opening the air passages (B B), and leaving the air chamber (C) available for the expansion of the solution, which occurs when the battery is working.

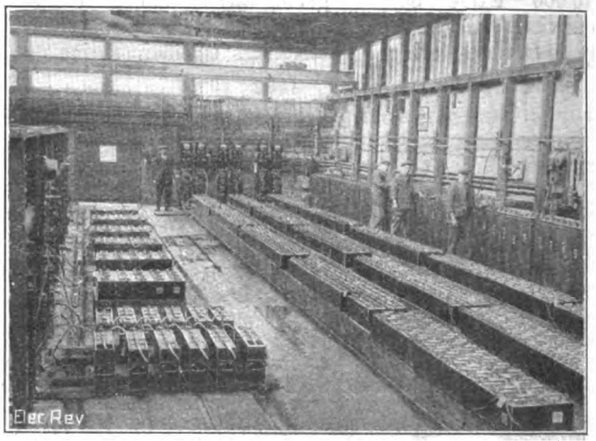
The works are electrically driven throughout; the total load on the generating station which is situated on the premises is about 4,000 amperes at 100 volts. Energy is purchased from the public supply and converted; part is generated on the premises, but the steam plant is mainly regarded as a stand-by. A Mather & Platt automatic pump capable of dealing with 1,000 gallons of water per minute, and some 4,000 sprinklers distributed throughout the





Figs. 2 and 3 (above).—Casting and Moulding Shops.





Figs. 4 and 5 (below).—Forming and Charging Shops.

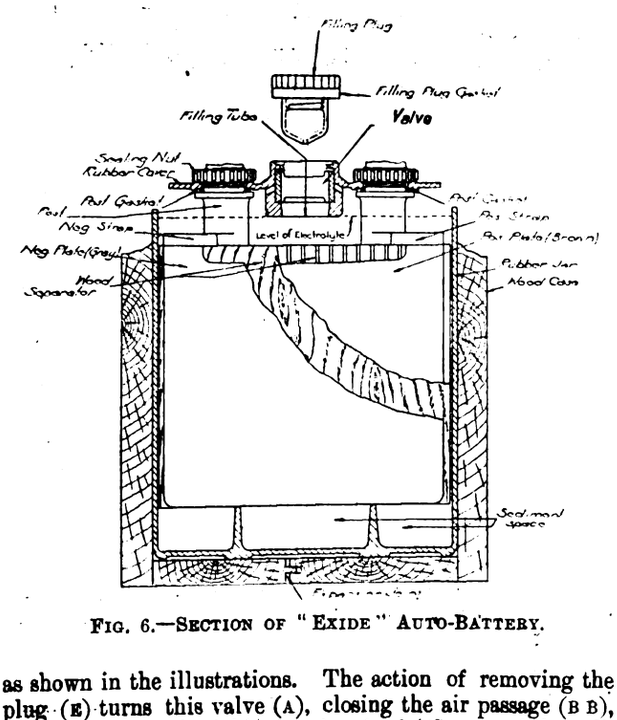


Fig. 6.—Section of "Exide" Auto-Battery.

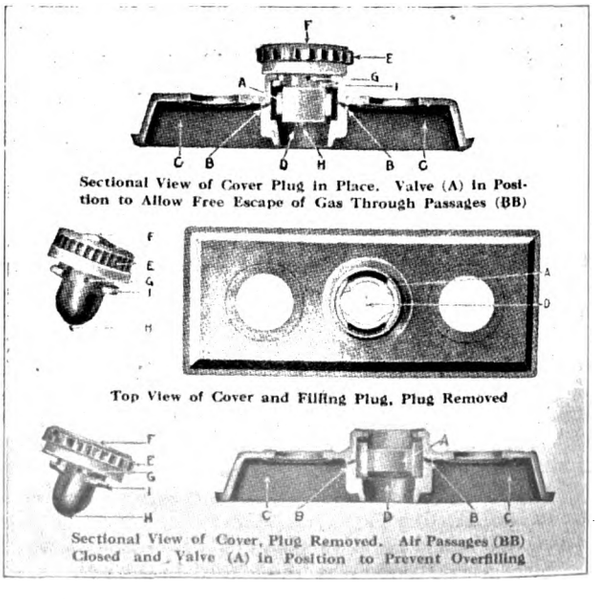


Fig. 7.—Non-Flooding Vent and Plug.

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works buildings, have been installed as a means of fighting fire. Adjacent to the battery charging shop (fig. 5) is a converter room equipped with a 66-kw. Phœnix moto generator, and the necessary switchgear for charging t' completed accumulators. On the left of fig. 5 will seen automobile batteries under charge, while on the will be seen larger batteries as used in British subm It is of interest to note that during the war one fir was building submarines at the rate of one per w

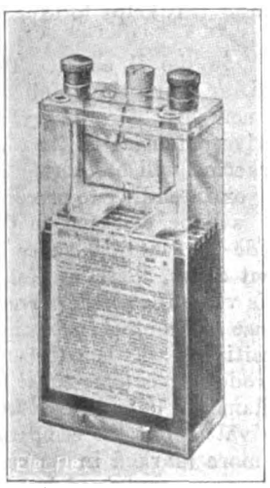

Fig. 8.—Non-Spillable Accumulator.

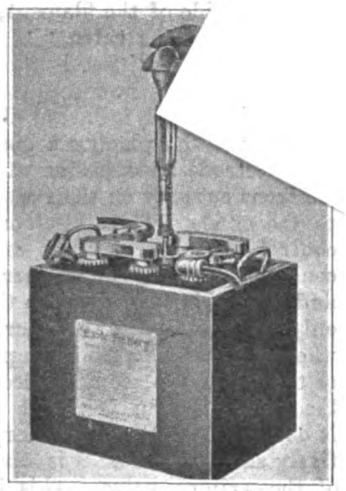

Fig. 9.—Combination Hydrometer.

of which were equipped with Chloride batteries for underwater propulsion. These batteries weigh 150 tons each, and are composed of 332 cells, each weighing just under ½ ton. The firm has received an unsolicited testimonial from the Admiralty, testifying to the high quality of batteries supplied during the war period. The firm's entire output was absorbed by the Admiralty, and there has not been a single recorded case of a battery failing, although the conditions to be fulfilled were severe, the submarines being required to remain submerged for 24 hours at a time.

The cell illustrated in fig. 8 represents an advance in portable accumulator manufacture. The rigours of war

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temperature; three deg. below 70° is shown minus
cating that the gravity should be corrected at that tempe
ture by deducting one point; three deg. above 70° is shown plus 1, which indicates that the gravity at that temperature should be corrected by adding one point to the reading, as shown by the hydrometer.

Another handy device supplied by this firm is the carbon electrode holder for re-burning battery connectors. The advantage of the outfit lies in the fact that a spare 6-volt battery can be used as the source of supply for the operation, rendering unnecessary the use of further accessory apparatus, like the hydrogen generator.

In conclusion, we have to thank the Chloride Electrical Storage Co., Ltd., and the members of its staff, for the cordial manner in which we were received and shown over the works at the time of our visit.

A NEW THERMIONIC VACUUM TUBE.

By JOHN SCOTT-TAGGART.

The present writer evolved the type of vacuum tube described below at the works of the Edison Swan Electric Co., Ltd., while carrying out some experiments on grid control during September, 1919. As is well known, the usual modern three-electrode valve consists of a filament surrounded by a cylindrical anode, a helical grid being placed between filament and anode. A positive potential on the grid will produce an increase in the anode current, while a negative potential will produce a decrease.

The writer's valve is illustrated in fig. 1, p. 262. As will be seen, the form and relative positions of the electrodes are novel. The filament F is vertically arranged, the top support being a nickel-iron spring which keeps the filament taut when the latter is incandescent. The anode takes the form of a small metal plate placed preferably at a considerable distance from F. The control electrode, corresponding to the grid of an ordinary valve, takes the form of a metal plate G, preferably of larger dimensions than P and situated within a few millimetres of the filament F. The particular valve with which the curves, fig. 2, were taken possessed the following dimensions: plate P 10 mm. by 10 mm. by 0.008 in. nickel sheet; plate G 22 mm. by 10 mm. by 0.008 in. nickel sheet; filament F crimped, 25 mm. by 2.3 mils, tungsten; distance F to P 9 mm.; distance F to G 2 mm.

A series of characteristic curves are shown in fig. 2, and illustrate the effect of the control electrode potential on the anode current to P. It will be seen from the curves A, B, and C that the vacuum tube operates in a very similar manner to an ordinary three-electrode valve; that is to say, an increase of control potential causes an increase of anode current, while the reverse applies if the control potential is decreased. It will be noticed that the portions of the curves lying to the left of the ordinate through zero potential on the control electrode are very regular and similar to those obtained with an ordinary valve. The bends at the lower ends of the curves are present, as usual. When, however, the control electrode is made positive, we notice that the curves commence to lean over rapidly to the right. This is attributable to the fact that G is now drawing to itself a considerable portion of the electrons emitted from F. A milliammeter in the G circuit corroborates this assumption. This effect is far more marked than in the case of an ordinary valve, since the plate is more suitable for the absorption of electrons. The G current, however, does not build up immediately, but only becomes important when the G potential is higher than about +2 volts. We consequently see why the anode current curves of fig. 2 only commence to lean over to

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where it comes through the cover, clamps the cover tight, the rubb… effective seal.

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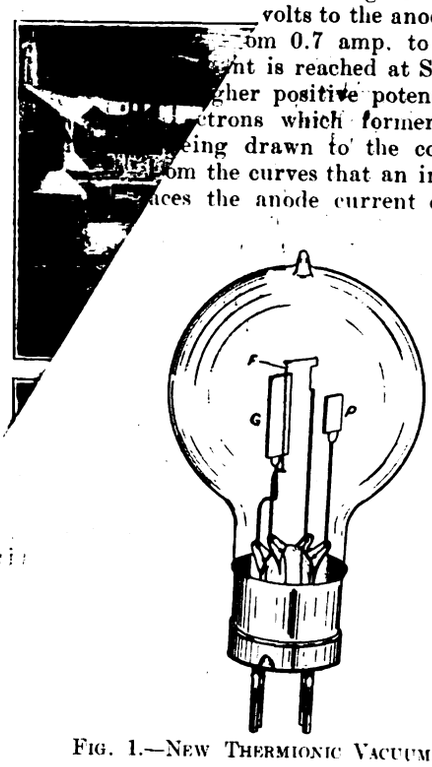

Fig. 1.—New Thermionic Vacuum Tube.

…ntial passes +2 volts. …e, the curves, it will be … When the control poten… …n those shown, the anode … value, and then begin to de… …wn in fig. 2 by the D curve, … volts to the anode and lessening … …om 0.7 amp. to 0.6 amp. The …nt is reached at S. As the control …gher positive potentials, the anode …ctrons which formerly went to the …ing drawn to the control electrode. …om the curves that an increase of anode …ces the anode current curve bodily to the left. In several other ways, the curves obey laws similar to those governing the characteristics of valves having grids placed between filament and anode.

It might at first be thought that the result of placing the control electrode behind the filament would be that an increase of control potential would partially neutralise the attraction of the anode, and so cause a decrease of anode current. This is what happens in the case of a valve described by Mr. J. Erskine-Murray, but the very opposite occurs in the writer's type of valve, which operates in the normal way. We may explain the action

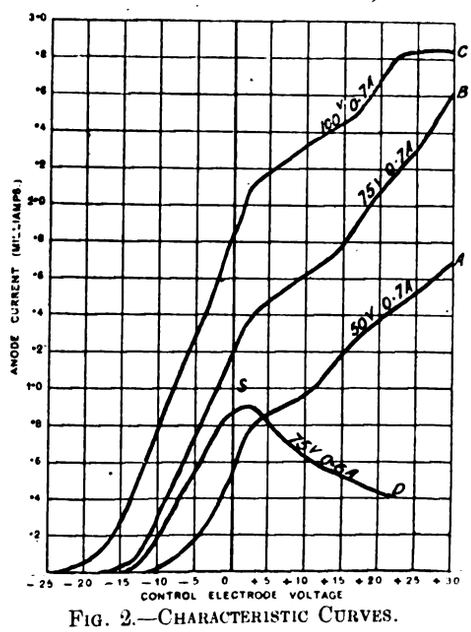

Fig. 2.—Characteristic Curves.

of the valve as follows: The filament F working at, say, 0.7 amp., is emitting a certain number of electrons per second. The anode P is capable of drawing to itself a certain proportion of these electrons. The remainder would be wasted, and would float around the filament and the inside of the bulb, especially behind the filament. These spare electrons would constitute a negative space-charge around the filament, and would tend to lessen the number of electrons passing to the anode. The effect now of applying a negative voltage to the control electrode G would be to repel many of the free electrons back into the neighbourhood of the filament, and so concentrate the space-charge; this in turn would lessen the anode current. When the control electrode is positive it will attract to itself most of the electrons constituting the space charge, and so cause an increase in the anode current. It is also certain that the electrostatic field of the control electrode extends itself on the other side of the filament, and this helps to explain the action of the valve.

A special condition is shown in the D curve. The anode current is now saturated, and practically all the electrons emitted from the filament are being drawn to the anode. By placing a positive potential on the control electrode an opposing attraction will be exerted on electrons actually on their way, or intending to proceed, to the anode. These electrons will be deflected to the control electrode, and the anode current will suffer in consequence. The anode current curve, therefore, falls, and it is to be noted that in this valve the anode current only decreases with an increase of control potential, when the latter potential is positive, and when the sum of the anode and control electrode currents is equal to the total emission from the filament. The same effect is obtainable with an ordinary valve, but the comparatively sharp bend at S is far more marked in the case of the writer's valve. This is easily explained by the fact that G is a large metal plate, far more capable of absorbing a large electron current than a very fine wire open helix.

Judging from the curves given, the amplification obtainable with this valve is not as high as in the case of the more usual pattern, although the actual results in a three-valve amplifier were almost as good. The representative point should preferably move only along the left-hand portion of the curve. The valve operates well as a detector, the point S being especially suitable for strong signals, both half oscillations producing a decrease of anode current. The vacuum tube also operates excellenfly as an oscillator and self-heterodyne receiver with 100 volts on the anode and 6 volts across the filament. No doubt, the characteristics and general properties of the valve could be greatly improved by further research on the sizes and relative positions of the electrodes.

COAL-PIT TO CONSUMER.

By "INTERESTED."

In the columns of the Electrical Review somewhere about the year 1910 I urged that riverside electricity works in particular, and other coal consumers situated alongside the river generally, should come to some arrangement as ship owners enabling them to purchase coal f.o.b. at the most convenient coalfield seaport, and to bring the fuel right up river alongside their own works without any further transhipping or handling. Had such a scheme come into operation about that time, or become a reality prior to the war—if only confined to the few electricity generating stations near or on the river bank—how many extra thousands of pounds would have been saved to those undertakings!

That period during the war, when shipping was being destroyed on a large scale week by week, was making —and eventually did make—the idea of coastal seaborne coal an impossibility owing to high freightage. Yet, during the whole of that period, one of our enterprising rivals calmly used his ship regularly carrying the precious fuel, thereby continuing in a higher degree that saving which was arranged for a few years earlier.

No doubt many readers will recall the s.s. *Wandle* coming up the river Thames after a smart and successful encounter with an enemy submarine. I could not sup-

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press a smile some days afterwards when the newspaper report of that encounter reached me, giving an account of the voyage, and wondered if such publicity given in the daily Press, and the advertisement thus given to the idea of coal coming up under bridges without further unloading and barging, would then awaken that particular latent business bump in the minds of many riverside works managers. Perhaps not. Anyway, I put it to all interested that there is money in the idea, and the recent information given me that certain business men who are not directly concerned as coal consumers are seriously considering the advisability of purchasing a fleet of small steamers for the purpose of dealing with this scheme, serves to show that more than one man is alive to the possibilities. Why do not the actual coal consumers step in and become ship-owners, and thereby take all the profits?

Ships are at a premium—and never more worth that premium than at the present day. Good Welsh through and through coal can be purchased at the pit somewhere in the region of 27s. 6d. per ton, which, when the 4s. duty is added, makes the figure 31s. 6d. per ton, and by comparison with the prices ranging in London for delivery alongside by barge, or to the handy railway siding, the amount per ton out of which to effect a saving is the very considerable figure of about 12s. 6d. This, of course, refers to rail-borne coal. Current rates for sea-borne fuel put that manner of carriage at the moment out of the question.

Certain difficulties there are, I know, to be overcome; all the stronger reason for those difficulties to be promptly tackled and surmounted at once. Worse were taken in hand during the war, with excellent results.

The question of carrying coal from the pits to the situation of the works where actual consumption takes place is not one confined to the river Thames, but applies equally well to other parts of the country, and places around the coast. Railway charges are on the increase, and shipping rates likewise present a reflection of nothing but increase, notwithstanding the allowance of 10s. per ton off bunker coal. Ship-owners say we are paying because of high wages and demand. Owing to the ship shortage, which shows no sign of altering in the near future, high freights are secured for a long time to come. Obviously the procedure to enable consumers to effect a saving is to become their own carriers.

Considering these persistent and increasing high charges for carrying coal in conjunction with the large profits that are being made by shipping firms, is not this an appropriate time for large coal consumers whose works are favourably situated, and who at the present day pay harshly for cartage, seriously to consider if some arrangement can be made upon the lines here suggested for reducing their costs by taking a good proportion of the profits now going into the pockets of the ship and barge owners, and at the same time assisting to reduce the congestion of our railways, also thereby placing themselves in a position more or less free from the worry and trouble of strikes? This is a big question, and, I am sure, a profitable one.

The mass of material and goods daily barged up our rivers to premises alongside or near the banks leads one to consider whether this question of what might be termed small ship holdings would not prove a paying one to businesses other than large coal consumers, which, at the present time, are paying heavily for continual unloading from ships and reloading into lighters, and the consequent lighterage. At the time the bridge was built across the Thames at Kew, granite used in its construction came round the coast up river to the spot, without transhipment. That was a good piece of business, and if one such instance ensures a saving, why not others, especially to consistent users of barges?

THE BRITISH INDUSTRIES FAIR.

On Monday last this Fair, for which great preparations have been in progress for some time past, was opened in three sections, namely, in London at the Crystal Palace, at Birmingham (Castle Bromwich), and at Glasgow (the Kelvin Hall of Industries). The displays are on a large scale, and they are being visited by many thousands of visitors from overseas. The Fairs remain open until March 5th, so that readers who have not already made arrangements for attending whichever of the three they are specially interested in should do so at once. This week we must be content with giving a list of the electrical and allied firms who are exhibiting, with a word or two to indicate the general character of their exhibits. Fuller reference to matters of interest will appear in later issues.

LONDON.

The Fair which was opened at the Crystal Palace, London, on Monday, is by far the largest and most important of its kind that has yet been held, and, moreover, although the Palace is the largest exhibition building in the world, it has proved too small for the demands that have been made upon it; as long ago as last October only 80 per cent. of the applications could be granted, and applications have continued to come in daily ever since that date. The gangways of the Fair as organised measure 3½ miles in length, and the stand frontage amounts to no less than five miles. Admirable arrangements have been made for the comfort of the buyers and exhibitors, and special services of trains bring the Palace within 15 minutes of the City and West End. No fewer than 150,000 invitations to visit the London section of the Fair have been issued by the Board of Trade, of which one-third have been sent to firms abroad.

A perambulation of the show, which comprises well over 1,000 stands and 19 trades, subdivided into about 330 classes of exhibits, produces a deep impression on the mind of the visitor. The general excellence of finish of the wonderfully varied exhibits, the care with which the space available has been utilised to the utmost, and the businesslike arrangement of the individual stands, do the greatest credit to the official organisers and to the exhibitors alike; there is a marked difference between the Fair and an ordinary exhibition laid out to attract the public as well as the tradesman. The Palace is one gigantic shop, crammed with attractive wares laid out in most effective fashion, and if to deserve success is to command it, success is assured.

The exhibits of electrical interest do not bulk so largely in this section of the triple Fair as at Birmingham, but what there are, are very good. They are mainly associated with dry batteries and pocket lamps, electrical glass-ware and reflectors, small accessories, X-rays, telegraphs, clocks, and toys.

	Stand No.
Ball & Brockhurst, electric clocks	A90
Joseph Bourne & Son, Ltd., insulators and battery jars	C38
British Ever-Ready Co., Ltd., dry cells and batteries, pocket and hand lamps	R21
British Glass Wool Co., Ltd., glass wool	G14
Burtles, Tate, Ltd., glassware for lighting	F27
A. Chase & Co., Ltd., electrical novelties	B100
Clifford Bros., Ltd., electrical fittings, lampholders, switches	P9
Corgran Co., electrical toys	B101a
Dubilier Condenser Co., Ltd., electrical toys	F7

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Stand No.

Edinburgh & Leith Flint Glass Co., electric lamp bulbs, &c. F7a
Doulton & Co., Ltd., porcelain and stoneware ... F12 & F31
Efandem Co., Ltd., dry batteries, lamp cases, and lamps R11
Gratham Manufacturing Co., electrical apparatus, telegraph keys, sounders, battery lighting sets, toys ... B12
Henry Harvey & Co., electric light reflectors P31
Hughes Label Co., Ltd., name plates and labels H40
Newton & Wright, Ltd., X-ray and electromedical apparatus E4
Orbit Electrical Co., Ltd., dry batteries A64
James Pitkin & Co., Ltd., electric chronographs, telegraphs, telegraph instruments, measuring instruments E1
Remoline Co., dry batteries, pocket lamps, toys A37
Rose Bros., dry batteries, electrical toys B21
Semaphore Engineering Co., Ltd., dry batteries, pocket lamps A39
Henry G. Richardson & Sons, glass electric fittings ... F26
Siemens Brothers & Co., Ltd., primary cells of all types, dry cells and batteries P3
Silent Electric Clock Co., Ltd., electric clocks and electrically controlled mechanisms for time indicating L73
The Sim, Ltd., electrical toys A115a
Vulco Manufacturing Co., accumulators, coils, &c. ... B107
John Walsh Walsh, lighting glassware and electric bulbs G25
Thos. Webb & Sons, Ltd., ornamental glassware, electric lamp bulbs F21
Wood Brothers Glass Co., Ltd., glassware, X-ray bulbs F10 & F13
A. C. Cossor, Ltd., incandescent electric lamps, X-ray tubes, wireless valves, vacuum pumps D1a
Marconi's Wireless Telegraph Co., Ltd., wireless telegraph apparatus, direction finders, detectors, valves, &c. F32

BIRMINGHAM.

From the electrical point of view, the show at Birmingham is the most important of the three. Castle Bromwich is only two stations out from New Street, and additional services of trains and motor 'buses run while the Fair is on. The aerodrome buildings adjoin the railway station. There are three buildings filled with exhibits, and the display is a thoroughly businesslike affair, a credit to the municipality and to the Birmingham Chamber of Commerce, who have taken the matter up so enthusiastically, and to the general manager, Mr. Charles Stanley. Those who have not time to visit all three cities will bear in mind that it is at Birmingham, and Birmingham alone, that they will be able to see the exhibits of electric lighting and heating manufactures, switches and switchgear, accumulators, vacuum cleaners, general hardware, tools, metal goods, motor accessories, weighing machines, and other goods of similar character. The greater number of electrical stands are in Building "A," and they will be found conveniently grouped at one end of the hall, or not far away therefrom. The catalogue is a finely prepared work, well worthy of the occasion, and it will doubtless be preserved by many colonial and foreign visitors for future reference.

The following firms are exhibiting in Building A :—

Premier Electric Heaters, Ltd., electric cooking and heating apparatus 1
Sun Electrical Co., Ltd., electric fires, heating and cooking apparatus, switchgear, lighting fittings, accessories, &c. 3
Bulpitt & Sons, Ltd., the "Better-Skeem" system of electric localised lighting, electric lighting fittings, lanterns, &c. 4
Chloride Electrical Storage Co., Ltd., storage batteries for use in country house lighting 15
Litholite Insulators, Ltd., moulded electrical insulators, electric lighting accessories 17
Donovan & Co., factory and domestic electrical apparatus, switchgear, motor starters, electrical accessories, lamps, bells, telephones, &c. A new departure in conduit switches is shown here 20
David Shanks & Co., Ltd., electric light fittings 21
Siemens Bros. & Co., Ltd., dry cells for all purposes, electric lamps, signs, electric light reflectors, electric irons, kettles, and radiators 22
Wm. Soutter & Sons, Ltd., electric light fittings ... 23
General Electric Co., Ltd., electric light fittings, switchgear, wires and cables, telephones, medical apparatus, vacuum cleaners, cooking and heating appliances, radiators, measuring instruments, &c. ... 24

Stand No.

Edison & Swan Electric Light Co., Ltd., electric light fittings and accessories, switchgear, wires and cables, conduit, bells, batteries, &c. 35
Sperryn & Co., Ltd., electric light fixtures and accessories 38
Chas. Joyner & Co., Ltd., electric light fittings, "Angelus" electric heating stoves 39
Ingram & Kemp, Ltd., electroliers and other electric light fittings 40
Player & Mitchell, Ltd., ships' electric light fittings ... 41
Benjamin Electric, Ltd., industrial lighting fittings, street lighting fittings, hand lamps, lighting accessories, battery horns for motor cars 42
Ward & Goldstone, Ltd., small generating sets and equipment for house lighting, electric wires, wiring system, &c. 43
Birmingham Guild, Ltd., electric light fittings 43a
J. H. Tucker & Co., Ltd., tumbler switches, and various electrical fittings and accessories, switchboards and switchgear 43
C. J. Thursfield & Co., Ltd., electric light fittings ... 46
Rex Import Co., Ltd., the "Rex Torrington" electric cleaner, electric clothes washers, electric hair brushes, &c. 47
J. Dugdill & Co., patent electric fittings 50
J. A. Crabtree & Co., Ltd., tumbler switches, and other accessories for electric lighting, heating, cooking, car ignition, &c. 50a
Best & Lloyd, Ltd., electric light fittings, electric heaters, &c. 51
Robinson & Hands Electrical Co., Ltd., fuseboards, lampholders, tumbler switches, &c. 53
Midland Electric Manufacturing Co., Ltd., Ironclad switches and switch and fuse gear 56
F. & C. Osler, Ltd., electric light fittings in metal and crystal glass 57
Etna Lighting & Heating Co., Ltd., electric lighting installation work for factories, country houses, &c. 58
Tok Manufacturing Co., Ltd., Tok rotary snap switches 52
Jackson Electric Stove Co., Ltd., various electric cooking and heating apparatus 63
Venner Time Switches, Ltd., automatic time switches 54
Improved Solidite Co., Ltd., substitute for ebonite, vulcanised fibre, porcelain, &c. 65
Semaphore Engineering Co., Ltd., dry batteries for various work, lighting sets for motor cycles, &c. 66
Austin Motor Co., Ltd., "Autoplant" electric generating plant 69
May & Padmore, Ltd., and Bastian Electric Heater Co., Bastian electric fire and heaters, electric furnaces, ovens, and flat irons, electrically heated water tanks ... ... 71 & 71a
Monometer Manufacturing Co. (1918), Ltd., melting furnaces, &c. 72
Jas. Hinks & Son, Ltd., lighting fittings 78
Samuel Heath & Sons, Ltd., electrical fittings and accessories 81
Burners, Ltd., electric light fittings, fire surrounds for electric radiators 86
Edgar A. J. Hooper, Ltd., electric light fittings 89
Berry's Electric, Ltd., "Magicoal" electric fires ... 102
Thomas R. Carpenter, Ltd., electric light fittings ... 104
Falkirk Iron Co., Ltd., electric heating and cooking apparatus 124
Burt, Escaré & Dennelle, Ltd., electric light fittings ... 134
Daisy Vacuum Cleaner Co., Ltd., electric vacuum cleaners 150
Birmingham Private Telephone (New System) Co., Ltd., automatic intercommunication telephones and other telephone apparatus... 151
Electric Appliances Co., Ltd., vacuum cleaners 157
Federation of British Industries (Information Bureau) 163
Thermal Syndicate, Ltd., "Vitreosil" specialities for electric lighting, lamp shades 164
Peyton & Peyton, Ltd. (and others), electric light fittings 168
J. G. Cracknell & Co., electric vacuum cleaners 171
Watertight Fittings, Ltd., electric lamp fittings 174
Changeable Sign Co., Ltd., illuminated electric signs ... 182a

Exhibitors in Building B :—

Henry Wiggin & Co., Ltd., electrical resistance wire and tapes, nickel 185
Vickers, Ltd., Cosmos electric lamps, electric irons, kettles, radiators, wires and cables, engineers' small tools, sewing machines, &c. ... ... 206 to 211
A large number of firms are showing drop forgings for electrical, automobile, aircraft, and other work, and the Association of Drop Forgers and Stampers is represented ... ... 212 to 236
London Electric Wire Co. & Smiths, Ltd., wires and cables for electrical apparatus 237
Electrical Conduits, Ltd., tubes and fittings for electrical installation work in buildings, ships, &c. 238
The Cold Rolled Brass and Copper Association, the Brass Wire Association, the Brazed Brass Tube Association, the Brass and Copper Tube Association, and the Nickel Silver Association ... ... 242 to 247

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	Stand No.
Thos. Bolton & Sons, Ltd., brass rods and wire, phosphor bronze wire, &c.	258
Chas. Clifford & Son, Ltd., brass rods and wire, &c. (And many other brass and copper firms.)	261
W. & T. Avery, Ltd., weighbridges and weighing machines	352
H. C. Slingsby, trucks, ladders, &c.	355
Stewarts & Lloyds, Ltd., steel piping, tramway poles, boiler tubes, &c.	358
Hunt & Mitton, steam fittings	360
Gledhill-Brook Time Recorders, Ltd., time recorders	364
National Time Recorder Co., Ltd., time recorders	378
British Time Recorder Co., Ltd., time recorders	382
Relay Automatic Telephone Co., Ltd., relay automatic telephone system	383
Simoon Engineering Co., Ltd., D.C. electric motors, motor generators, ironclad switchgear	384
Vislok, Ltd., safety locknut	389
British Engineers' Association	406
Alloy Welding Processes, Ltd., A.W.P. electric arc welding plant	407
Consolidated Pneumatic Tool Co., Ltd., electric drills and other tools	420
Exhibitors in Building C:—	
Association of British Driving Chain Manufacturers	461
May & Padmore, Ltd., Bastian electric fire and heaters, electric furnaces, electrically heated water tanks	468
Best & Lloyd, Ltd., electric fittings and heaters	477
W. Canning & Co., dynamos for electro-plating, &c.	485
Vacuum Oil Co., Ltd., lubricants	493
Industrial Appliances, Ltd., "Railodok" electric truck	503
Western Electric Co., Ltd., Electric trucks, telephones, and telephone switchboards	511
British Ever-Ready Co., Ltd., electric cycle lamps and electric motor car accessories	525
Sphinx Manufacturing Co., sparking plugs with bar-type electrodes	527
Lucas Electrical Co., Ltd., Thomson-Bennett magnetos, Lucas "Magdyno" combined lighting and ignition set for motor cycles	530
Greenwood & Batley, "Bipol" accumulators, portable electric lighting apparatus, charging equipment	533
British Lighting & Ignition Co., Ltd., "Blic" magnetos	546
Pinchin, Johnson & Co., Ltd., enamels, varnishes, &c.	564 & 571
Frederick Crane Chemical Co., Ltd., lacquers for electric lamps, varnishes, enamels, &c.	569

GLASGOW.

The Glasgow Fair has been organised by the Corporation with the support of the Board of Trade. This is Glasgow's third Fair and the largest it has yet held. There are about 300 exhibitors in all, and they demonstrate British ability in the production of textiles, boots and shoes, dyes, chemicals and foodstuffs. In addition there are various miscellaneous stands, such as labour-saving machinery, transport trucks, and so forth. Mr. J. M. Freer is the general manager at Glasgow.

CORRESPONDENCE.

Letters received by us after 5 P.M. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Electrolytic Meters.

An article written by Mr. C. W. Marshall on "Meters" published in the Electrical Review, February 6th, has caused some comment on electrolytic meters. May I venture to express my views?

First, no meter reader should be an authorised person to break the test room seal and so expose the interior of a meter. In the case of resetting an electrolytic meter this has to be done, and as the record of the reading is lost only an inspector should carry out this operation.

Second, should any dispute arise concerning the reading after a meter has been reset, it cannot be checked.

Third, if these meters are not reset with very great care they are liable to stop, due to the column of mercury breaking.

Fourth, there is the liability of loss of revenue due to the mercury rising above the reading on the dial when not reset in time.

Although the makers have improved very much upon the earlier types, they have not yet overcome the trouble arising from crystallisation and electrolysis, and the result is an accumulation of defective meters, and consequently loss of capital.

Owing to the meters being unrepairable in the department they have to be sent to the makers, and commenting upon this, I have found it much easier to get new meters, as for some reason or other they are very reluctant to undertake the repairing, and also the cost of repairs approaches very near the price of a new meter.

The electrolytic meter is affected by vibration and dampness, and also takes up more room, due to a space having to be left over the meter to allow for resetting.

In refixing, the man is unable to report if the meter is working, and this entails another visit two or three days later.

Compared with the "rotary" meter, the life is not so long, and extra time is taken up in resetting and writing to consumers who have queried their readings.

Another point in favour of the rotary type beyond their reliability is the fact that readings can always be checked.

A. W. C.

February 18th, 1920.

With further reference to the controversy Electrolytic *v.* Motor Meters, I did not mean to imply that the electrolytic meter was as extensively used as the motor meter, but merely to point out that the former type may by no means be ignored in the search for a cheap meter, which was the basis of Mr. Marshall's article.

As regards price competition, the price given by Mr. Marshall for a mercury meter (which he suggests as the coming cheap meter) is £4 10s., whereas the price of the corresponding electrolytic meter is about £2. I am quoting the Reason meter, which does not require refilling and therefore does not demand any allowance on the initial price for maintenance (filling) charges. Having the above prices in view, I am still of the opinion that, even eliminating compensating devices, &c., the mercury motor meter manufacturer will have a big problem to reduce his prices to less than half the present prices, and even then I do not admit that the electrolytic meter cannot be still further developed and cheapened.

With regard to size, I specified "lighting demand," and not heating, &c. It is usual to charge a reduced price for heating and cooking, and this necessitates a separate meter, which may be much rougher than the lighting meter, seeing that low starting current is not an essential.

In conclusion, it would be interesting to have the suggestions for a cheap meter which Mr. Marshall promises in the last paragraph of his article.

H. W. M.

February 23rd, 1920.

With regard to Mr. C. W. Marshall's recent article in your Journal, while we are not able at present to supply any type of electricity meters at a price as low as £2, we certainly can quote figures that are very much more favourable than those which Mr. Marshall suggests as being the present-day approximate costs.

Moreover, we have available a D.C. mercury motor meter which we are able to supply at quite attractive prices, and whose watt loss does not exceed that allowed by the British Engineering Standards Specification No. 37, 1919.

We shall be very happy to give Mr. Marshall or indeed any other potential client further details on receipt of an inquiry.

For the **Edison Swan Electric Co., Ltd.,**
E. H. Miller, *Sales Manager.*
Ponder's End, *Inst. & Meter Dept.*
February 19th, 1920.

Radiators for Bathrooms.

There is a demand for a good radiator suitable for use in a small bathroom. This should be made with a non-metallic body, while the elements should be protected so that they will not be liable to be damaged by drops of water falling on them. The switches also should be made with special regard to insulation, as it is quite possible that people will operate them with wet hands.

Wiring contractors occasionally fit an ordinary iron radiator with cotton flex in bathrooms, but this is a practice that should not be encouraged. There is no reason why a line of radiators should not be developed for bathrooms which would be both safe and very convenient.

If any maker has anything suitable, perhaps he will communicate it to your "Correspondence" column.

Radiator.

February 21st, 1920.

Wages in the Aluminium Trade.—Representatives of employers and workers in the aluminium industry of Great Britain and Ireland met in conference last week, in London, to discuss a claim by the National Union of General Workers, the National Amalgamated Union of Labour, and the Workers' Union, for an advance of 15s. per week for all employed in the industry. The question of future relations between employers and employed in the industry was also discussed, and will be considered by a joint body.—*The Times.*

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NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

A New Marconi Ammeter.

The accompanying illustrations represent the new type of hot-wire ammeter that was shown at the Physical Society's Exhibition by Messrs. Marconi's Wireless Telegraph Co., Ltd. In place of the usual single wire exerting a pull at the middle of the heated wire, there is a bifilar attachment, kept taut by a spring connected to the pointer; elongation of the heated wire allows the pointer to move. The hot wire circuit forms the secondary of a transformer, the primary of which carries the current to be measured; hence damage to the moving parts does not affect the main circuit, which is designed principally for wireless telegraph purposes. The secondary is mounted on an ebonite block, which can be moved to adjust the zero, carrying with it the whole of the moving parts, so that the calibration is not affected. Fig. 1 shows the 5-in. dial pattern, and fig. 2 is a sketch of the moving parts. The filament resistance is 0.685 ohm, that of the secondary 0.18, and of the primary 0.003 ohm, and the accuracy is within 2 per cent. for wave-lengths between 300 and 3,000 m. The safe overload is 20 per cent.

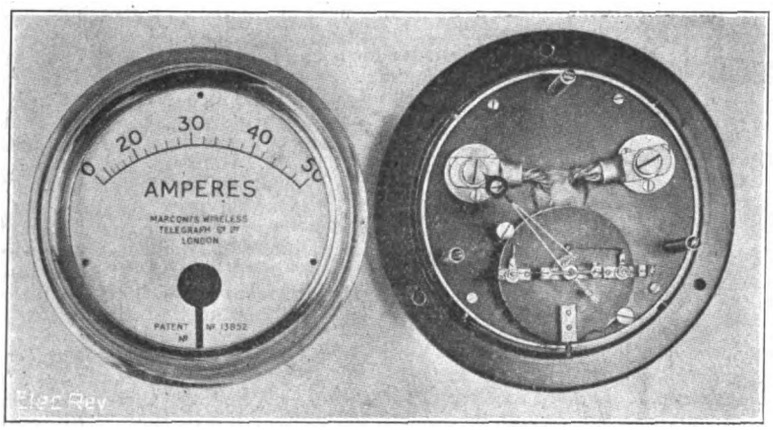

Fig. 1.—Marconi Hot-wire Ammeter.

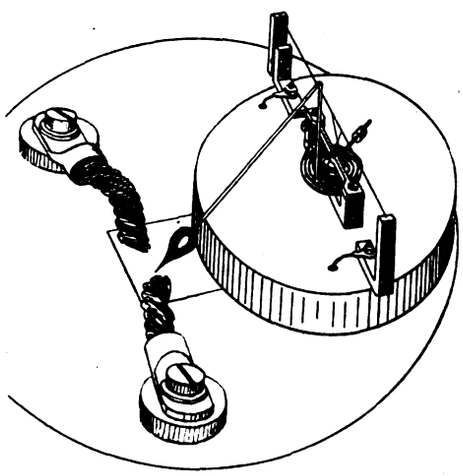

Fig. 2.—Arrangement of Moving Parts.

A Lamp Shade Tilter.

Messrs. Fitments, Ltd., of 58, Spital Street, Dartford, have recently developed a simple device for securing a lamp shade at any desired angle. As will be seen from the illustration (fig. 3) it consists of two parts, one of which is clamped between the two rings of the holder and the other pivoted to it, hooking on to the lamp cord.

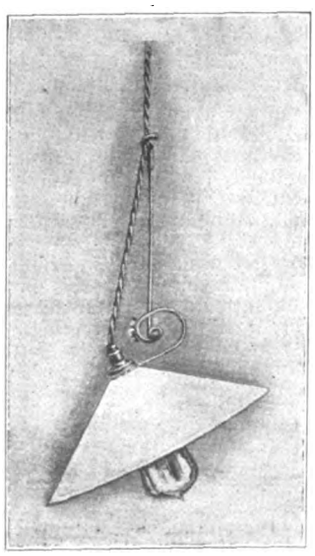

Fig. 3.—Grip Tilter.

A Coaxial Turbo Gear.

A recent issue of the *American Machinist* gives details of a new turbo gear recently introduced by an American manufacturing company. Fig. 4 is a sectional elevation of this type of gear. A is a shaft made from an alloy steel forging, possessing at one end a double helical pinion B which engages with three double helical planetary gear wheels C. These gears are bushed with bronze and revolve on the pins D, which are rigidly secured in a two-part steel cage E. One end of this cage has a stem, and the other three projections. G is a cage plate connected to the three projections of the cage by bolts F, making the planet gear housing practically a single piece, and affording a support for both ends of the pins D. The cage plate G has a central projection running in a ball-bearing, while the stem at the other end of the cage is the low-speed shaft H, which is also supported by a ball bearing. The inner end of the high speed shaft A runs in bearing I within the cage. This bearing has only a slight load. Rigidly keyed to the housing is the gear ring J with which the planet gears engage. K is a lubricating pump which distributes oil from a reservoir in the bottom to all parts of the gear. The entire mechanism is enclosed to protect it from dirt and moisure only the ends of the two shafts projecting. It is claimed that by means of this gear a speed ratio as high as 19 to 1 can be obtained. The device can either be used for stepping-up or stepping-down speeds, and, according to the makers, has an efficiency of from 98 to 99 per cent.

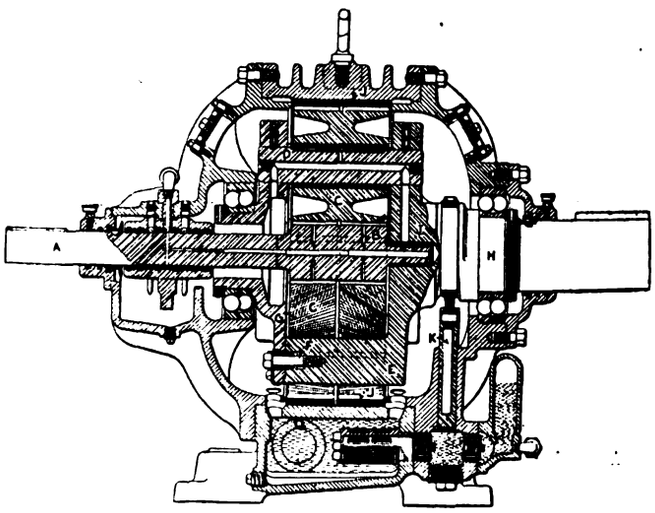

Fig. 4.—Sectional Elevation of Turbo Gear.

The Orling Jet Relay.—In our notice of this device on February 6th, a slip occurred, the current strength in the receiving coil when printing signals at the rate of 450 letters per minute being given as 4×10^{-12} ampere. The current was, in fact, 0.02 micro-ampere, and the resistance of the coil being 1,000 ohms, the *power* input was 4×10^{-13} watt.

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BUSINESS NOTES.

Bankruptcy Department.—The Board of Trade announce that the Department of the Inspector-General in Bankruptcy has removed from No. 1, Horse Guards' Avenue, Whitehall, S.W. 1, to Great George Street, Westminster, S.W. 1. (Telephone Vict. 9800).

Catalogues Wanted.—The Superintendent of Stores, Mesopotamian Railways, has informed the D.O.T. that he desires to receive British manufacturers' catalogues of the following among other materials :—Rolling stock, pumps, motor-rail cars, permanent way material, workshop machinery, mathematical instruments, piping, general hardware, cranes, electrical plant and accessories, steam and oil engines, conveyors, elevators, and labour-saving devices generally. Publications should be sent to the Superintendent direct at Makinah, Mesopotamia.

German Stock Quotations in January.—The *Economic Review* gives a list of rises in German stocks and shares in January, from the *Deut. Allg. Ztg.* for January 31st. The following electrical securities appear :—

	Dec. 31st	Jan. 15th.	Jan. 30th.
Deutsch-Ueberseeische Elektrizitats-gesellschaft	915	760	955
A.E.G.	245	259	325
Felten & Guilleaume	246	293	405
Schuckert	151	184	215

Auction Sales.—By order of the Disposal Board, Ministry of Munitions, Mr. M. Marshall will sell by auction, on March 2nd, 3rd, 4th and 5th, at Georgetown, Glasgow, high-class engineering plant and machinery, machine tools, hydraulic power plant, electric motors, electrically-driven blowers, &c. For full particulars see our advertisement pages to-day.

In our advertisement pages again this week will be found particulars of important sales which are to take place at Shoreham Camp on March 3rd and 4th. Messrs. Harris & Gillow are the auctioneers, and the lots to be disposed of include a very large assemblage of building materials, timber, camp equipment, electrical appliances, and almost every class of hut.

By order of the Disposal Board, Ministry of Munitions, Mr. C. D. Phillips will sell by auction, on March 18th, at Swindon, valuable machinery, plant, stores, timber, &c. For full particulars see our advertisement columns this day.

E.D.A. Activities.—In view of the ever-increasing interest evinced by the public in matters electrical, it is well to learn something of the powers that are behind this move towards efficiency. A bulletin recently published by the British Electrical Development Association affords an opportunity of gaining an insight into the nature of its activities. The part of the Association's work that places facts and figures before the general public, supply undertakings and commercial enterprises, through the medium of the Press and other channels of publicity, although a very important branch, is by no means the only method by which the Association seeks to further the electrical cause. As a link between the industry and various Government departments, it has rendered invaluable service. The Board of Trade and the Ministries of Food and Health have constantly been consulted and informed on the multitudinous questions into which electricity enters, and the organisation has without doubt secured "official recognition." In connection with housing, the Association has grasped the opportunity of pointing out to Government officials, local authorities, architects, and engineers, the numerous advantages of incorporating an electricity supply in all building schemes, and in addition to this has furnished notes, reports, and lantern slides, for the use of lecturers and societies dealing with that important question. To assist the industry to arrive at a solution of what is at present an unsettled matter—a simple and more uniform treatment of various aspects of the industry—inquiries regarding tariffs, cooking apparatus, design, and housing, and electricity supply, are being made to ascertain the general view entertained upon these subjects by various authorities. These reports will be collated and circulated, and good results are expected.

Among the pamphlets lately issued by the B.E.D.A. are "Freedom from Domestic Worry," a reproduction of an appreciative letter by a satisfied housewife; "Do it Electrically," setting forth the advantages of electric fires, kettles, &c.; "Everybody wants Electricity," which is described as "a plea for public patience while machinery and organisation are preparing to meet the present overwhelming demand"—surely an indication of the success of the Association—and the last leaflet is an illustrated contrast between the kitchen of yesterday and the kitchen of to-day and to-morrow—a comparison of coal and electricity.

The British Electrical Development Association having been incorporated, we have received a copy of the Memorandum and Articles of Association. It will be noticed that the Association is now described as "The *British* Electrical Development Association." As previously explained, it was found necessary to insert the word "British" in order to secure sufficient variation from the title of another company already on the registers. In general practice, and in connection with publicity matter, the usual monogram "E.D.A." will be employed.

Electric Lamps Profiteering Sub-Committee.—The Electrical Lamps Sub-Committee of the Profiteering Act Department (Central Committee) held its eighth meeting on February 17th, and considered its draft report.

Trade Announcements.—MR. J. H. EDWARDS, joint managing director of Messrs. George Hill & Co., Ltd., electrical, mechanical and tramway engineers, 25, St. Ann Street, Manchester, who has been actively associated with the business for the past 20 years, has purchased the whole of the shares held by the late joint managing director, Mr. A. R. Walmsley.

The Ramsgate and District Electric Supply Co. has opened showrooms and offices in Queen Street.

As from March 1st, the head office of MESSRS. DRAKE & GORHAM, LTD., will be removed from 66, Victoria Street, where they have been established since 1886, to 36, Grosvenor Gardens, Westminster, S.W. 1. Telegraphic address, "Accumulator, Sowest, London"; telephone No., Victoria 9060 (5 lines). Stores and works addresses remain unchanged, viz.: Stores, 67, Long Acre, W.C. 2; works, Rockingham Works, Newington Causeway, S.E.

MESSRS. CHAS. CHURCHILL & CO., LTD., have opened a new branch office at 53, Bridge Street, Sheffield, to deal with increasing business in small tools and supplies.

Mexican Measures.—Mr. John Lind, who was at one time personal representative of President Wilson in Mexico, has published an interesting account of his experiences. The following extract from his book, "The Mexican People," contains a valuable hint to English firms interested in Mexican trade, particularly to those who come into competition with Germany in that country :—"We must get into line with the commercial world in the matter of weights and measures. I asked an intelligent German merchant in Vera Cruz one day to explain to me how it had come about that Germany had absorbed so much of the trade that at one time went to England. He reached into a drawer, pulled out an invoice from England, and said 'Do you see those denominations of yards, feet and inches, gallons and pints; pounds, two kinds of ounces, grains and pennyweights, the whole summed up in pounds, shillings and pence! Well,' he continued, 'a Mexican, even if he can read a little English, needs an interpreter and an accountant to put this into the language of civilisation. And,' he added, 'their business methods generally are just as antiquated as their methods of computation. That is why we get the business, and then we make, not what suits us, but what the trade wants."

Wage Demands at Port Elizabeth.—According to a Press report from Port Elizabeth, it appears that the Amalgamated Society of Engineers there recently presented a further demand for increased wages and reduced working hours. The City Council refused to accede to the demands, which a Special Committee characterised as a flagrant breach of the terms of the agreement previously entered into. A statement issued by the Committee shows that the daily wages paid in January, 1918, January, 1919, July, 1919, and the new demands respectively, were :—

Fitters : 13s. 8d., 16s., 20s., 27s. 4d.
Electricians : 12s. 8d., 17s., 20s., 27s. 4d.
Switchboard attendants : 7s., 10s., 13s., 19s. 1d.
Drivers : 10s. 6d., 12s. 6d., 16s., 21s. 9d.
Firemen : 10s. 6d., 12s. 6d., 16s., 21s. 9d.

The figures are based on an eight-hour day, and include all bonuses. The new demands include a reduction in working hours from 48 to 44 per week.

New Italian Electrical Companies.—Under the style of Stabilimento Meccanico Agostoni e Ca has been formed, at Milan, a company with a capital of 255,000 lire for the manufacture of motors and accessory plant.

Airaghi e Vittadini is the designation of a company formed at Milan for the manufacture of electric heating apparatus. Its capital is 35,000 lire.

Messrs. Damiani e Bonato have been established as a company at Milan with a capital of 50,000 lire, for the manufacture of electric apparatus.

At Turin has been formed a company under the style of Crespi e Garlasco, with a capital of 60,000 lire, for the trade in electrical articles and material.

For the manufacture of argon electric lamps there has been established at Turin, the Fabbrica Piemontaise Lampade Elettriche Argon, with a capital of 30,000 lire.

Swiss Engineering and Electrical Trades in 1919.—The *Neue Zürcher Ztg.* (January 13th and 14th) quotes from the December report of the Schweizerische Kreditanstalt the following regarding the Swiss engineering and electrical trades in 1919 :—"In the engineering industry work was slack at the beginning of the year, owing to an absence of orders from abroad, upon which the industry depends. Later in the year matters improved, since many firms received orders in connection with the electrification of the Swiss railways. Production was of necessity reduced owing to the introduction of a 48-hour week. The increase of wages and salaries made the cost of production greater. In the electricity industry the factories were very busy after the first few months of the year, large orders for electrical machinery being received from N. France and Belgium, as well as from Swiss firms. The Gotthard railway management placed important orders for electric locomotives and alternate-current generators. In the later months of the year orders were received from Scandinavia, Italy, and England, in addition to increased orders from France.—*Economic Review.*

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The Liverpool Electrical Dispute.—The Mersey District Committee of the Electrical Trades Union has addressed the following circular to electrical employers:—

"It has come to the notice of my committee that a circular, dated February 7th, 1920, has been addressed to you by Mr. L. G. Tate, the general secretary of the N.F.E.A. Certain of the statements in the circular are grossly inaccurate and misleading, and my District Committee desire to acquaint you with the exact situation. The circular states that the Electrical Trades Union in the Liverpool area have asked for wide concessions, and states that your Council have instructed the Liverpool members that the concessions may not be granted. It is alleged that the result is 'a complete withdrawal of labour from our Liverpool members.' There are two points involved here. First, the so-called concessions which it is alleged the E.T.U. are *asking* for were actually and unanimously agreed to by the District Joint Industrial Council for the electrical contracting industry, Mersey area. The terms do not represent the conditions which the E.T.U. are pressing upon a reluctant body of local employers, but something which the elected representatives of these employers on the District Joint Industrial Council have already agreed to *after five months' negotiation*. There is the strongest reason to believe that the Liverpool employers are prepared to put the conditions in force, at once, but that your Council are preventing them from doing so. To such an extent is this true that not less than 58 firms have already agreed to the conditions, and are now working to them. Then with reference to the allegation that 'the result is a complete withdrawal of labour from our Liverpool members.' This would give the impression that the E.T.U. had withdrawn the whole of its members. This is not true. The fact is that on January 20th, acting, it appears, under instructions from the National Council of the N.F.E.A., the Liverpool members *locked out* the members of the E.T.U., because of the employés at two firms having refused to work under the old conditions. The principle which the E.T.U. is fighting for is whether an agreement, drawn up by the local employers' association and the E.T.U., shall be put into force in accordance with the custom that has prevailed for many years, or whether the National Council of the N.F.E.A. shall be allowed to impose their will on the local representatives. So strongly do certain of the local members of the N.F.E.A. feel on the matter, that six out of the 28 firms comprising the branch have put the conditions in force themselves in defiance of your National Council, while yet another firm, under threat of resignation, was given permission to put the rules in force. The circular also omitted to state that before any rupture took place the E.T.U. offered to submit the question to an independent person to adjudicate. This offer was not accepted."

Lead.—In their report dated February 21st, Messrs. James Forster & Co. state:—

The conditions remain unaltered, and until imports increase substantially we must expect advancing markets and a growing scarcity of metal. It is scarcely realised that the quantity left for home absorption in the imports and exports of the last three months amount to 316 tons per week, or not sufficient to keep a single sheet lead mill going. Japan has been again in the market, as also has been Canada, but such business in the existing conditions should not be encouraged. Consumers here have not been active buyers of late, but are finding difficulty in obtaining delivery of what they have bought, owing to the delay in discharge of steamers at the docks.

Messrs. G. Cawson & Co. report:—

The position with regard to supplies remains unchanged. Arrivals are coming in quite freely, and there is plenty of lead available for all requirements—any surplus is still going into store. The delay in delivery from Australian steamers is again acute. This, however, does not now trouble receivers, as they are fully supplied with lead. The only weak point in the market is the immense supply of antimonial lead, which is now obtainable in large quantities at £10 to £12 per ton below the price of ordinary soft lead. It has been pointed out to us that our estimate of the present Australian production is considerably over-stated. We gladly correct this, and will give a fresh estimate as soon as we can get details together.

Agents in Overseas Markets.—The Press and the Department of Overseas Trade have repeatedly brought to the notice of United Kingdom manufacturers the necessity of appointing suitable agents in overseas markets in order that our trade in these markets may be established and maintained. So far many firms have shown a tendency to neglect the opportunities offered for appointing reliable agents, probably because they are very busy and cannot guarantee delivery. Commenting on this tendency, H.M. Trade Commissioner in Winnipeg states that the difficulties of the position in some industries are fully understood by importers and prospective agents, who are, however, still very anxious to open negotiations, even though deliveries at present may not be possible. Hesitancy on the part of United Kingdom manufacturers might be taken as an indication that Canadian business is not desired, and once this impression is gained the result will be that Canadian importers will turn to other (foreign) sources of supply. The Commissioner advises that reliable agencies should be arranged forthwith by United Kingdom manufacturers with reliable Western Canadian representatives. Such representatives would do a great deal of useful educational work until such time as deliveries can be made. He says: "A Western Canadian agent who represents a British house is proud of the fact, and does not hesitate to let the trade know it. Western Canada is apparently on the threshold of a period of great expansion and development, and its requirements in manufactured goods from now on will exceed any previous record." In certain lines of products the United Kingdom will need to make more strenuous efforts than heretofore to obtain a substantial share of Western Canada's trade. This applies particularly to all metal products, including machinery of all kinds, electrical equipment for power and lighting; engines, both stationary and portable; telephone construction equipment; automobiles, and hardware. "A large number of inquiries at this office for agencies from British manufacturers are in respect of the lines above named. In these lines the United States enjoys the bulk of the trade, and I would strongly urge that no opportunity should be missed in connecting reliable agents on this side with interested United Kingdom manufacturers. The time will come sooner or later when the United Kingdom will need every order that can be obtained, British manufacturers will then be glad of reliable connections previously made in Western Canada through which they can compete for business. Generally speaking, the American manufacturers will not let the fact that they cannot deliver at the moment interfere with making agency arrangements now. Whether they can make deliveries promptly or not they will continue to advertise their products, and keep their agents frequently posted as to every phase of their business. Agents have informed me that if they are unable to secure the representation of British firms, they will have no alternative but to turn to the United States for business connections."

"Safety First."—The first annual report of the British Industrial "Safety First" Association was presented at the general meeting of the members at the Mansion House on February 24th. The list of officers contains the names of a great many men eminent in the industrial life of the country, and includes Lord Leverhulme, Lord Ashfield (Sir Albert Stanley), Sir Auckland Geddes, M.P., Sir Kenneth Crossley, and Sir W. Joynson-Hicks, Bart., M.P., chairman of the London "Safety First" Council.

The report, in commencement, states that in consequence of the war, involving the fate of nations, the safety of individuals was apt to be overlooked, and it was not sufficiently appreciated that preventable accidents were responsible for a great deal of suffering and unrest, and acted as a drag upon the industry of a nation. Reference is made to the enormous strides made by American "Safety First" authorities, which have a total membership of over 3,700 undertakings employing more than 6,000,000 workers. Acknowledgment of the efforts of firms and trade unions in this country who have rendered valuable service, both personal and financial, is embodied in the report. Details are given of the methods by which the Association is furthering its object. Many special articles have been contributed to technical and trade journals, and special mention is made, in this connection, of the work of Sir Herbert Morgan, K.B.E.

In May, 1919, the first series of bulletins was issued, and at the close of the year 30,000 had been distributed, in addition to thousands of pamphlets mainly for workpeople. In December the official organ of the Association, *Safety First*, made its appearance. A gallant conduct award, as described in a recent number of the Electrical Review, has been instituted for acts of bravery performed in the prevention of accidents at the works of associated firms. Valuable data regarding accidents are obtained by means of a form on which details are returned to the headquarters of the Association by employers. A form of publicity employed in London was the showing of lantern slides at the leading London kinematograph theatres. The Association was favourably commented upon by the Chief Inspector of Factories and Workshops in a report issued as a "White Paper" by the Home Office, and representatives of five Government departments have been officially permitted to serve on the Council. Attention is drawn to the statement of a firm which is a member of the B.I.S.F.A. that the number of cases treated at its "first aid" station was reduced from 1,300 to 600 by means of its first month's "safety first" campaign. An appeal is made for voluntary workers in each industry to review bulletins, criticise drawings and photographs as to accuracy and detail, and to suggest from experience subjects for propaganda.

The hon. secretary of the B.I.S.F.A. is Mr. H. E. Blain (operating manager of the London Underground Railways, &c.) with offices at 2 and 3, The Sanctuary, Westminster.

Touring by Motor Coach.—We have received a small brochure, bearing the above title, from the Lancashire United Tramways, Ltd., which forms a guide to the various districts served by the undertaking's motor coaches. It is profusely illustrated by photographs.

Electrical Plant in China.—There is a very large and increasing demand for electrical plant and machinery from all over China, and it is greatly to be regretted that the big British companies are not doing more to capture this trade. It is a business that needs a highly-trained technical staff, and, for that reason, it would be advisable for manufacturers to have their own offices and men here (Shanghai). At the present moment the British Municipal Council at Tientsin is calling for tenders for turbo-alternators. A large industrial undertaking here wishes to erect its own power-generating plant for 500 to 1,000 H.P., but it will not apply to any of the local firms because of the fact that they are only middlemen. It requires here a man who will advise the directors as to the best system the work of the undertaking requires.—*The Times Trade Supplement.*

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Foreign Catalogues.—The Foreign Catalogue Library, commenced by the Department of Overseas Trade in 1915, has proved of great service to the British manufacturer. Nearly 2,000 firms have made use of the catalogues. They have benefited not only from the opportunity to study foreign competitive prices, but have also received useful ideas from designs of specific items, such as fancy metal goods. This has been especially the case with new firms. The catalogues are indexed under the class of goods and the name of the manufacturer, and are lent to the applicants for varying periods. The library now contains over 13,000 catalogues from all parts of the world, the majority being German and Austrian, but including American, French, Italian, Spanish, Portuguese, Dutch, and British Dominions. A section of the library covers mail order, shop and exhibition catalogues. A certain amount of difficulty is being met with in securing post-war catalogues. During 1919 nearly 9,000 catalogues were borrowed by over 600 firms.—*Board of Trade Journal.*

Book Notices.—*Faraday House Journal.* Vol. VIII, No. 5. Lent Term, 1920. London: Faraday House. This issue contains, besides the usual supply of notes and notices of interest to students, an article by Dr. Alex. Russell on "The Design of Distributing Mains," in which he, assuming that the demand is known, investigates how to proceed, and gives a few of the considerations that have to be taken into account. Elementary algebra only is used to discuss the somewhat difficult mathematical theorems that arise even in the simplest cases. Mr. S. O. Pearson, B.Sc., deals with the bridge method of testing condensers of low insulation resistance. The results of the final examination held at the end of the Summer Term are given, while the register shows a considerable increase in the number of students, both in college and at works.

"*Journal* of the Institute of Metals." Vol. XXII. 428 pp. and 31 plates. Edited by G. Shaw Scott, M.Sc. London: The Institute of Metals. Price 31s. 6d. net.—This contains, amongst other valuable matter, a verbatim report of the lecture by Prof. F. Soddy, M.A., F.R.S., on "Radio-Activity," and the communications and discussions at the recent Sheffield meeting. Amongst the many practical papers contributed are "Season Cracking," by Dr. W. H. Hatfield and Captain G. L. Thirkell, A.I.F., B.Sc., and one by a lady metallurgist, Miss Hilda Fry, and Dr. D. W. Rosenhain, F.R.S., on "Observations on a Typical Bearing Metal." The volume concludes with a section, of nearly 70 pages, devoted to abstracts of papers relating to the non-ferrous and allied industries, which have been compiled from the transactions of scientific societies and the technical Press of the whole world.

Revue de l'Ingenieur et Index Technique, Vol. XXVI, No. 1, January, 1920 (100 + xxvi. pp.). Contains articles upon the coal problem—the utilisation of lignite and inferior grades, &c.; a review of the situation regarding the reconstruction of the devastated areas of Northern France; notes on American and European steel works, &c. A brief *résumé* of the proceedings of the Académié des Sciences and the Société Française de Physique is also included, in addition to the very complete index of technical works.

"*Bulletin* of the U.S. Bureau of Standards," Vol. XIV, No. 4 (Scientific Papers Nos. 318 to 329 inclusive), 293 pp. Washington: Government Printing Office.—Included in this publication are papers on radiometry, metallurgy, photography (astronomical), &c., and one providing new formulæ for the calculation of mutual and self-induction.

"*Mechanical World* Year Book for 1920." Pp. 328 + 316 and diary. London and Manchester: Emmott & Co. Price 2s. net.—Several additions have been made to the Year Book, including sections on "Water and Hydraulic Work" and "Heating and Evaporating Liquids." Many of the original features have been extended and brought up to date.

"Flow and Measurement of Air and Gases." By A. B. Eason. Pp. xii + 252, 56 figs., and 31 tables. London: C. Griffin & Co., Ltd. Price 25s.

"Handbook of Physical Measurements." By E. S. Ferry. Vol. I: Fundamental Measurements, Properties of Matter, and Optics; pp. ix + 251, 142 figs. Vol. II.: Vibratory Motion, Sound, Heat, Electricity and Magnetism; pp. x + 233, 128 figs. London: Chapman & Hall. Price 9s. 6d. each volume net.

"Graphical and Mechanical Computation." By J. Lipka. Pp. ix + 264; 110 figs. London: Chapman & Hall. Price 18s. 6d. net.

"The Management Problem." By E. T. Elbourne. Pp. ix + 144. London: The Library Press, Ltd. Price 4s. 6d. net.

"General Conditions in Electrical and other Engineering Contracts." By W. S. Kennedy. Pp. vii + 110. London: Sweet and Maxwell. Price 12s. 6d. net.

"The Baudot Printing System." By H. W. Pendry. Pp. v + 184; 91 figs. London: Sir I. Pitman & Sons. Price 6s. net.

"Mr. Touch-Button, or the Home of Beautiful Ideals." By Nancy Berry (48 pp.). London: "Country Life," Ltd. Price 3s. net. This "story for children, written by a child," is a tale of an "all-electric" house, cleverly written and well illustrated. Mr. Herbert H. Berry, apologising to Rudyard Kipling, contributes a revised version of the popular "If," and an epilogue explaining the circumstances under which the story came to be written.

British Engineering Standards Association publications:—No. 73, "British Standard Specification for Two-pin Wall-plug and Sockets"; No. 79, "Report on British Standard Special Trackwork for Tramways"; No. 98, "British Standard Specification for Goliath Lamp Caps and Lampholders." 1s. 2d. each post free from the offices of the Association, 23, Victoria Street, S.W. 1.

Catalogues and Lists.—Mr. E. J. Hill, of 29, Ludgate Hill, E.C., has issued a pamphlet on "Advertising—A Factor in Trade Expansion," in which the expert advertising service that he is prepared to render is described, examples of his designing work being shown.

Messrs. Ross & Co., 62, Robertson Street, Glasgow.—List Section P. An illustrated and priced catalogue of electric bells and bell indicators.

The Cressall Manufacturing Co., Staniforth Street, Birmingham.—List 1,920, containing priced and illustrated details of "Cressall" electric sterilisers and water boilers.

The British Thomson-Houston Co., Ltd., Mazda House, 77, Upper Thames Street, E.C. 4.—"Incandescent Electric Lamp Handbook, No. 1B" (64 pp.). A combined catalogue of "Mazda" lamps and handbook of useful information regarding electric lighting. Definitions of lighting units, a glossary of trade terms, and several curves and diagrams are included, and the publication forms a valuable reference handbook for both electricians and those outside the industry.

The L.P.S. Electrical Co., Avenue Road, Acton, W. 3.—Two leaflets dealing with current-carrying test-clips for making quick temporary connections and battery-charging clips. Illustrated and priced.

Standardisation of Gears.—At the request of the Machine Tool Trades Association, a conference, under the ægis of the British Engineering Standards Association, has been arranged to discuss the question of the standardisation of gears.

Primarily, its purpose is to give the industry an opportunity of deciding whether standardisation in this field would be practicable.

The subject of gears generally appears to cover too large a field to make it susceptible of any great degree of general standardisation. It is probable that whilst the conference will, in the first instance, be obliged to take a brief survey of the whole subject, any proposed investigation from the point of view of standardisation will have to be narrowed down to attacking a few definite points in some particular branch of the industry.

American manufacturers are devoting considerable attention to this question, and as the B.E.S.A. is in close communication with the American industry through the American Engineering Standards Committee, such a conference as is now proposed should do much to bring British manufacturers together at a most opportune time, as well as promote Anglo-American co-operation on what is acknowledged to be a most important subject to the industries of both countries.

The conference is to be held under the direction of the Sectional Committee on Machine Parts, their Gauging and Nomenclature, on March 5th next, at 2.30 p.m., at the Institution of Civil Engineers, Great George Street, S.W. 1. Any individual firm or expert who has not received a communication with regard to the conference, and who is interested in the question, is invited to communicate with the Secretary of the British Engineering Standards Association, 28, Victoria Street, S.W. 1.

For Sale.—Portsmouth Corporation invites tenders for the purchase and removal of five Lancashire boilers; Newcastle-on-Tyne Corporation Tramways and Electricity Department has for sale 380 Brockie-Pell arc lamps and 30,000 carbons; Southampton Corporation Electricity Committee are prepared to consider offers for one Parsons-E.C.C. turbo-alternator set, with surface condensing plant and exciter, &c. Poplar Borough Council Electricity Department has for disposal one 1,300-kw. and two 1,000-kw. Parsons-Bruce Peebles turbo-alternators, complete with condensing plant; Accrington Corporation Electrical Engineering Department invites offers for one compound boiler feed pump, one mechanical water cooler, one mechanical water cooler converted as a wet air filter, and a quantity of cast-iron piping. For particulars see our advertisement columns to-day.

When in Rome—Call on the Consul.—H.M. Commercial Counsellor in Rome remarks "that it would certainly be in the interests of business men generally if they made a habit of calling upon him, and on the Consuls where they are transacting business. Experience has proved that while people never fail to appeal to the Consul when in need of assistance they frequently omit to call and discuss commercial matters. If a practice of doing so were made, both they and others might derive considerable advantage from business information and experience."

Merchandise Marks Committee.—At the meetings of the Merchandise Marks Committee, which were held at the Board of Trade on Thursday and Friday, with Mr. Joseph Hood, M.P., in the chair, the effects of the compulsory marking of foreign goods with an indication of their origin, and of the use of a National Trade Mark, were dealt with by witnesses from a number of Chambers of Commerce and associations.

Electric Grills and Irons for Panama.—It is reported from the British Consular Office at Colon that the Commissary Department of the Canal is experiencing difficulty in obtaining electric grills and irons from the United States, owing, it is said, to the abnormal demands received by manufacturers, particularly for electric irons, during the past year, and to the fact that it is becoming increasingly hard to obtain the necessary raw material. Any British manufacturers who are in a position to quote for these goods should address communications to the Purchasing Agent, Commissary Department, Panama Canal, 24, State Street, New York.

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Concerts.—The employés of Messrs. Pope's Electric Lamp Co., Ltd., held their second concert on 17th inst. We understand that the event was even more successful than the first, held a month ago.

The Halifax Tramways Club held a smoking concert last week to welcome the returned ex-service men. Mr. Galloway, tramway engineer, presided.

The Swiss Glow-Lamp Industry.—It is stated that the American Westinghouse Co., which as lessee of the Bollag glow-lamp works in Aarau has carried on this branch for some years past, has now acquired the works by purchase for the purpose of extending the manufacture of lamps in that country.

Dinner.—Ex-service members of the Blackpool Corporation Tramways and Electricity Institute were entertained to a welcome-home dinner and smoker on Friday last, when 150 participated in an enjoyable programme. Mr. Charles Furness, the borough tramway manager and electrical engineer, presided.

Prolongation of Patent.—An application for the prolongation of a patent expiring next July, by the owner, Mr. C. Smith, was before the Chancery Division last week. The Act of 1919 automatically prolonged the life of the patent by two years, and Mr. Justice Sargant ruled that an application two years before expiration was premature, as the question whether the patentee had been adequately remunerated could not be decided until near the end of the life of the patent. The petition was adjourned accordingly.

Importation of Copper Cable into Australia. — A December newspaper just to hand states that by Official Proclamation in the Commonwealth *Gazette* the importation of stranded copper cable into Australia, save under licence from the Minister of Customs, is prohibited.

Joint Industrial Council.—The inaugural meeting of the District Council (No. 4) of the Monmouthshire Joint Industrial Council was held at Cardiff on February 12th, the Lord Mayor presiding. Alderman A. Sinclair, J.P., Mayor of Swansea, was elected chairman, and Mr. J. L. Davies, of the E.T.U., vice-chairman. The constitution already formulated was approved. Mr. Rees Llewellyn said that basic rates should be adopted at once to arrest the dissatisfaction spreading among the workers of the district.

New French Company.—La Société d'Entreprises de Réseaux Electriques is the name of a new company which has lately been formed in Paris (33, Avenue des Champs Elysées), with a capital of 1,000,000 francs, to engage in the establishment of electricity distribution systems.

The Non-Ferrous Mining Committee.—The Committee appointed by the Board of Trade, under the chairmanship of Mr. H. B. Betterton, M.P., to inquire into non-ferrous mining in the United Kingdom, has now completed the taking of evidence, and is preparing a report which it hopes to present in a few weeks' time.

Liquidations. — Sparking Plug Patents, Ltd.—Winding up voluntarily. Liquidator, Mr. F. B. Lodge, of Rugby. Meeting of creditors will be held at 63, Temple Row, Birmingham, on March 11th.

Enfield Electric Cable Manufacturing Co., Ltd.—A meeting is called for March 29th, at Central House, Finsbury Square, E.C., to hear an account of the winding-up from the liquidator, Mr. W. L. Smith.

Bankruptcy Proceedings.—E. Bohm, electric lamp manufacturers, 5, Boxworth Grove, Barnsbury, N. Order for bankrupt's discharge granted on consenting to judgment being entered for £15.

LIGHTING AND POWER NOTES.

Argentina.—Water Power.—The *Economic Review* states that a report has been submitted to the Government by a Berlin engineer relating to the proposed harnessing of the Iguassa Falls. The latter are situated on the Brazilian frontier, at the junction of the Iguassa and Panama Rivers. The potentialities of the falls are as great as those of Niagara, and, it is said, they have a greater available head. This undertaking will form the subject of negotiations between the Governments of Argentina and Brazil.

Australia.—Victoria.—Extensive boring in the Morwell brown coal fields, upon which £3,000,000 is to be spent for the production of a cheap power supply, has proved that in an area of 1 sq. mile there is between 120,000,000 and 150,000,000 tons of coal. This is calculated to be sufficient to maintain an output of 100,000 H.P. for a period of 150 years. The total resources are estimated to be 20,000 million tons.

Bexhill-on-Sea.—Lighting Prices.—The Corporation has considered suggestions that, in view of the reduction in cost of coal, the charges for electric lighting, &c., should be reduced. The committee regrets that the present position does not justify any lowering of prices for electric light. Reserve funds, which before the war had been accumulated, have been completely absorbed. Labour and general costs conditions, apart from the cost of coal, are so different from what Parliament could be expected to contemplate over 20 years ago, when a maximum price of 8d. per unit was fixed, that the committee considers the town is to be congratulated on there not having been occasion to apply for power to increase the maximum charge.

Continental.—Denmark.—A sum of 5,137,000 kroner is being spent on enlarging the plant at the Copenhagen municipal power station. A new turbo-generator with boiler equipment is to be installed. The Soroe municipal authorities have decided to take over the local gas and electricity undertakings.

France.—The Union Française d'Electricité is building near Paris the largest power station in Europe (400,000 H.P.). The Zoelly type has been adopted for the steam turbines, the orders for which are being shared with the American industry. In Europe they have been divided between the Société Alsacienne de Construction Mécanique at Belfort; Schneider & Co. at le Creusot; and Escher, Wyss & Co., at Zürich. All the turbines will be of 60,000 H.P.—*Economic Review.*

Spain.—The Compania Anonima Mengemor de Electricidad has recently commenced working on a hydro-electric station at Carpio, on the Guadalquivir. The available head averages over 60 ft., and the total power which will be developed is 7,000 H.P. The plant is to consist of three 3,500-H.P. turbines connected to 3,000-volt three-phase generators. Transmission will be effected at pressures of from 25,000 to 30,000 volts.

Cupar (Fife).—Electricity Supply.—The Town Council has been advised to proceed at once with a scheme for supplying electricity for power, lighting, and heating, and a Committee has been appointed to deal with the matter.

Dublin.—Street Lighting.—As a protest against the order necessitating the possession of permits by persons in the city between midnight and 5 a.m., the Corporation has decided to switch off all street lighting at 11.30 p.m.

East Midlands.—Whitley Council. — A conference of representatives of the Industrial Council of East Midland electricity undertakings and of factories and workmen's unions was recently held at Nottingham. The Council has been constituted upon the basis of the Whitley scheme to deal with all labour matters affecting public and private works in the area, including South Notts., South Derbyshire, South Leicestershire, South Lincolnshire, Rutland, and Northants, with the exception of Peterborough. A Committee consisting of 24, in equal proportions, representing employers and workmen's unions, had been appointed at a previous meeting to consider the proposed constitution, a draft of which was presented and deferred for further consideration at another conference.

Ennis (Co. Clare). — Lighting Scheme. — A public meeting discussed the proposal to form a company for an installation of public electric lighting, and a committee was appointed to consider details. It is estimated that £15,000 will be required.

Hamilton.—New Plant.—A 500-KW. rotary converter is to be added to the plant at the Corporation power station.

Ilfracombe. — Opposition to Bill. — The Urban District Council is to petition the House of Lords to prevent the Bill being promoted by Edmundson's Electricity Corporation and others becoming law. Dartmouth Corporation is associated with Ilfracombe in this protest.

Leicester.—New Power Station.—The Corporation has under consideration proposals for the erection of a generating station which will have an ultimate capacity of 30,000 KW. The first part of the plant to be installed, if the sanction of the Electricity Commissioners is obtained, will be two 10,000-KW. turbo-generators with the necessary boilers, coal and ash-handling gear, &c. The estimated cost of the scheme, including buildings, is £600,000.

Liverpool.—Breakdown.—A breakdown of one of the sets at the Liverpool power station on the morning of February 21st, was responsible for the tramway service in several areas of the city being held up for one hour. Within 20 minutes of the breakdown, repairs were effected which made a modified service available, and an hour afterwards the whole system was resumed.

Londonderry.—Price Increase.—The Corporation has increased the charges for electric lighting and power by 50 per cent.

Lowestoft.—Loan.—The T.C. is applying for sanction to borrow £3,993 for the purpose of plant extensions and contingencies.

Nottingham.—Price of Power.—At a recent meeting of the Corporation, the price charged for power (2½d. per unit) was adversely commented upon, as it was stated to be a hindrance to the prosperity of the district. Coventry and Wolverhampton were quoted as towns making a reasonable charge for electrical power.

Oldham.—Working Expenses.—The Corporation electrical engineer reports that for the fortnight ending February 11th, the expenses of the undertaking totalled £3,012 15s., equal to ·867d. per unit, compared with £1,815 18s., equalling ·702d. per

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unit, for the corresponding period last year. The units sold totalled 833,908, a record in the undertaking's history. Last year's figure was 620,165. Coal per unit generated was 2·78 lb., compared with 2·80 lb. last year.

Preston.—HOUSE LIGHTING.—The tramway engineer is to report to the Housing Committee with regard to the possibility of supplying electricity to the Holme Slack and Ribbleton sites, from the tramway power station.

INADEQUATE SUPPLY.—The National Electric Supply Co. has intimated to the Corporation that the increased output following upon the extension of the company's plant will only be sufficient to meet the demands of applicants already waiting. Further requirements will have to be met by the bulk supply the company is to receive from Blackburn, which, it is stated, may not be available until next year.

Ryde (I.O.W.).—PRICE INCREASE.—The Isle of Wight Electric Light and Power Co. has increased the price of energy as follows from the date of the December meter readings:—First 300 units per quarter, 8d. per unit; next 3,000, 4d.; beyond, 3d.

South Africa.—LADYSMITH.—The price of electricity is being raised from 9d. to 10d. per unit.

BEAUFORT WEST.—The municipality proposes to raise a loan of £13,000 for the installation of an electric lighting scheme.

Spalding.—ELECTRIC LIGHTING.—The Urban District Council has rejected a proposal to apply for a prov. order for electric lighting. It is stated that private firms are putting in their own installations, owing to dissatisfaction with the gas supply provided by the Council.

Taunton.—LOAN.—The Town Council is applying for a loan of £3,000 for transformers, motors and extensions of mains and services.

Warrington.—INADEQUATE SUPPLY.—A joint meeting of manufacturers and representatives of the Corporation was held on February 19th for the purpose of considering ways and means of meeting the urgent demand for electrical power for industrial purposes. Mr. Rylands, for the manufacturers, said that if the Corporation was unable to supply the necessary power, manufacturers would have to arrange to provide it themselves. Dr. Joseph, chairman of the Electricity Committee, stated that the output of the present plant was already at a maximum, but a scheme was at present under consideration which would involve an expenditure of £500,000.

TRAMWAY AND RAILWAY NOTES.

Australia.—TRAMWAY TRUST REPORT.—The report of the Prahran and Malvern Tramways Trust for the year ended September 30th, 1919, states that owing to a strike of employés, revenue was decreased by £3,600, and a seamen's dispute caused a further loss of £7,460. The total income for the year was £214,728, and expenditure £195,321. The net surplus was £3,580, of which amount £3,529 went to the constituent councils, and £51 to the City of Melbourne.

The undertakings controlled by the Trust, and other similar bodies, have lately been taken over by the Melbourne and Metropolitan Tramways Board.

Blackburn.—ALTERATION TO TRACK.—The Oswaldtwistle Urban District Council has approved the Corporation's proposal to alter the tramway lines near the Blackburn Road railway bridge.

Bradford.—IMPROVED SERVICE.—The tramway difficulties are gradually being overcome. At one time the Saturday service of cars got down to as low as 140; now the number is 170. Eighteen of the new cars are now working, while other eight are undergoing the painting process. This completes the first order of 26 cars, but there are another 20 also on order. The greatest difficulty has been the lack of motors, but the supply of these has greatly improved. In another month or two there will be a very decided improvement.

Burnley.—FARE INCREASE.—The balance-sheet of Burnley tramway department shows a deficit on last year, despite greatly increased traffic. This will necessitate an immediate increase in fares up to the highest legal amount. The last increase in fares took place in June, 1918, but the financial result has not proved sufficient to meet the situation.

Continental.—FRANCE.—The Société Hydro-Electrique des Pyrénées has applied for leave to construct a fall of 365 metres from the River Nagear, yielding 3,000 H.P., which is to be wholly utilised by the Castelet carbide of calcium factory.

SWEDEN.—RAILWAY ELECTRICATION.—Ever since 1905, the Royal Waterfalls Commission and the Board of Directors of State Railways have made investigations concerning the utilisation of the country's water-power for the electrification of the State railways. Interested firms were invited in 1908 to prepare their proposals, and the directors found that the one emanating from the Allmanna Svenska Electriska Aktiebolaget, in conjunction with another company, was most advantageous for the State and in the best interests of the Swedish industries. In accordance with the joint proposal of the two companies, a single-phase alternating-current system with a frequency of 15 cycles would be used for the electrification. The economic advantages of the system are most apparent when used for long sections with heavy trains, where it is required to transmit comparatively large amounts of power over long distances, at reasonable cost. The difficulties with this system were considered to be mainly of a technical nature in connection with the design of the electrical equipment for the locomotives; especially as machines of the capacity required had not been built at that time. Porjus has many interesting features to offer from an hydraulic engineering point of view. At the source of the Lule River, in the Great Lule Lake, begins a 3½ km. long stretch of rapids, approximately 8 metres high, below which a smaller lake, the Great Porjusselet, is located. Immediately below Porjusselet are the real Porjus falls, which extend approximately 2 km. down the stream. At the lower end of Porjusselet is constructed a dam by means of which practically the whole head in the small so-called Luspe Rapids above Porjusselet is made available. The length of the dam is no less than 1,254 metres, and the gross head after construction of this dam averages 56 metres. The damming up of Porjusselet is, however, only sufficient for the weekly regulation. On one side of the dam are arranged intakes for the power station canal, which is approximately 600 metres long. The canal is open for the first part, but enters the rock as a tunnel on the left side of the river, and emerges in front of the power station, where a small fore-bay is arranged. By means of the closed intake tunnel, the dangers from ice formations are reduced. The power station is partly located underground, blasted down in the rock to a depth of 50 metres. Only the switchgear building is located above ground. Five vertical penstocks lead down from the forebay to the turbines, from which a common tailrace tunnel, approximately 1,200 metres long, returns the water to the river basin at the so-called Lilla Porjusselet, a smaller still water below the Porjus Rapids. This peculiar method of construction was due to the local conditions, and has been found after investigation to be the cheapest and most reliable. The machinery hall, which is completely blasted out from the rock, has a width of 11 metres and a length of 95 metres. From one of the sides extend the 15-metre deep and approximately 6-metre wide recesses for the turbines. Space has been provided in the now completed portion for five turbines, but only four have been installed as yet. Of these, two are connected to single-phase generators for railway service, one to a three-phase generator, and one to a spare set consisting of a three-phase generator and a single-phase generator connected together. All the turbines are designed for a capacity of 12,500 H.P. each. At a later extension, the machinery hall will be enlarged to make room for an additional development of five turbines, also to be divided between the single-phase and three-phase systems.—*Journal of the Swedish Chamber of Commerce.*

The scheme for the extension of electrical working on the Swedish State railways, which was prepared by the State Railway Administration, has been delayed by the Hydraulic Department. It is considered that adequate water-powers are available for the purpose, but some time is required for determining the manner in which the supply of power to the railways will be made. The railway authorities are said to desire single-phase current of from 15 to 16⅔ periods, and the question has to be examined as to how this shall take place, as the generators at the existing hydro-electric works are generally for 50 periods.

HOLLAND.—It is reported from Rotterdam that the Dutch Government is to dispatch a commission to the United States to investigate the systems of electric railway working in that country. One-half of the members have been appointed by the State Water Department and the other half by the Administration of the Netherlands Railways. The commission will also inspect electric railways in Europe, and will eventually present a report as to the system best suited to the requirements of those of the Dutch railways which are to be electrified.

GERMANY.—Owing to strikes, wage increases, &c., the Berlin tramways undertaking showed a deficit of 19,000,000 marks for 1919. On January 1st the fare was raised, but, in spite of this, the continued increase of working expenses has resulted in the loss of a further 1,000,000 marks.

ITALY.—Steps have been taken to adapt the Corgola torrent for the generation of electricity, to be employed in connection with the development of the metal-bearing beds which run from the Lago d'Iseo to near Manive, a distance of 20 km. It is estimated that there are 5,000,000 tons of iron ore in this area, which was known and worked in the time of the Romans.

The Societa Elettrica Bresciana is carrying out some noteworthy plans of development. It has under construction two new hydro-electric stations—the Selvanizza and the Scoltella, both on the River Cedra. The former, when completed, will develop 32,000,000 KW. at an estimated outlay of 4,500,000 lire; the latter will cost 4,600,000 lire, and will involve the construction of a reservoir of 500,000 cb. metres content, and a machinery equipment comprising two groups of 3,500 H.P. each. It has also begun work on the conversion of Lake Idro into a reservoir.

The Chamber of Commerce of Turin gives the following particulars of the big Italian railway electrification scheme which has been officially sanctioned. The scheme contemplates electrifying 6,000 kilometres of railways worked by the State, or in course of construction, and railways or tramways the subjects of concessions, in working or under construction. An outlay of 800,000,000 lire is authorised, which will be spread over eight financial periods from 1919. For the financial year 1919-20, the sum of 60,000,000 lire is allotted. The works will be carried out either directly by the State railway administration or with the help of private industry, under the control of the administration. The supply of electric locomotives

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will be undertaken by the railway administration. The current will be obtained from private sources. The programme contemplates, first, the electrification of heavy traffic lines, in a certain number of passes through the Apennine mountain chain, and the principal arteries of the Peninsula network, stretching from Milan to Reggia Calabria and from Turin to Trieste. It is the intention of the administration to set up in the Apennines central stations in places where lignite and turf can be used, in order to create reserves for the Alpine network. In the North, the resources of the Trentino region are fully sufficient for the growing wants of the region. In these first operations, it is hoped to effect a yearly saving of 1,500,000 tons of coal, without reckoning the reduced consumption in local industries.

Huddersfield.—TRACK RENEWALS.—The tramway lines in various parts of the borough are being re-laid.

Jamaica.—RAILWAY ELECTRIFICATION.—An exhaustive report has been received by the Government of Jamaica from an expert of the Westinghouse Electric International Co. on the proposal to electrify the railway of the Colony, and to provide energy for other industrial purposes. The report deals with the harnessing of two large rivers for the purpose. The estimated cost of electrifying the railway, including the required power station, equipment, and transmission lines to supply other proposed plants and industries, is as follows:—

Power plants	$849,320
Sub-stations	333,320
Overhead construction and bonds	1,854,300
Motive power—electric locomotives and motor-cars —net (cost of new, less sale of old motive power)	357,650
Total	$3,393,590

The saving in the cost of operating the railway would be approximately $265,600 per annum, which is 7·83 per cent. of the cost of electrification. This assumes the sale of power to outside consumers at actual cost. The sale of power to outside consumers would result in a profit sufficient to increase the return on the cost of electrification to approximately 10·5 per cent. It is shown that conditions other than reduced cost of operation in the immediate future justify electrification of the railway at the earliest possible date. It is proposed that some of the power, if the scheme is carried out, should be used to operate plants on some of the sugar estates, to supply current for the sewerage works in Kingston, and to provide for the lighting of the thoroughfares of the city and other districts.—*The Times Trade Supplement.*

Lancashire.—EMPLOYES' WAGES.—In the event of the present application of the tramway workers for a 10s. per week increase being granted, it will have a serious effect on many undertakings. At Rochdale, it is stated, it will mean an increased wages bill of £10,000 per annum, and £12,000 at Bolton.

Leeds.—PROPOSED FARE INCREASE.—There is a likelihood of the tramway fares being increased in the early future, as it is stated the department is not paying its way. The present fare in Leeds is 1½d. for two miles. A meeting of the Tramways Committee took place last week, but no definite proposals were formulated.

London.—TRAMWAYS, &c., BILL.—The estimates required by the Standing Orders of Parliament have been prepared by the London County Council, showing in detail the expenditure of capital that will be required in the event of sanction being given to the Council's Tramways and Street Improvements Bill of the present session. The total expenditure is estimated at £5,118,500. Of this sum £3,363,500 is estimated to be required in connection with and for the construction and equipment of the proposed new tramways and the reconstruction of the embankment tramways, £1,355,000 is required for a new street and street widenings, and £400,000 is to provide omnibuses from or to any point within the county, or beyond the county, but within the Metropolitan Police District.—*The Times.*

UNDERGROUND RECONSTRUCTION.—At the annual meeting of the City and South London Railway Co., Lord Ashfield said that the cost of re-building the line would be £2,300,000.

Mansfield.—EXTENSION OF TIME.—The Light Railway Co. has applied to the Ministry of Transport for an extension of time until April 9th, 1922, for the completion of railways at Sutton-in-Ashfield and Skegby.

TELEGRAPH AND TELEPHONE NOTES.

Another Atlantic Cable.—President Mackay, of the Mackay Companies, in his annual report, announces a plan to lay another cable to Europe because of the present great volume of business. The organisation has been buying debentures of the Commercial Cable Co. in London, taking advantage of the low sterling exchange.—*The Times.*

European Telegraphs.—At the outbreak of war direct telegraph circuits between England and Europe were interrupted, and the circuits, the Continental terminals of which were in possession of the Allies, were taken over for military purposes. Within the past few months direct commercial service has been gradually restored, and the British Post Office now has direct wires from London to the following places:—Bordeaux, Boulogne, Calais, Dunkirk, Havre, Lyons, Marseilles, Nantes, Paris Central, Paris Bourse, Genoa, Milan, Rome, Antwerp, Brussels, Ghent, Amsterdam, Hague, Rotterdam, Berlin, Bremen, Cologne, Dusseldorf, Emden, Frankfort-on-Main, Hamburg, Leipzig, Madgeburg, Berne, Geneva, and Zurich.

Finland.—A telephonic connection between Tornea and Haparanda is being planned. The Director of Telegraphs will shortly place before the Finnish Government a proposition that the State should construct a telephonic installation from Uleaborg to Tornea. By this means it would be possible to telephone from Sweden to the most remote parts of Finland.—*Economic Review.*

Italy.—The *Economista Italia* states that wireless stations have been opened at Misurata and Azizia, in Tripolitania, subject to the tariff fixed in Tripoli. The Thié station, subject to the tariff fixed by Eritria, has also commenced working.

United States.—The New York telephone service has fallen grievously from its former state of efficiency. Since the Armistice it has steadily and rapidly deteriorated until to-day, says *The Times*, "There is no more despised and abused institution in the world." The vice-president of the company has issued a plea for mercy to the public. He admits that the service is bad, and cannot promise any real improvement for many months. According to him, the daily average of calls in New York before the war was 2,000,000. This number had increased to 4,000,000 on the first of the present year. Yet all through the war the telephone industry was classified as non-essential, with the result that the company was unable to make new extensions to meet the amazing growth of traffic. To add to its difficulties, its staff of operators is short by 3,000. The company intends to spend during the next 12 months £7,200,000 in establishing new exchanges, and to add £400,000 to the amount of its pay-roll.

It is announced that the U.S. Government will return to private operation, on February 29th, all private wireless stations taken over during the war period.

Wireless Time Signals.—The *London Gazette* of February 20th contains an Admiralty Notice to Mariners, No. 316 of 1920, which cancels former Notice, No. 171 of 1920, containing general information and a list of wireless time signals intended to provide, in a form suitable to give all information required by the wireless operator, a complete and up-to-date list of all time signals issued by wireless stations throughout the world.

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the ELECTRICAL REVIEW *in which the "Official Notice" appeared.)*

OPEN.

Australia.—MELBOURNE.—March 30th. City Council. 12,000 metal filament incandescent lamps. (February 6th.)

April 12th. City Council. Two 2,000-KW. rotary converters; H.T. switchgear, 6,600 v.; D.C. switchgear, 600 v. (January 30th.)

Belfast.—March 10th. Electricity Department. Stores, including meters, cables, electrical accessories, lamps, carbon brushes, &c. (February 20th.)

March 22nd. Electricity Department. Coal-handling plant. (February 20th.)

Chester-le-Street (Co. Durham).—March 3rd. Urban District Council. Underground mains and all equipment for lighting district by electricity. Mr. F. J. Gray, Clerk, Council Offices.

Doncaster.—March 2nd. Electricity Department. Two 3,000-KW., three-phase turbo-generators, with condensing plants. (February 20th.)

Dundee.—Tramways Committee. Stores for a year, including armature coils, commutators, insulated wire, lamps, switches, &c; overhead equipment materials. Mr. P. Fisher, General Manager.

Edinburgh.—March 29th. Electricity Supply Department. Condensing plant for Portobello station. Specification No. 23. (See this issue.)

France.—March 5th. French State Railway authorities, 43, Rue de Rome, Paris. Tenders for an electric lighting and power installation at the new railway works at Sotteville Quatre-Mares, near Rouen.

March 2nd. French State Railway authorities, 43, Rue de Rome, Paris. For the supply and laying of two three-phase high-tension cables between the La Garenne Chatou and St. Germain sub-stations.

Gellygaer.—March 21st. Urban District Council. Transformer plant, H.T. and L.T. switchgear, 11,000 v. and 500 v.; overhead line material. (See this issue.)

Gillingham.—February 28th. Electric Light and Power Department. Two 700 to 800-B.H.P. combined Diesel engines and alternators. (February 20th.)

Corporation. Two 3-ton steam or 3-ton electric travelling jib cranes.

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Hebburn.—Electric lighting of the premises of the New Town Working Men's Social Club. Specifications from the Stewards.

Halifax.—March 12th. Tramways and Electricity Committee. One 1,000-KW. turbo-alternator, with condenser. (See this issue.)

Hammersmith.—March 3rd. Electricity Committee. Stores for 12 months, including electric light sundries, insulated wire, meters, jointing compound, &c. (February 13th.)

Lincoln.—March 2nd. Electricity Department. One automatic battery, for St. Swithin's Power Station. (February 6th.)

London.—Great Central Railway. March 17th. Stores for 12 months, including electrical line construction, electrical apparatus, wires, cables, lamps, &c. Specifications from Mr. W. Williams, Stores Superintendent, G.C.R., Gorton, Manchester.

H.M. Office of Works. March 12th. Electrical accessories for 12 months. (See this issue.)

Macclesfield.—March 15th. County Asylum. Electrical goods for six months. Mr. W. G. F. Tingay, Clerk.

Merthyr Tydfil.—March 9th. Board of Guardians. Electrical fittings for six months. The Workhouse Master.

New Zealand.—DUNEDIN.—April 26th. City Council. (*a*) electric car bodies; (*b*) car trucks; and (*c*) car equipment. Documents may be consulted by British firms interested, at the Department of Overseas Trade (Development and Intelligence), 35, Old Queen Street, S.W. 1 (Room 49).

Plymouth.—March 18th. Electricity Committee. Turbo-alternator, converter and booster. (See this issue.)

CLOSED.

Croydon.—Town Council :—

Dust destructor, South Norwood.—Meldrums, Ltd., £13,884.

Epsom.—Urban District Council :—

Distributing mains and laying.—Siemens Bros. & Co., Ltd., £7,332 (less £349 credit for old copper, and adjustment of labour rate, £154).

London. — STEPNEY. — CORRECTION. — In our list of the tenders submitted to the Borough Council (see ELEC. REV., February 20th, page 242) the price quoted by the Mirrlees-Watson Co., Ltd., for condensing plant, is incorrectly given. It should be £14,960 *not* £16,960.

FULHAM.—Electricity Committee. Recommended :—

Feed-water heater, £328.—Worthington, Simpson & Co.

South Africa.—LADYSMITH.—Corporation. Accepted :—

Two Babcock & Wilcox water-tube boilers, with mechanical stokers, superheaters, filters, &c.—Messrs. Reunert & Lenz. Delivery is expected about the middle of April.

FORTHCOMING EVENTS.

Royal Institution of Great Britain.—Saturday, February 28th. At Albemarle Street, W. At 3 p.m. Lecture on "Positive Rays," by Sir J. J. Thomson, Pres. R.S.

Faraday Society.—Monday, March 1st. Joint meeting with the London Section of the Society of Chemical Industry.

Society of Engineers.—Monday, March 1st. At Burlington House, W. At 5.30 p.m. Paper on "Some Engineering Work done by the 277th Railway Co. (R.E.) in France and Belgium During the War," by Mr. R. H. Cunningham.

Rontgen Society.—Tuesday, March 2nd. At the Royal Society of Medicine, Wimpole Street, W.C. At 8 p.m. Third "Silvanus Thompson Memorial" Lecture on "Analysis by X-rays," by Prof. W. H. Bragg, F.R.S.

Liverpool Engineering Society.—Wednesday, March 3rd. At the Royal Institution, Colquitt Street. At 8 p.m. Paper on "Water-tube *versus* Cylindrical Boilers in the Mercantile Marine," by Mr. E. A. Atkins.

Association of Engineering and Shipbuilding Draughtsmen.—Wednesday, March 3rd. At 7.30 p.m. At the Engineering Lecture Theatre, Liverpool University. Mr. D. H. Tates, A.M.I.M.E., on "The Una-Flow Steam Engine." Thursday, March 4th. At 8 p.m. At Milton Hall, Manchester. Mr. Peter Doig on "The Screw Propeller." Friday, March 5th. At 7.30 p.m. At the Applied Science Department, Sheffield University. "Flat Plates," by Mr. C. C. Pounder, A.M.I.M.E. Friday, March 5th. At the Technical School, Barrow-in-Furness. Mr. M. Coronel on "Gearing Design."

Institution of Electrical Engineers.—Thursday, March 4th. At the Connaught Rooms, Great Queen Street, W.C. (7 for 7.30 p.m.). Annual dinner. Informal meeting. Monday, March 1st. At the Institute of Patent Agents, Staple Inn Buildings, W.C. At 7 p.m. Lecture on "The Future of Labour in the Engineering Industry," by Mr. R. E. Dickinson.

(**Western Centre.**)—Monday, March 1st. At the Merchant Venturers' Technical College, Bristol. At 7 p.m. Lecture on "Electric Clocks," by Prof. D. Robertson.

(**Students' Meeting**).—Friday, March 5th. At the City and Guilds (Engineering) College, South Kensington, S.W. At 7 p.m. Address by the President.

British Industries Fairs.—At the Crystal Palace, London; Castle Bromwich Aerodrome, Birmingham; and the Kelvin Hall, Glasgow. Open until March 5th.

Junior Institution of Engineers.—Friday, March 5th. At 39, Victoria Street, S.W. At 7.30 p.m. Lecturette on "Notes on Gauge Testing and Measuring Appliances," by Mr. F. H. Holt.

NOTES.

The 25,000-KW. Turbo-Alternator at Manchester.—In our article on the new plant at Stuart Street generating station, Manchester, last week, the generating set was inadvertently described in the foot-lines to figs. 2 and 4 as a "Metropolitan-Vickers Turbo-Alternator." This description was correct so far as the alternator was concerned, but the turbine and condensing plant, as stated in the body of the article, were supplied by the chief contractors, Messrs. Richardsons, Westgarth & Co., Ltd., of Hartlepool. The turbine is one of their standard combined impulse-reaction turbines of the Brown-Boveri type, except for modifications made by the firm to suit the special conditions at Manchester.

Smoke Abatement.—Dr. Addison, the Minister of Health, has appointed a Committee to consider the present state of the law as regards the pollution of the air by smoke and other noxious vapours, and to advise what steps are desirable and practicable to diminish the evils still arising from such pollution. Lord Newton will be chairman of the new Committee, and Mr. E. C. H. Salmon, of the Ministry of Health, will act as secretary; any communication should be addressed to him at the Ministry of Health, Whitehall, S.W. 1.

The Status of Engineers.—Application will be made to the Legislative Assembly of the Province of British Columbia at the next session on behalf of the Association of Professional Engineers of British Columbia for a private Bill to be known as the British Columbia Engineering Profession Act, for the purposes of governing and regulating the practice of civil, mining, metallurgical, mechanical, electrical, and chemical engineering in that province, the qualification, examination, and registration of intending practitioners, discipline of members, and so on.—*Electrical News.*

Parliamentary.—In the House of Commons, last week, the following Bills were read a second time :—Central London and Metropolitan District Railway Companies (Works) Bill, L.C.C. (General Powers) Bill, London United Tramways Bill, and the South Metropolitan Electric Tramways Bill.

The *Daily Telegraph* says that objection was taken to the second reading of the Metropolitan Electric Tramway Bill, and also to the London Electric Railway Companies' Bill, which deals with an increase in fares.

Record of Electrical Plant Installed During the War.—The head of each naval establishment on shore is requested by the Admiralty to arrange for a summarised description of all new electrical plant installed during the war in the establishment under his superintendence, to be forwarded at an early date. Any new applications of electricity made during the war are also to be reported, and a comparison made with pre-war plant and methods. This information is required in connection with the preparation of a Technical History of the War by the section of the literary staff at the Admiralty, of which Commander Rollo Appleyard, R.N.V.R., is the head.—*United Service Gazette.*

A Dot-and-Dash Duck.—A correspondent writes :—A neighbour of mine who bought some ducks a few weeks ago found that one of them was exceptionally intelligent, and had an unusually loud and penetrating voice. He had a friend living about 200 yards away, to whom he had often wanted to send short messages. My neighbour, who during the war was a wireless operator on one of his Majesty's ships, soon discovered that if he took the duck up in his arms, it rapidly responded with a long-drawn qu-a-a-a-a-ck when he gently pulled its tail and held it for a second or so, and that it also readily shot out a short sharp quack when he pulled the tail and let go instantly. He now sends his messages by Morse code to his friend, who is looking for an equally intelligent duck with a voice of 200 yards' range with which to reply.—*Morning Post.*

A.O.E.C.—The annual meeting of the Association of Officers and Staff Members of Electricity Companies was held at Caxton Hall, on January 30th, and was well attended. In moving the adoption of the report, the chairmain, Mr. A. E. Beale, said that the Association was to be congratulated on Sir Alexander Kennedy having accepted the presidency of the Association and on the imposing list of vice-presidents; several prominent officials had declined nomination, being of the opinion that they could more effectually assist if they were not officially connected with the A.O.E.C. The Chairman then touched shortly on the ramifications of the Association during the year, and laid particular stress on the Executive Committee's work in connection with the Electricity Supply Bill. This had resulted in the embodiment of Clause 16 in the Electricity (Supply) Act, 1919, containing all the essential provisions embodied in the corresponding clauses of the Acts constituting the Metropolitan Water Board, Port of London Authority, and Ministry of Transport. He concluded by paying a high tribute to the hon. secretary, Mr. O. M. Andrews, for his devotion to the interests of the Association, and for his efforts in connection with the Bill. The retiring Executive Committee and officials were then re-elected for the ensuing year. It was resolved that a testimonial should be presented to the hon. secretary in recognition of his services to the Association.

German Exhibitions in 1920.—During 1920 general exhibitions will be held at Leipzig, Breslau, Frankfurt-on-Main, Königsberg, and special exhibitions in Berlin, Düsseldorf, Elberfeld, Königsberg, Leipzig, and Stuttgart.—*Times.*

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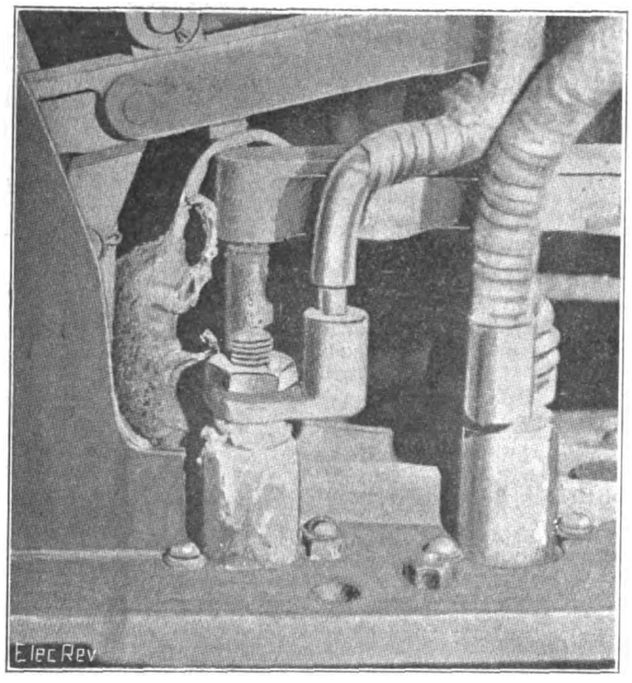
X-Ray Kinematography.—The daily Press announces that two French medical men, Dr. Formon and Dr. Comandon, have produced a combined X-ray and kinema apparatus which, it is claimed, permits the filming of the interior of animals so as to show on the screen all the movements of the various organs. The apparatus is expected to be of great assistance to medical science, especially in the training of students. The films allow every movement of the organs to be watched on the screen, and any irregularity noted.

Appointments Vacant.—Telegraph mechanicians (£250 + £170), for the Government of the Gold Coast Posts and Telegraph Department; shift engineer (85s.), for the Whalley County Asylum; mains assistant (£105 + 20 per cent. + £90), for the Portsmouth Corporation Electricity Department: sub-station attendant (79s. 10d.), for the Bootle Corporation Electricity Works; mains engineer (£300), for the Wigan Borough Council Electricity Department; plumber-jointer (84s.) for the Bolton Corporation Electricity Department; junior charge engineer (£100 + 20% + £90), for the Barrow Corporation Electricity Department. See our advertisement pages to-day.

The Calcutta Corporation is inviting applications until May 1st, for the post of lighting superintendent. A lengthy advertisement, stating the gas and electrical duties, salary, conditions, &c, will be found in *The Times* for February 23rd.

Tale of a Rat.—An electrical breakdown of an unusual but, unfortunately, not unprecedented nature, is illustrated in the accompanying reproduction of a photograph taken at the Daimler Co.'s Radford works. On a recent Thursday night the supply suddenly failed, and a lengthy investigation of the electrical



equipment resulted in the finding of the body of a badly burnt rat, which had apparently attempted to walk across the high-pressure terminals of an oil-immersed switch. Thereby it started a short-circuiting current, which had persisted and formed an arc, with disastrous results, as will be seen in the illustration, to the rat, and also to the main switch.

Fatalities.—An inquest was held, on February 19th, into the cause of the death of Harold Bligh Hill, aged 30, an electrician, employed in the L.C.C. sub-station, Upper Street, Islington, the previous Saturday night. He and a man named Frank Antill went to their duties as usual, and about two o'clock deceased went down into the basement to clean up; having removed the screens, although the live pressure was on, he proceeded to clean one side of the switchboard using no gloves, whereas under the regulations, he should not attempt to do any cleaning to the apparatus while the pressure was on. The telephone bell ringing, Antill went to answer it, and when he returned to the basement he found the deceased lying down by the side of the switchboard, apparently in an unconscious condition; he summoned the police surgeon, who found life was extinct, there being burns on both hands. Dr. B. H. Spilsbury, the Home Office expert pathologist, who had made a post-mortem examination of the body of the deceased, proved that death was due to an electric shock. Mr. T. L. Horn, electrical engineer in charge of the electricity distributing system, said that after the occurrence he examined the apparatus and found all in order. Deceased, to do the cleaning work, should first have made certain that the pressure was off and the switchboard dead, and under no circumstance should he have done the work whilst the current was on, for such was highly dangerous, and he was by rule forbidden to do such work alone. It seemed that he went to do the work whilst his mate had gone upstairs to attend to the telephone, and whilst the latter was away it was possible, owing to his having removed the screen, for him to have slipped over a mat, and, in trying to save himself from falling, put out his hands, which came in contact with the live metal. The Coroner recorded a verdict of "Accidental death."

The Sydney *Evening News* reports an inquest on Miss E. G. M. H. Vidal (30), at Wollongong, who was ironing, when she was heard to scream, and was found standing by the table with her hands "twisted round an electric iron." When the iron was prized out of her hands she fell to the floor, and could not be revived, though attempts to restore animation were carried on for 1½ hours. Mrs. C. Markham said she had received a shock from the iron previously. Miss Vidal's slippers were damp, and an inspector for the City Council, Mr. E F. S. Murphy, said he found the frame of the iron alive. If she had been on a dry floor, and had had dry footwear on, she would not have received the shock. The verdict was "Accidental death."

The G.E.C. All-Electric House.—On Friday, last week, at the invitation of the General Electric Co., Ltd., a Press visit to the "All-Electric House" exhibited by the company at the Ideal Home Exhibition, took place; there was a very large attendance, and great interest was manifested in the house and its equipment, which was described in our issue of February 13th. Great credit is due to the company for the enterprise of which this unique exhibit is the embodiment; as we have repeatedly pointed out, the scarcity and high price of domestic help have brought the subject of labour-saving appliances in the home into the forefront, and have created an ideal opportunity for that development of the applications of electricity in the household which is so long overdue. The comfort and convenience afforded by the electrical equipment of the house are sufficient to induce a craving for their realisation in the breast of every housewife who inspects the installation, and the exhibit should exercise a marked influence on progress in this branch of the electrical industry.

Presiding at a luncheon given by the General Electric Co. to its guests at the Clarendon Restaurant, Mr. Hugo Hirst said he was disappointed with the part played by electricity at the Ideal Home Exhibition; there had been a gap of six years, during which the apparatus had remained in much the same stage of development as in 1914. Before the war the domestic appliance industry could not be developed as it should have been, because the supply authorities would not push the business adequately; nevertheless, an order for 2,000 electric ovens was put in hand by his company—then the war put a stop to the work, electric heating and cooking and other domestic uses of electricity being forgotten in view of the more important problems that they had to face. Now they were starting again where they left off; they would "get there" all right, but before these apparatus that were exhibited could be used in their millions, they must lay down factories and produce the goods cheaply enough to enable the general public to adopt them, and they must also ensure that electrical energy should be provided here at as low a price as anywhere. Although labour and coal were costly, electricity would play a fundamental part in the national reconstruction; they must endeavour to produce the KW.-hour for one-tenth of a penny, or even less. Then all houses would be fitted electrically, at the cost of shillings, where pounds were now quoted. That was his view of the problem, and the way in which it should be solved; only thus could the real "electric home" be attained.

In reply to the toast of his health, Mr. Hirst remarked that he could employ thousands more men but for the Trade Union restrictions on output, which delayed the building of the new factories which the General Electric Co. was erecting.

The arrangements for the visit were in the hands of Mr. H. Clifford Palmer, and were admirably organised and carried out.

Volunteer Notes.—The Volunteer Signal Company of the Royal Engineers, which was formed in Glasgow in 1918, with Major E. T. Goslin as commanding officer, has been disbanded. With the consent of the contributors to the fund which was raised by the Scottish Centre of the Institution of Electrical Engineers and the Electrical Contractors' Association, Major Goslin has now handed over a balance of £197 to the Benevolent Fund of the Institution of Electrical Engineers.

Canals and Inland Waterways.—At a meeting of the Royal Society of Arts held on February 18th, Mr. A. Neville Chamberlain, M.P., who presided, stated that the financial condition of inland waterway undertakings was due to the competition of the railways which were subsidised by the State. He considered that the work of improving matters in this direction should be carried out by the Government, as private undertakings would not see in the scheme a paying proposition. Mr. Chamberlain suggested the formation of Committees to control and operate the canals and inland waterways.

Electrolytic Copper in France.—According to *La Journal Industrielle* of February 6th, for which we are indebted to the Department of Overseas Trade, a company known as Hydro-electrique et Métallurgique du Palais during the war constructed a hydroelectric plant at Le Palais (Vienne), 2 km. from Limoges, and a works for the production of electrolytic copper, in order to secure a measure of independence of America in the supply of copper for war purposes. The works was laid out and equipped for an annual output of 12,000 tons of electrolytic copper. The company is contemplating the construction on the Taurion, a tributary of the Vienne, of new hydroelectric works for similar purposes, but in view of the existing conditions no date can be assigned for their completion.

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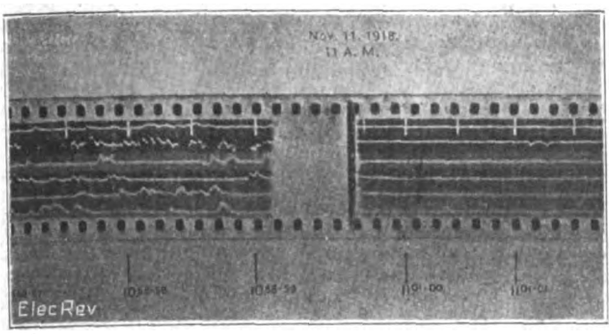
The End of the War.—The recording tape illustrated below, which we reproduce from the *Journal of Electricity*, presents a remarkably graphic history of "the end of the war," over a year ago, November 11th, 1918. It is the tape from an American electrical listening instrument on the battle front, used to locate enemy batteries, and is calibrated to show fifths of a second of time. With photographic accuracy it shows the cessation of artillery activity on the American sector near the river Moselle, at 11 o'clock on the day of the Armistice.



END-OF-THE-WAR RECORD.

The perfection of sound-ranging devices is typical of the many services rendered by engineering and technical enterprise toward the winning of the world conflict. These were among the scientific instruments which the Germans were never able to produce successfully for themselves. The uncanny accuracy of this sound-detecting equipment is indicated by the record of one instrument which located 117 gun positions in a single day. The recording microphones were so delicate that their use had never been considered possible outside of laboratories, yet they were employed with success amid the din and concussion of heavy bombardments. So accurately did their data check, that enemy gun positions could be determined within 50 ft. by instruments several miles away.

Electricity Supply in Victoria.—We have received from the Secretary to the Electricity Commissioners of Victoria, Australia, their report on the utilisation of brown coal and water-power for the production of electrical energy, which leads them to the following conclusions:—That the necessary steps should be taken to inaugurate a State scheme for the supply of electrical energy, and that for this purpose a power house of an initial capacity of 50,000 KW. should be established on the Morwell brown coal field, at a cost, including the transmission lines and sub-stations, estimated at £2,737,392. It is important that the scheme should be in operation early in 1923. Hydroelectric power schemes are in the meantime deferred, pending the completion of investigations now in progress. The Morwell power house should be linked up with the Newport power house, and both operated under the control of a single authority. Research work on brown coal should be continued; the coal field should be opened up for the supply of fuel to the public, and the manufacture of briquettes should be tried. A sum of £150,000 is required to house the workmen, and £30,000 for briquetting plant, bringing the total estimate up to £2,917,382. The Commissioners recommend that a reduction of import duties should be obtained on items of plant required for the scheme that cannot be made in Australia, particularly the alternators.

We are informed that the report has been adopted by the Victorian Government, the Bill has been passed, and steps are being taken to proceed with the scheme at once.

Relative Costs of Coal and Oil.—The *Board of Trade Journal* has recently published figures collected by H.M. Commercial Secretary at Washington, showing that, although a few years ago there was a saving of 10·2 per cent. in the use of oil fuel, as compared with an equivalent quantity of coal, the prices of the two types of fuel have not risen in equal ratio, and so the present balance is slightly in favour of coal. In the Chicago district, for instance, the percentage increase in the cost of oil during the last few years has been 280, while the price of coal has only advanced 67 per cent. These figures are based on heat values only, plant efficiency in the case of oil being greater than that obtained by the use of coal.

Scientific Research in Australia.—A Bill which, when it becomes law, will create the "Commonwealth Institute of Science and Industry," is now on its course through the Federal Legislature. The underlying idea of the measure is to establish a body that will carry out scientific research work in relation to (1) the primary industries, and (2) the manufacturing industries. It will co-ordinate the scientific work which is now being undertaken by the States, will prevent overlapping and so ensure greater efficiency. The Institute is to be controlled by a Directorate of three scientific directors, who have not yet been appointed. They will be responsible to the Minister for Trade and Customs. Pending the passage of the Bill, the Advisory Council of Science and Industry, established in March, 1916, is preparing the ground, and is exercising in a preliminary way the functions that will belong to the future Institute. Researches into many problems affecting Australia have already been initiated and other investigations previously in progress have been encouraged and co-ordinated. Amongst other matters, a scheme for the creation of an Australian Engineering Standards Association has been prepared and approved by engineering associations and leading engineers throughout the Commonwealth. Conferences for the standardisation of structural steel sections, railway rails and fishplates, and tramway rails have already been convened, in each case with entirely successful results.—*Board of Trade Journal.*

Hydraulic Power in the Rumanian Rivers.—H.M. Commercial Secretary at Bucharest has reported through the D.O.T. that according to an estimate of the hydraulic reserves of Rumania published in the *Bulletin* of the State Railways there is a total of 841,093 H.P. which could be transformed into energy. This conclusion is based upon the flow in the rivers at the driest season of the year. In order to arrive at the actual H.P. available it would appear to be the practice to increase this by 150 per cent., a course which brings the total available H.P. up to 2,250,000. The *Bulletin* states that in 1913 only 41,000 H.P. was explaited.

INSTITUTION NOTES.

Belfast Association of Engineers.—Under the auspices of this Association a paper on "The Ultimate Constitution of Matter" was read by Mr. W. C. Ward, at the Municipal Technical Institute, on February 19th. Mr. Alex. Browne (president), occupied the chair, and there was a good attendance.

Institution of Mechanical Engineers.—The annual report for 1919 states that grants in aid of research work during the year were as follows:—Alloys, £220; steam-nozzles, £150; hardness tests, £150; and cutting tools, £100. Mr. A. F. Shore, of New York, was awarded a grant of £20 from the Sir Robert Hadfield Prize Fund, for a paper on "Hardness Determination," and a grant of £7 for his paper on "The Measurement of High Degrees of Hardness," was made to Mr. J. Innes. The accounts show an income of £22.684. against an expenditure of £24,843, a loss on the year of £2,159.

E.P.E.A.—The annual dinner of the North-Eastern Division was held on the 17th inst., at the Savoy Restaurant, Newcastle-on-Tyne, under the presidency of Mr. A. S. Blackman, M.I.E.E., M.I.M.E.

Mr. A. L. Lunn, Past President of the E.P.E.A., in proposing the toast of "The Guests," said he was pleased to note the presence of so many chief engineers. The Association was not looked upon with favour when it commenced its activities, but events had proved that it was started at the right time. He had recently read in the journal of the Electrical Trades Union, that "there was only one fly in the ointment, and that was the E.P.E.A.," and they were going to dig it out, but the E.P.E.A. was here to stay, and its work should have commenced 25 years ago.

Mr. R. P. Sloan, C.B.E., M.I.E.E., in responding to the toast, said he had always felt a great interest in the work of the E.P.E.A. He noted that the membership of the Association had increased by 40 per cent. during the previous year. The E.P.E.A. had been a benefit to the electricity supply industry, as it had been the means of compelling the employers to come together. The objects of the E.P.E.A. were laudable ones, and they could rely upon his sympathy and support.

Mr. E. Moxon proposed the toast of the E.P.E.A., and Mr. C. Vernier, M.I.E.E., in response, indicated the work of the Association in connection with the Electricity (Supply) Act, and the issue of Award No. 9,281. In his opinion, the most important work that the Association had accomplished, was the formation of the National Joint Board of Employers and Staff Members (Electricity Supply Industry). This Board was actively engaged at the moment in the consideration of the minimum salaries of the technical staffs of the undertakings, and its work was of great importance to all concerned.

An interesting and enjoyable musical entertainment was provided to the appreciation of all present.

Royal Institution.—On March 8th and 10th Sir John Cadman's postponed lectures on "Modern Development of the Miner's Safety Lamp," and "Petroleum and the War," will be delivered.

Physical Society of London.—At the annual general meeting on February 13th, Prof. C. H. Lees, F.R.S., delivered his presidential address, on "The Temperature of the Earth's Interior." The foundation of an International Union of Physics was unanimously approved, and it was announced that Prof. W. H. Bragg, C.B.E., F.R.S., had been elected president, the secretaries being Mr. D. Owen, D.Sc., and Mr. F. E. Smith, O.B.E., F.R.S.; foreign secretary, Sir Arthur Schuster, F.R.S.; and treasurer, Mr. W. R. Cooper, M.A.

Bradford Engineering Society.—At a meeting at the Technical College on February 16th, Major S. Utting, M.I.M.E., A.M.I.E.E., lectured on "Induced Draught for Boiler Installations," with special reference to the 'Prat' System." The chair was occupied by the President (Mr. W. Leach).

Institution of Electrical Engineers.—The third ordinary meeting of the LIVERPOOL SUB-CENTRE was held, on February 16th, at the University, Liverpool, when Lieut.-Col. F. C. Aldous, D.S.O., and Mr. A. L. Scanes delivered a joint lecture on "Electric Power Supply in the Rhine Valley." Prof. E. W. Marchant presided over a large attendance of members. Lieut.-Col. Aldous delivered the first part of the lecture, which dealt with the Electrical Features of Power Supply in the Rhine Valley, Mr. Scanes following with a brief description of the Mechanical Features. The lecture was illustrated by a large number of interesting lantern slides. A discussion followed, in which Messrs. Dickinson, T. D. Clothier, W. Lang, Ohlson, Povey, and the chairman took part. The lecturers suitably replied.

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OUR PERSONAL COLUMN.

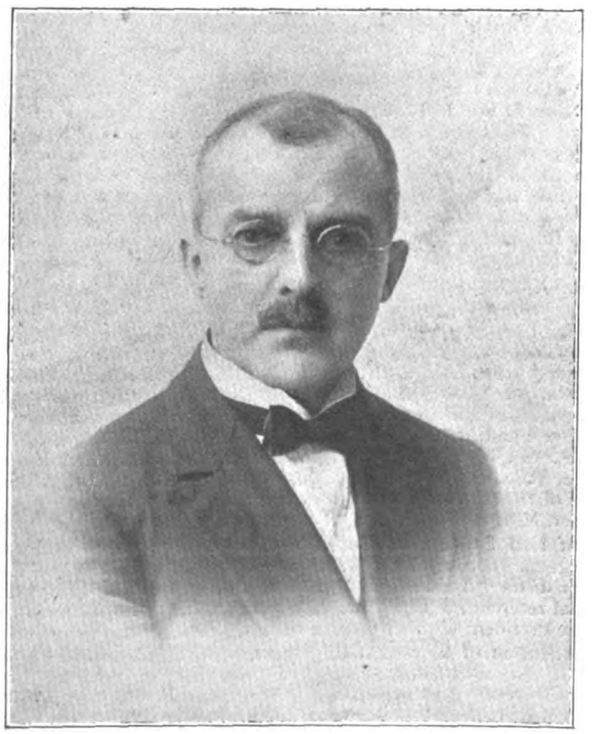
The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

The Electricity Commissioners.—In our last issue we published the announcement of the appointment of four of the Electricity Commissioners—Sir John Snell, Mr. H. Booth,

Photo by] [*Keith Dannatt.*

SIR JOHN F. C. SNELL.

Mr. W. W. Lackie, and Mr. A. Page—with portraits of the two last named. We now have pleasure in reproducing the portraits of the Chief Electricity Commissioner, Sir John Snell, and Mr. Booth. In our issue of June 26th, 1914, p. 1075, we had already given a short biography of Sir John



H. BOOTH.

Snell, together with his portrait, on the occasion of his knighthood, whilst he was president-elect of the Institution of Electrical Engineers.

It is believed that the fifth Commissioner will be Mr. Hayward, of the London County Council.

On November 19th, the Hackney B.C. referred back to the Establishment and General Purposes Committee for further consideration the recommendation to increase the salary of Mr. L. L. ROBINSON, the borough electrical engineer, from £750 to £1,050 per annum, rising to £1,200 per annum. On proceeding to further consider the matter, the committee had before it a communication dated November 24th by Mr. Robinson, asking for remuneration in accordance with the scale authorised by the Associated Municipal Electrical Engineers (Great Britain and Ireland). After conferring with the Electricity Committee on the question, a joint meeting of the two committees passed a resolution expressing the opinion that the above-mentioned scale should be adopted from April 1st, 1920, it being understood that the addition to the basic salary for new consumers should not exceed £250 in any year. The salary for the year commencing April 1st, 1920, under the scale, will be made up as follows: Basic salary £1,000, plus £169 additional for consumers, plus £175 10s., being 15 per cent. to cover the extra cost of living in London, plus £134 10s., an over-all 10 per cent. increase for depreciation of money values, giving a total of £1,479. The committee recommends: That as from April 1st, 1920, the scale of salary of the A.M.E.E. (Great Britain and Ireland) be adopted in respect to the salary of the borough electrical engineer on the understanding that the addition to the basic salary in regard to the number of consumers is not to exceed a maximum of £250 in any year.

Mr. F. C. WILSON has been elected chairman of the Liverpool Tramways Committee, in succession to Ald. Russell Taylor.

We are informed that Mr. E. G. BAKER has resigned his appointment with the Morecambe Corporation electricity works.

After two months' holiday on account of ill-health, Mr. F. H. RUDD, Corporation electrical engineer at Rochdale, has now resumed duty.

Wigan Tramways Committee has appointed Mr. R. HOGGARD, formerly chief traffic assistant to the Sheffield Corporation Tramways, to be traffic superintendent, at £275 per year.

Liverpool Tramways Committee has decided to recommend the City Council to appoint Mr. P. PRIESTLEY as general manager of the Corporation tramways, to succeed Mr. C. W. Mallins.

Stirling T.C. has increased the salary of the electrical engineer, Mr. W. R. MURRAY, by £50 a year to £350.

Obituary.—MR. E. G. WAY.—The death has occurred, at the age of 37 years, of Mr. Edwin George Way, of the firm of Wort & Way, electrical engineers, of Salisbury, and Radnor House, Downton, Wilts.

NEW COMPANIES REGISTERED.

Electroducer, Ltd. (163,977).—Private company. Registered February 12th. Capital, £2,300 in 40 "A" shares of £50 each and 6,000 "B" shares of 1s. each. To acquire patents and rights, to enter into agreements with manufacturers for the right to manufacture and sell the company's electric cooking appliances, and to enter into an agreement with C. H. Lauth. The first directors are: C. H. Lauth, 11, Highbury Mansions, N.1; T. Jacob, The Oaks, Barnet Lane, Elstree; T. Plant, 98, Balham Park Road, S.W.; G. Maunsell, 116, Grosvenor Road, N.5. Registered office: 334, Upper Street, Islington, N.

R. W. Crabtree & Sons, Ltd. (163,908).—Registered February 10th. Capital, £600,000 in £1 shares (300,000 3 per cent. cumulative preference). To carry on the business of electrical, manufacturing, mechanical, motor, hydraulic and general engineers, fitters, founders, boiler makers, &c. Minimum cash subscription, 7 shares. The first directors are: C. H. Crabtree, Water Lane, Leeds; A. E. Crabtree, Water Lane, Leeds; E. Gillett, Hawthorn Road, Willesden Green; A. Terrey, 28, Keith Road, Hayes, Middlesex. Qualification, £2,000. Remuneration, £200 each per annum (£50 extra for the chairman). Solicitors: Ashurst, Morris, Crisp & Co., 17, Throgmorton Avenue, E.C.

Radio Press, Ltd. (164,035).—Private company. Registered February 13th. Capital, £100 in £1 shares. To carry on the business of proprietors and publishers of newspapers, journals, magazines, books, &c., dealing with radio telegraphy and telephony, submarine signalling, &c. The subscribers (each with one share) are: B. Binyon, 34, Norfolk Street, W.C., managing director; E. A. B. Snoaden, 34, Norfolk Street, W.C., secretary. Table "A" mainly applies. Registered office: 34, Norfolk Street, W.C.

West Yorkshire Motors, Ltd. (164,097).—Private company. Registered February 14th. Capital, £5,000 in £1 shares. To take over the business of a wire worker carried on by F. G. Brockway, at Providence Street, Elland, Yorks., and to carry on the same and the business of manufacturers of and dealers in electric motors and dynamos, generating plant, &c. The subscribers (each with one share) are: F. G. Brockway, 24, Waverley Road, Elland, wire manufacturer; E. Turner, 18, Huddersfield Road, Elland, electrical engineer. The subscribers are to appoint the first directors. Registered office: Providence Street, Elland, Yorks.

Standard Electric Welding Co., Ltd. (164,324).—Private company. Registered February 20th. Capital, £5,000 in 10s. shares. To carry on the business indicated by the title, and to adopt an agreement with the Shipbuilding and Engineering Appliances Co., Ltd. The first directors are: J. D. Andrew, 24, Grainger Street West, Newcastle-on-Tyne, consulting engineer; W. J. Pickersgill, Eden House, Newcastle Road, Sunderland, shipbuilder; T. H. Pattinson, 2, Esplanade, Sunderland, shipbuilder; T. W. Crozier, 25, Marine Terrace, Blyth, shipbuilder; J. H. Readhead, East Garth, South Shields, shipbuilder. Registered office: 24, Grainger Street West, Newcastle-on-Tyne.

Technical & General Advertising Agency, Ltd. (164,186).—Private company. Registered February 17th. Capital, £1,000 in £1 shares. To carry on the business indicated by the title. The subscribers (each with one share) are: H. E. Littlewood, 9, Ashburnham Gardens, Upminster, solicitor's clerk; T. Harvey, 58, Thornhill Road, N.1, solicitor's clerk. Table "A" mainly applies. Solicitors: Vint, Hill & Killick, Commercial Bank Buildings, Bradford.

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London Mica and General Supply Co., Ltd. (163,926).—Private company. Registered February 11th. Capital, £1,000 in £1 shares To take over the business of a mica and general merchant carried on by S. Grout, at Islington, as the London Mica and General Supply Co. The first directors are: S. Grout, 13, St. Helen's Park Road, Hastings; F. A. Smith, 6, Beatrice Road, Walthamstow; W. Beaumont, Firnichill, Blatchington Road, Tunbridge Wells. Registered office: 51, Upper Street, Islington, N.

R. Cranmer Brown, Ltd. (164,229).—Private company. Registered February 18th. Capital, £5,000 in £1 shares. To take over the business of electrical, mechanical and general engineers, contractors, &c., carried on as "T. P. Pollitt & Co., Ltd.," at 9, Wellington Street, Hull. The first directors are: G. H. King, Normont, Kelvinside Gardens, Glasgow; R. C. Brown, 157, Boulevard, Hull. Solicitor: H. Wray, Hull. Registered office: 9, Wellington Street, Hull.

Fletcher Electro Salvage Co., Ltd. (164,150).—Private company. Registered February 17th. Capital, £10,000 in £1 shares. To take over the business of electro depositors of metal carried on by R. J. Fletcher and G. Martin at 3, Penarth Street, Old Kent Road, S.E., as "Fletcher & Martin." The subscribers (each with one share) are: W. C. Petrie, 2, Tudor Street, E.C., manufacturer; R. J. Fletcher, 3, Penarth Street, Old Kent Road, S.E., engineer. The first directors are not named. Registered office: 3, Penarth Street, Old Kent Road, S.E.

Charles Parker (London), Ltd. (164,067).—Private company. Registered February 14th. Capital, £5,000 in £1 shares. To take over the business of manufacturing electrical engineer, magneto specialist, &c., carried on by C. C. Parker at 75, Park Road North, Acton, W. The first directors are: C. C. Parker, 13, Hardwicke Road, Chiswick, W.3, manufacturing electrical engineer (permanent managing director); R. J. Hewett, 12, Hardwicke Road, Chiswick Park, W.3. Secretary: Phyllis M. Hesilridge. Solicitors: A. E. Griffiths & Son, 44, Bedford Row, W.C.

Anglo-French Engineering Co., Ltd. (164,246).—Private company. Registered February 19th. Capital, £50,000 in £1 shares. To carry on the business of mechanical, electrical and general engineers, &c. The subscribers (each with one share) are: A. M. Ingledew, 4, Mount Stuart Square, Cardiff, solicitor; A. D. Greatrex, 12, Fenchurch Avenue, E.C.3, steamship manager. The subscribers are to appoint the first directors. Solicitors: Ingledew & Sons, 4, Mount Stuart Square, Cardiff.

Jovel Engine (England), Ltd. (164,268).—Registered February 19th. Capital, £100,000 in £1 shares. To acquire from the Jovel Engine (Parent) Co., Ltd., the benefit within the U.K. and Isle of Man of an existing invention relating to rotary internal-combustion engines, &c. The first directors are: J. A. Vielle, 81, Alleyn Park, S.E.21; R. W. Jodrey, Chocorua, High Road, N.20; E. A. Kite, 31, Warwick Gardens, W.; J. W. R. Bryant, Onslow Court Hotel, S.W.7. Solicitors: E. A. Kite, 2, Dean's Yard, S.W. Registered office: 17, Waterloo Place, S.W.

United Weldings and Electrical Co., Ltd. (164,283).—Private company. Registered February 19th. Capital, £5,000 in £1 shares. To take over the businesses of electrical and oxy-acetylene welders, electrical, mechanical and sanitary engineers, &c., carried on at 116, Chorlton Road, Stretford, as the United Weldings and Electrical Co., and at 3, Carter Street, Greenheys, Manchester, as "Robinson Bros." The subscribers (each with one share) are: Mrs. H. Pearson, 37, Park Street, Chorlton-on-Medlock, Manchester; Lily M. Pearson, 37, Park Street, Chorlton-on-Medlock, Manchester; G. J. Robinson, 80, Shrewsbury Street, Brooks Bar, Manchester, engineer. The first directors are: G. Robinson and C. H. Pearson (managing director). Registered office: 3, Carter Street, Greenheys, Manchester.

Cavan Electric Light and Power Co., Ltd. (4,895).—Private company. Registered in Dublin, February 4th. Capital, £4,000 in £1 shares. To carry on the business indicated by the title. The first directors are: H. McCauley, Farnham Hotel, Cavan, hotel proprietor; A. McCarren, Dromkeen, Cavan, pork merchant; J. F. O'Hanlan, "Anglo Celt," Cavan, journalist; R. Cinnamond, Church Street, Cavan, flesher; J. Cullen, New House, Cavan, wine merchant. Secretary: P. Reilly. Registered office: Main Street, Cavan.

Newtownbarry Electric Light Co., Ltd. (4,873).—Private company. Registered in Dublin, January 9th. Capital, £3,000 in £1 shares. To carry on the business indicated by the title. The subscirbers (each with one share) are: G. T. Lewis, Weston, Newtownbarry, draper; D. Lennon, Main Street, Newtownbarry, general merchant. The first directors are: R. W. Hall-Dare, N. Thackery, D. Lennon, D. E. J. Lawlor and G. Lewis. Secretary: G. Lewis. Registered office: Newtownbarry, Co. Wexford.

Turner & Newall, Ltd. (163,992).—Private company. Registered February 12th. Capital, £3,000,000 in £1 shares (not more than 1,000,000 7 per cent. cumulative preference and the remainder ordinary). Objects: To take over the businesses of (a) Turner Brothers Asbestos Co., Ltd. (incorporated in 1899), (b) the Washington Chemical Co., Ltd. (incorporated in 1893), and (c) of Newhalls Insulation Co., Ltd. (incorporated in 1908), and to carry on the business of manufacturers of and dealers in asbestos, cotton, rubber goods, belting, packings, fire appliances, boiler and pipe coverings, &c. The subscribers (each with one share) are: Sir Samuel Turner, Chaseley, Rochdale; F. S. Newall, Castle Hill, Wylam, Northumberland, chemical manufacturer. The first directors are: Sir Samuel Turner, F. S. Newall, R. Turner, G. S. Newall, C. H. Turner, S. Turner, jun., and H. R. Turner. Solicitor: G. L. Collins, Lower Gates, Rochdale.

Chiswick Ignition Works, Ltd. (164,011).—Private company. Registered February 13th. Capital, £1,000 in £1 shares. To carry on the business of electrical engineers and contractors, &c., and to enter into an agreement with L. H. Lamkin. The subscribers (each with one share) are: L. H. Lamkin, 42, Durham Road, South Ealing, W.5, electrical engineer; F. Hales, 121, Harthani Road, Isleworth, clerk. The first directors are not named. Solicitor: J. A. T. Good, 40, Chancery Lane, W.C.

Electric Fires, Ltd. (164,072).—Private company. Registered February 14th. Capital, £10,000 in 4,000 10 per cent. cumulative preference and 5,900 ordinary shares of £1 each and 2,000 founders' shares of 1s. each. To acquire and turn to account any inventions relating to electrical or other fires, radiators, stoves, &c. Life directors: C. H. Smith, 32, Parliament Hill, N.W., electrical engineer; F. L. Newhouse, The Old Farm House, West Runton, Norfolk, manufacturer. Solicitor: J. N. Watts, 55 and 56, Chancery Lane, W.C.

P.S.C. Co., Ltd. (164,124).—Private company. Registered February 16th. Capital, £3,000 in £1 shares (1,000 cumulative preference). To carry on the business of electrical engineers, agents for commutator bar copper and other requisites for the engineering and allied trades. The subscribers (each with one share) are: Major P. Garton, Inglenook, Gerrards Cross, Bucks; Capt. J. M. Campbell, 37, Queen's Club Gardens, S.W.7. The first directors are: Major P. Garton, Capt. J. M. Campbell, Major A. P. Reed and Major C. Suckling. Registered office: 64, Victoria Street, Westminster, S.W.

Anerley Engineering Works, Ltd. (164,245).—Private company Registered February 19th. Capital, £500 in £1 shares. To carry on the business of electrical and general engineers and contractors, &c. The subscribers (each with one share) are: E. Harrison, R.A.C. Club, Pall Mall, S.W., engineer; W. Baines, Broad Street House, E.C.2, clerk. The first directors are: E. Harrison, G. Harrison and E. Reyd. Registered office: 97, Anerley Road, S.E.20.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Dartmoor Electric Supply Co., Ltd.—Issue registered January 30th, 1920, of £600 debentures, part of a series of £5,000 already registered.

Hall Pearn & Co., Ltd.—Mortgage on land and premises in Water Street and Back Water Street, Manchester, subject to certain rent charges, registered January 29th, 1920, to secure £3,600. Holder: G. A. T. Jesson, Endsley, Swinton.

Sheerness & District Electric Power & Traction Co., Ltd.—Satisfaction registered January 20th, 1920, to the extent of £200, balance of charge registered February 15th, 1915.

North Wales Power & Traction Co., Ltd.—Particulars filed January 20th, 1920 (by permission of Court) of £250,000 debentures charged on land and hereditaments, and the company's undertaking and property, present and future, including uncalled capital, amount of present issue being £200,000.

Creed & Co., Ltd.—Mortgage on 1, 2 and 3, Addiscombe Road, Croydon, registered January 22nd, 1920, to secure £3,000. Holder: Dr. H. W. Drew, Blatchington, Seaford.

CITY NOTES.

London Electric Supply Corporation, Ltd.

Mr. R. H. Benson presided at the annual meeting on February 20th. He said the present was a crucial moment in the fortunes of the electrical industry; its future as always, was a political question. The speaker gave an interesting review of the pioneering work and the difficulties of the early years of the Deptford undertaking. He said that the value of the pioneering enterprise of the companies could never be overestimated. Municipalities followed, and obtained provisional orders, and in some cases actually competed with the companies. He hoped that at last all the undertakers, whether companies or local authorities, would work together in unison to supply cheap power and plenty of it under the new Act. If we had kept the lead that we had in 1888 the German A.E.G. and the American G.E.C. might have been secondary concerns to-day, or at least Great Britain might have kept abreast and furnished electrical plant to the world as well as to our industries at home. As matters stood, they had several times had to go abroad for their plant; and even to-day British makers could not accept orders, and it was necessary to go to Switzerland. The speaker went on to inquire why Britain lost the lead, and he blamed Parliament. He discussed the position of power supply in the London district. In order to enable all the London companies to pool their resources and experience, a little company called The London Electricity (Joint Committee) 1920, Ltd., had been registered. This was an outcome of the Electricity Supply Bill. At a moment when economy in public finance was imperative, the feeling prevailed that, apart from the improvidence of dismembering existing organisations and scrapping technical and local experience, the Treasury might well be appalled at the prospect of having to find £200,000,000 or more for compulsory purchase of existing plant and development of super-stations up and down the country, especially at the moment when confronted with vast expenditure for housing. In the London district alone the value of existing plant might perhaps be put at £23,000,000, and it was probable that as much again could well be spent in the course of the next ten years. The financial problem of finding the money in such a way as not to be a burden to the State, but a positive source of revenue, and a contribution to the relief of taxation, was, in his opinion, not insoluble. Success depended on two main things: (1) increased output of power and no handicaps; (2) the restoration of the credit of the industry and active support at Westminster instead of harassing conditions. It was the first rule of finance to make the best possible security, to be absorbed by the savings of the public, from the well-to-do down to the humblest.

London Underground Electric Railways.

Lord Ashfield (chairman and managing director) presided at the meeting of the London Electric Railway Co. and the Metropolitan District Railway, on February 19th. At the former, he said he hoped that before long they would be able to sufficiently advance fares to avoid further need for the Government subsidy, and to ensure that the stability of their undertakings should be maintained. The increase in gross receipts was £261,495, but the expenses advanced by £244,308. The purchase of 40 new carriages had been authorised during the year. The cost of this rolling stock, which was similar to that now in use, was £177,700, which was about 240 per cent. more than in 1913. A further £28,000 expenditure on capital account included £28,000 for equipping lifts with landing control. They had not been able to undertake further necessary and substantial improvements because of the present very unsatisfactory results from operation of the undertaking. Speaking of the aggregate results of the five companies, the speaker said that on a total capital of £20,113,420 there was a balance of only £496,387 available for dividend. The subsidy of £566,370 from the Government must some day be wiped away, and increased revenue from passengers must

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take the place of that subsidy. In none of the five companies were they able to set aside sufficient to meet depreciation in the value of the rolling stock and equipment, especially when they took into account the enormously enhanced prices. If those allowances were made they had failed to earn sufficient to meet their actual charges without any dividend margin. To have provided enough to pay their expenses and a very modest return of 4 per cent., the public would have had to pay £1,274,629 in increased fares. Lord Ashfield proceeded to give figures to illustrate the advances in costs since 1913. The ratio of working expenses to gross receipts to-day was higher than in 1919, and they were confronted with demands for further increases in wages. In their Bill they were asking for power to charge such fares as would secure a revenue that would maintain the stability of the undertakings.

Speaking at the meeting of the Metropolitan District Railway, Lord Ashfield said that the arrangement between the five companies had been described as an "unholy alliance," and harmful to the public interests. He disagreed. The object of the arrangement was to give temporary assistance to any one of the companies which might meet with a period of adversity. If it were brought to an end it would not prove to anybody's advantage. He could not believe that the Government would go on indefinitely paying a subsidy to secure to the London public a system of transport the costs of which were greater than the revenue received from the passengers. They had on each passenger an actual loss of .07d., and if they had regard to the necessity for making adequate allowance for depreciation and for the increased cost of all equipment, and were to pay 4 per cent. return, the actual loss per passenger during 1919 would have been .38d. per passenger. Since the war labour costs had increased by 173 per cent., coal prices by 182 per cent., and petrol by 280 per cent. Their Bill sought power to increase the maximum charges and to abolish the workman's fares. It should not be the responsibility of the companies to determine whether or not any particular section of the community should be carried at the expense of another section. On the average fare paid by a workman for a single journey last year there was a loss of nearly one halfpenny on the average cost of a journey. Somebody else had to make that difference good.

On February 20th Lord Ashfield presided at the meeting of the City & South London Railway. He said that on that railway they had during the rush hours of traffic practically reached the point of saturation, and substantial improvement in earnings could not be effected through any increase in passengers carried. They had spent during the year £22,300 upon various improvements which formed part of an expenditure of £2,300,000, which though a public need, could not be carried out until the financial position of the undertaking improved. They had powers to raise fares, but were not acting on them, because they were waiting to join in with a general scheme, in the hope that there would be established in London a system of fares more or less upon a uniform basis.

On the same day Lord Ashfield also presided at the meeting of the Central London Railway. He referred to the advancing expenses, and to the new demands, which together led to their seeking Parliamentary powers to increase the maximum charges. He also mentioned the new powers that are being sought to extend the railway from Shepherd's Bush to form a junction with the L. & S.W. Railway.

German Companies.

The Fabrik Isolierter Drahte vorm. Vogel, of Berlin, reports gross profits of 5,030,000 marks for 1918-19, as compared with 4,480,000 marks in the preceding year. After writing off depreciation the net profits amount to 1,780,000 marks, as against 2,720,000 marks, and the dividend is at the rate of 18 per cent., as in 1917-18. It is proposed to increase the share capital by 4,000,000 marks to 11,500,000 marks.

The accounts of the Elektrowerke A.G., of Berlin, whose share and loan capital is held by the Government, have just been issued for the year ended March 31st, 1919. The company's works are built on the Golpa lignite fields, and supply energy to the Imperial nitrogen works at Piesteritz. After meeting general expenses, interest charges, &c., the accounts show gross profits of 2,003,000 marks, which sum has been written off for depreciation, as against 227,000 marks applied to that purpose in 1917-18.

The directors of the Elektrische Licht und Kraft Anlagen, A.G., of Berlin, reporting on the year 1918-19, state that the situation of the company would justify favourable hopes were it not for the fact that the increase on the loan of 8,000,000 marks raised in 1907 was also payable in Swiss francs and redeemable in 1927. The payment of interest in francs had so prejudiced the otherwise satisfactory results for 1918-19 that it was impossible to distribute any dividend, which was also the case in the preceding year.

The report of the Telephonfabrik A.G. vorm. J. Berliner, of Hanover, states that the working results in 1918-19 were unfavourably influenced through the circumstance that the worst period of the crisis took place in the year. The factory at Olmutz was sold, but no reliable information was available concerning the works at Budapesth. After making provision for depreciation the accounts show net profits of 678,000 marks, as compared with 1,194,000 marks in 1917-18, and the dividend is at the rate of 6 per cent., as against 10 per cent. in the previous year.

Fife Tramway, Light & Power Co., Ltd.—Presiding at the annual ordinary meeting, held in Edinburgh, Mr. Wm. Low, LL.D., O.B.E., submitted figures showing that the profits of the company had steadily increased every year until last year they came to £43,501, compared with £38,652 in the previous year, and £30,577 in 1917. The figures, he said, were very satisfactory, particularly in view of the fact that the company was not assisted by any special war contracts. The power company was making steady progress, the total units sold during the year amounting to 14,891,112, being an increase of 2,600,000 units compared with the previous year. The gross receipts from the sale of electricity amounted to approximately £73,560, as compared with £53,160, but the company did not obtain the full benefit of the increased business owing to costs rising rapidly and the increased charge to the consumer lagging behind the increased costs. There were over 300 applicants on the waiting list, totalling something like 3,000 H.P. The dividend on the ordinary shares is at the rate of 8 per cent. per annum.

City of London Electric Lighting Co., Ltd.—Dividend on the company's preference shares for 1919, 12s. per share, being at the full rate of 6 per cent. per annum; and on the ordinary shares, 20s. per share, being at the rate of 10 per cent. per annum. In addition the directors recommend a bonus of 6s. per ordinary share, being the equivalent of 3 per cent. on account of reductions of dividends during the war, thus restoring the rate of dividend paid for 1914 and 1915 to the pre-war rate of 10 per cent., leaving the reductions in 1916, 1917, and 1918 to be dealt with in the future. This bonus will also be subject to the deduction of income tax. After the payment of the dividends and bonus, less income tax, and providing for other appropriations, about £23,000 remains to be carried forward.

Oxford Electric Co., Ltd.—Net revenue for 1919, including £200 brought forward, £10,065. Debenture and sundry interest £2,126; 5 per cent. dividend on preference capital; 5 per cent., less income tax, on ordinary shares; carried forward £188. The improvement in local commercial conditions consequent upon the resumption of academic life resulted in an increased output during the last quarter of the year. It is expected that the improvement will be maintained. The new business obtained has been quite satisfactory. Capital expenditure during the war has been met almost entirely out of revenue, but in order that profits may be distributed and funds provided for plant and machinery to meet the anticipated increased demand this policy cannot be continued any longer; an issue of capital will therefore be made in the near future.

Torquay Tramways Co., Ltd.—Total profit for 1919 £33,248, against £27,178 for 1918. After deducting debenture interest and sinking funds, &c., the balance is £25,548, plus £2,904 brought forward. To reserve and renewals £10,000; reserve for equalisation of dividends £3,000; 8 per cent. dividend on ordinary shares, £9,600; carried forward, subject to excess profits duty, £5,786. Ten motor omnibuses on order should be delivered shortly. Passengers carried 6,571,441, against 5,729,073 in 1918. Car miles run 561,522, against 578,768 in 1918. Average receipts per car mile 23.71d., against 19.60d. in 1918. Average receipts per passenger, 2.03d., against 1.98d. in 1918. Cost of energy per car mile 2.62d., against 2.24d. in 1918.

Cambridge Electric Supply Co., Ltd.—For 1919 there was a total profit of £8,657 plus £2,552 brought forward. Debenture and other interest absorb £1,866, depreciation fund £2,500, 5 per cent. dividend is to be paid, and £2,382 carried forward. Further money must be raised to provide for mains extensions, &c. The remaining £1 per share on 9,911 shares is to be called up and a further £10,000 is to be raised by the issue of debentures for a period of 10 years, carrying interest at 7½ per cent. per annum. The offer will first be made to the shareholders. Mr. D. Munsey has resigned, after 27 years as a director, owing to advancing years.

Automatic Telephone Manufacturing Co., Ltd.—The company announces that assents having been received from the shareholders for exchange of the requisite number of shares, the directors are completing the transaction mentioned in the company's circular letter dated February 7th, 1920. The option offered to the shareholders to exchange their present shares for shares in the new company will remain open until after the annual general meeting, which will be held as early as possible in March.

Mersey Railway Co.—For 1919 the amount available for payment of interest is £18,113. Interest on new first perpetual debenture stock £26,775. Interest 4 per cent. on 1866, 3 per cent. on 1871, 3 per cent. on 1882/3/5, and 1 per cent on the B debenture stock. Carried forward £60. The company is applying to Parliament for an extension of five years of the period during which the payment of interest on certain of the debenture shocks is contingent on the available net revenue of the company.

Charing Cross, West End & City Electricity Supply Co., Ltd.—Dividend on the ordinary share capital of the West End undertakings for the half-year ended December 31st, 1919, at the rate of 5s. per share, making, with the interim dividend already distributed, 7 per cent. for the year 1919.

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Lancashire United Tramways Co.—During 1919 the combined traffic receipts of the operating companies amounted to £194,987, and electrical energy sold and miscellaneous receipts to £22,105; total £217,092; less working expenses, £128,586; cost of generating electrical energy sold, £16,621; general charges, £9,066; rent of leased lines, £5,191; total £159,464, leaving £57,628, to which must be added the dividend on holding in the New St. Helens and District Tramways Co., £3,068, giving a profit on the combined undertakings f £60,696. The receipts show an increase of £35,051. The increase in expenditure amounted to £41,798. The 25 motor coaches mentioned in last year's report are in service. The results were so satisfactory that the directors have decided to extend this side of the undertaking, and have put on order a further 30 vehicles. The interest and dividends received from the operating companies, together with motor coach and sundry receipts, amounted to £37,965. After deducting interest on the prior lien debenture stock and expenses, the full interest of 5 per cent., less tax, will be paid on the second mortgage debenture stock for 1919. £7,219 remaining is carried to depreciation account.

St. James' & Pall Mall Electric Light Co., Ltd.—During 1919 connections were increased from 18,114 KW. to 18,902 KW.; 12,190,175 units were supplied to consumers. Net profits £35,001, plus £4,576 brought forward. After paying 7 per cent. on the preference shares and 12 per cent. on the ordinary, £8,577 is to be carried forward. The report makes reference to the Electricity Supply Bill, in the same terms as in the case of the report of the Westminster Electric Supply Corporation (see ELEC. REV., February 20th). Units generated by steam plant 395,545; purchased 15,860,440=16,255,985; consumed as follows: Private supply, 12,190,175; works, 249,743; batteries, 199,834; transmission and transformation, 2,905,054; distribution, &c., 711,179.

Stock Exchange Notices.—The Committee has ordered the undermentioned to be officially quoted:—

Chili Telephone Co., Ltd.—11,000 shares of £5 each, fully paid.

Electro-Bleach & By-Products, Ltd.—Ordinary shares of 10s. each, fully paid; and 7 per cent. participating preference shares of £1 each, fully paid.

Melbourne Electric Supply Co., Ltd.—Seven per cent. first cumulative preference shares of £1 each.

Smithfield Markets Electric Supply Co., Ltd.—Gross profit for 1919 £6,588, against £470, and the net profit £5,464, against a loss of £1,749 last year. £2,000 to depreciation fund, £400 to debenture stock redemption fund. After deducting the balance at debit of profit and loss account at the end of 1918, the balance is £2,529, out of which 2 per cent. is to be paid on the ordinary shares and £1,329 is carried forward. There has been a gradual improvement in the trading conditions in the Central Markets which is reflected in the larger output of current.

Traction and Power Securities Co., Ltd.—The net revenue for 1919, after deducting expenses, amounted to £30,793, plus £10,033 brought forward. Dividend at the rate of 7s. per share, free of tax, leaving £10,932 to be carried forward. The Clyde Valley Electrical Power Co. has paid dividends aggregating 5 per cent. on its ordinary shares during the year. The ordinary shares are worth more than the price at which they stand in the books of the company.

Liverpool Overhead Railway Co.—Gross revenue receipts for 1919 £172,104; working expenses, including appropriation to reserve, £141,273. Passengers carried 22,440,103, as against 20,880,235 in 1918. Debenture interest £6,755; balance brought forward £6,120; dividend 5 per cent. on the two classes of preference shares, and 3¼ per cent. for the year on the ordinary; £6,015 carried forward.

Chelsea Electricity Supply Co., Ltd.—Dividend on the ordinary shares at the rate of 5 per cent. per annum for the half-year, making 4 per cent. for the year; £16,688 to depreciation; £1,089 written off cost of extinction of founders' shares; £1,500 carried forward.

City of Buenos Ayres Tramways Co., Ltd.—Final dividend of 1s. 3d. per share for 1919, making 5 per cent. for the year, less tax. £6,200 to general amortisation fund; £138 carried forward.

County of London Electric Supply Co., Ltd.—Final dividend at the rate of 11 per cent. per annum on the ordinary shares, making 8 per cent. for the year (increase of 1 per cent. over 1918); £50,000 to depreciation; £45,000 to general reserve; £19,000 to be carried forward.

Company to be Struck off the Register.—The following is to be struck off the Register within three months unless cause is shown to the contrary:—

Faringdon Electric Light & Power Co., Ltd.

Kensington & Knightsbridge Electric Lighting Co., Ltd.—Dividend of 4½ per cent. on ordinary shares for the last half of 1919, making 7 per cent. for the year.

Mather & Platt, Ltd.—Dividend 10 per cent. per annum, free of tax. This is on the increased capital; calculated upon the old capital the rate is equal to 17½ per cent.

Telegraph Construction & Maintenance Co., Ltd.—A further dividend of 7½ per cent. is announced.

Tramways Light & Power Co.—After meeting loan and debenture charges and paying the preference dividend, a dividend at the rate of 7 per cent. per annum is to be paid for the half-year July to December, 1919, on the ordinary stock. To reserve £10,000; carried forward £3,833. Large extensions to plant and mains are now in progress in connection with the power companies, and to meet the cost additional ordinary stock is to be issued.

Direct West India Cable Co., Ltd.—Interim dividend at the rate of 6 per cent. per annum, free of tax, on the ordinary shares, for the past half-year.

Halifax & Bermudas Cable Co., Ltd.—Interim dividend at the rate of 6 per cent. per annum, free of tax, on the ordinary shares, for the past half-year.

South London Electric Supply Corporation, Ltd.—Final dividend at the rate of 8 per cent. per annum for the half-year on the ordinary shares, making 6 per cent. for the year.

Newcastle-upon-Tyne Electric Supply Co.—Total dividend on the ordinary shares for 1919—8 per cent.

Hadfields, Ltd.—Further dividend of 1s. 6d. per share, free of tax, on the ordinary shares.

STOCKS AND SHARES.

TUESDAY EVENING.

STOCK EXCHANGE markets have been overcast, and rather badly, by anticipations of a rise this week in the Bank Rate. As the matter will be decided before these notes are in the hands of readers, it is not much use attempting prophecies. Banks are known to be averse at the present time from lending fresh money on speculative shares—indeed, they do not seem to be eager to lend money at all, the reason being doubtless the fact that trade requirements are regarded as having the first claim upon loanable capital, and with the Government no longer creating credit at the rate which it did during the war, there is some indication of a shortage of capital. This has its influence throughout all the markets of the Stock Exchange. It depresses the gilt-edged stocks, from the War Loan downwards, and the sharp reminder to operators that they must no longer rely upon ready assistance from the banks in financing their commitments has caused a fair amount of selling. The markets with which we deal in these columns are not much affected, except indirectly. The electric lighting dividends are good, and would probably have proved favourable had it not been for the depression which is overhanging the Stock Exchange as a whole.

The Metropolitan Electric Supply dividend, making 6 per cent. for the year against 5 per cent. in 1918, caused the price to stiffen to £4. The Chelsea dividend of 5 per cent., making 4 per cent. for the year, also an increase of 1 per cent., has had no effect upon the quotation, which remains at 3¼. The County dividend, in spite of being better, is regarded as a trifle disappointing, and the price of the shares slipped back to 9½, showing a fall of 5s. Other electric lighting shares are unchanged on the week. Amongst the prior-charge issues, County debenture at 77¼ is ¼ lower, which is due, of course, to the dulness of the Consol market. The manufacturing group is quiet. Interest is taken in the forthcoming new issue by the General Electric Co. Edisons, after being 26s. 3d., reacted to 25s. middle, although there are buyers at this price. India-Rubber shares stiffened to 16, and Siemens are a good market at 30s. 6d. British Insulated dropped back sharply to 2 1-16. Automatic Telephones are about 20s., with little doing in them. A further rise in British Aluminiums lifted the price to 37s. middle.

Central London Assented ordinary has fallen another four points, making seven in the course of a fortnight, and this has brought the yield on the stock into nearer line with other Home Railway issues. Business has been done as low as 50 within the last few days. Districts are flat at 18. Underground Income bonds are 2 lower at 76; the £10 shares have receded to 2¾.

Mexico Tramways 5 per cent. bonds are down 5 points at 37½. Mexican Light and Power preferred lost 2¼ to 32¼. These falls are the more disappointing because of fairly substantial rises which have occurred in Mexican Railway stocks just lately. Another department in which activity and strength were noticeable until the money fears arose was that for Argentine Railway and Land descriptions, but the advances failed to spread to the tramway group, where the only movement is ⅛ rise in Anglo-Argentine Tramways first preference. British Columbia Electric Railway 4½ per cent. debenture is 1½ down. Bombay Tramways continue their amazing flight. In the £10 ordinary shares there was not a solitary deal recorded between one at 101 and the next, the other day, at 145. The preference have put on 30s. at 18½. Whatever the real reason for these extraordinary prices may be, the secret is certainly well preserved. Brazilian Tractions remain at 54, although within the past few days there has been speculative buying on the part of people who usually know what they are about, and who are content to lock up money for a few months, if necessary, in order to take substantial profits in the future.

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Marconis dropped nearly 10s. to 3¾, on sales said to come from Italy. (They always say this in the Stock Exchange when Marconis fall back.) A point rally from the worst has made the price 3 13-16. American Marconis remained firm at 29s., but Marines came on offer at 2¾. Great Northern Telegraphs shed another £1. With the rate of exchange moving in favour of the Scandinavian and adjacent countries, the recent flatness of Great Northerns should be checked. Western Telegraphs are 20s. higher at 21½, this being the only change in their own particular group. The Anglo-Americans are rather lower. Telegraph Constructions lost 10s., there being a little disappointment at the dividend proving to be 7½ per cent., making 10 per cent. for the year, the same as that paid previously. Henley's at 2½ are the turn easier.

Rubber shares are amongst the few that oppose firmness to the prevailing dull tendency in Stock Exchange markets. An impression is current that it will not be long before the price of the raw stuff takes a sharp upward turn, of which, however, there is no indication at present. The Americans are declared to be buying as much as they are able to do without disturbance of the price for the produce. Iron, steel and armament shares are better on persistent rumours of amalgamations, upon a strikingly large scale, amongst various companies in the North and in the Midlands. This consideration has assisted the maintenance of steadiness in engineering shares also.

Before the end of the week it may be that the Yorkshire Electric Power Co. prospectus will be published. The underwriting advance proof states that the company is about to issue £230,000 5½ per cent. redeemable debenture stock at 88, repayable at 100 on December 31st, 1944, at latest, and in addition 40,000 ordinary shares of £10 each at par.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1917.	Dividend 1918.	Price Feb. 24, 1920.	Rise or fall.	Yield p.c.
Home Electricity Companies.					
Brompton Ordinary	10	8	6½	—	£6 7 0
Charing Cross Ordinary	4	4	8⅝	—	5 6 8
do. do. do 4½ Pref.	4½	4½	2⅝	—	8 8 8
Chelsea	5	5	8½	—	6 8 1
City of London	8	8	14	+ ½	7 2 10
do. do. 6 per cent. Pref.	6	6	9⅝	— ⅛	6 4 8
County of London	7	7	9½	— ¼	8 4 2
do do. 6 per cent. Pref.	6	6	9	—	6 13 4
Kensington Ordinary	7	6	5½	—	5 14 3
London Electric	Nil	Nil	1⅝	—	
do. do. 6 per cent. Pref.	6	6	8½	—	8 11 6
Metropolitan	4	5	4	+ ⅛	7 10 0
do. 4½ per cent. Pref.	4½	4½	2⅞	—	7 16 6
St. James' and Pall Mall	9	10	6½	—	7 13 10
South London	5	5	2⅝	—	7 12 8
South Metropolitan Pref.	7	7	1	—	7 0 0
Westminster Ordinary	9	8	6	—	8 6 8
Telegraphs and Telephones.					
Anglo-Am. Tel. Pref.	6	6	91½	—1	6 10 3
do. Def.	1½	33/6	20½	— ⅛	7 6 4
Chile Telephone	8	8	6½	—	*1 13 2
Cuba Sub. Ord.	7	7	10⅜	—	*6 18 4
Eastern Extension	8	8	20	—	*5 0 0
Eastern Tel. Ord.	8	8	195	—	*5 2 7
Globe Tel. and T. Ord.	7	8	20	—	*4 18 6
do. do. Pref.	6	6	9⅜	—	6 4 8
Great Northern Tel.	22	22	23½	—1	8 17 6
Indo-European	18	18	48½	—	6 18 4
Marconi	20	25	3⅛	— ⅜	6 11 7
Oriental Telephone Ord.	15	10	2⅛	—	4 16 0
United R. Plate Tel.	8	8	8⅛	—	*4 19 3
West India and Panama	1/8	1/8	1½	—	5 11 1
Western Telegraph	8	8	21½	+1	*4 13 0
Home Rails.					
Central London Ord. Assented	4	4	51½	—4	7 15 4
Metropolitan	1	1½	23	—	5 8 8
do. District	Nil	Nil	18	— 1	Nil
Underground Electric Ordinary	Nil	Nil	2⅜	+ ⅛	Nil
do. do. "A"	Nil	Nil	7/-	—	Nil
do. do. Income	4	5	76	—2	—
Foreign Trams, &c.					
Adelaide Sup. 6 per cent. Pref.	6	6	87½	—	7 14 10
Anglo-Arg. Trams. First Pref.	5½	Nil	3⅜	—	—
do. do. 2nd Pref.	—	—	8⅜	—	—
do. do. 5 Deb.	5	5	63½	—	7 15 0
Brazil Tractions	—	—	5⅝	—	—
Bombay Electric Pref.	6	6	18½	+1½	8 4 10
British Columbia Elec. Rly. Pfce.	5	5	64	—	7 15 0
do. do. Preferrred	Nil	2½	56xd	—	8 18 6
do. do. Deferred	Nil	Nil	48xd	—	6 10 5
do. do. Deb.	4½	4½	62½	—1½	6 18 3
Mexico Trams 5 per cent. Bonds	Nil	Nil	37½	—5	Nil
do. 6 per cent. Bonds	Nil	Nil	83½	—	Nil
Mexican Light Common	Nil	Nil	22½	—	Nil
do. Pref.	Nil	Nil	32½	—2½	Nil
do. 1st Bonds	Nil	Nil	52½	—	—
Manufacturing Companies.					
Babcock & Wilcox	15	15	8⅝	—	*4 2 9
British Aluminium Ord.	10	10	1⅝	+ 1/16	5 8 8
British Insulated Ord.	25	12½	2⅛	— ⅛	6 1 1
Callenders	25	25	9⅝	—	6 9 10
,, 6½ Pref.	5	6½	4⅜	—	6 16 10
Castner-Kellner	25	20	4	—	—
Crompton Ord.	7	10	22/6	—	8 17 10
Edison-Swan, "A"	—	10	1¼	—	8 0 0
do. do. 5 per cent. Deb.	4	5	79½	—	6 5 9
Electric Construction	10	10	1¼	—	8 0 0
Gen. Elec. Pref.	6	6½	19/6	—	6 13 4
do. Ord.	10	10	2½	—	*4 9 0
Henley	25	25	2½	— ⅛	5 0 0
do. 4½ Pref.	4½	4½	3⅝	—	6 4 2
India-Rubber	10	10	16	+ ⅛	*6 5 0
Met.-Vickers Pref.	—	—	8⅞	—	5 0 4
Siemens Ord.	—	10	30/6	+6d.	*6 11 2
Telegraph Con.	20	20	29	— ⅛	*4 2 8

* Dividends paid free of Income Tax.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Tuesday, February 24th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Oxalic	per lb.	1/5	...
a Ammoniac Sal	per ton	£96	...
a Ammonia, Muriate (large crystal)	,,	£75	...
a Bisulphide of Carbon	,,	...	...
a Borax	,,	£42	...
a Copper Sulphate	,,	£51	...
a Potash, Chlorate	per lb.	11d.	...
a ,, Perchlorate	,,	1/8	...
a Shellac	per cwt.	£44	...
a Sulphate of Magnesia	per ton	£15	...
a Sulphur, Sublimed Flowers	,,	£28	...
a ,, Lump	,,	£25	...
a Soda, Chlorate	per lb.	6d.	...
a ,, Crystals	per ton	170/-	...
a Sodium Bichromate, casks	per lb.	...	...
METALS, &c.			
g Babbitt's Metal Ingots	per ton	£118 to £345	
c Brass (rolled metal 2" to 12" basis)	per lb.	1/4	...
c ,, Tubes (solid drawn)	,,	1/7½ to 1/7¾	...
c ,, Wire, basis	,,	1/4⅜	...
c Copper Tubes (solid drawn)	,,	1/10	...
g ,, Bars (best selected)	per ton	£173	£2 inc.
g ,, Sheet	,,	£173	£2 inc.
g ,, Rod	,,	£178	£1 inc.
d ,, (Electrolytic) Bars	,,	£130	£2 dec.
d ,, ,, Sheets	,,	£156	...
d ,, ,, Wire Rods	,,	£145	£2 dec.
d ,, ,, H.C. Wire	per lb.	1/5½	½d. dec.
f Ebonite Rod	,,	3/-	...
f ,, Sheet	,,	2/6	...
n German Silver Wire	,,	3/-	...
h Gutta-percha, fine	,,	18/-	...
h India-rubber, Para fine	,,	2/7	...
i Iron Pig (Cleveland Warrants)	per ton	Nom.	...
l ,, Wire, galv. No. 8, P.O. qual.	,,	£52 10/-	£4 inc.
g Lead, English Pig	,,	£53 5/-	45/- inc.
g Mercury	per bot.	£24 10/- to £25	£2 to £2 10/- inc.
e Mica (in original cases) small	per lb.	6d. to 4/6	...
e ,, ,, ,, medium	,,	5/- to 10/-	...
e ,, ,, ,, large	,,	12/6 to 25/- & up	...
g Phosphor Bronze, plain castings	,,	1/8 to 2/-	...
g ,, ,, rolled bars and rods	,,	2/2 to 2/6	...
g ,, ,, rolled strip & sheet	,,	2/3 to 2/9	...
d Silicium Bronze Wire	per lb.	1/11½	½d. dec.
r Steel, Magnet, in bars	,,	1/8	1d. inc.
g Tin, Block (English)	per ton	£413 to £414	£23 inc.
n ,, Wire, Nos. 1 to 16	per lb.	5/5	2d. inc.
White Anti-friction Metals	per ton	£90 to £345	...

Quotations supplied by—

a G. Boor & Co.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
r W. F. Dennis & Co.

A Joint Electricity Authority for Cheshire and Flintshire.—A meeting of local authorities, convened by the Chester Corporation, was held on February 16th, at the Chester Town Hall, to consider a scheme for the formation of an Electricity District and a Joint Electricity Authority for an area extending from Mostyn, in Flintshire, to Tarporley, in Cheshire. The Mayor of Chester presided, and there was a large attendance of delegates. According to the *Observer*, the chairman said he believed the ultimate scheme was to have a group of districts round the North Wales Power Co.'s Station. Mr. E. N. Humphreys, chairman of the Chester Electricity Committee, after explaining the provisions of the Electricity (Supply) Act, said that in July last, Mr. S. E. Britton, electrical engineer to the Chester Corporation, was invited by Sir John Snell to indicate the most suitable area for the North Wales district, and afterwards to convene meetings of the engineers of the various local authorities to discuss the sub-division of the district. Mr. Britton's figures indicated that within the district there was a potential demand of 20,000 H.P., and there was an ample supply of coal and water at hand.

Mr. Britton submitted a map showing the area under consideration, and the larger district embracing the whole of North Wales and part of Cheshire, the latter being the outcome of a suggestion made by Sir John Snell. It was thought that the plant at Queen's Ferry was suitable for the immediate requirements of the district, and the water-power resources of North Wales were far greater than the electrical needs. It was proposed to erect a power station on the Mersey to supply places on both banks, including Birkenhead and Liverpool.

Further consideration of the question was adjourned to a future conference.

An X-ray Victim.—Mr. A. C. Taylor, secretary, dispenser, and radiographer to the Peterborough Infirmary, has fallen a victim to X-ray dermatitis in a virulent form, and is a patient in a private ward of the institution.

Peterborough Infirmary was one of the first hospitals in the country to install Röntgen rays in 1896, and Mr. Taylor both set up and operated the installation.—*The Times.*

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THE PROTECTION OF A.C. SYSTEMS WITHOUT THE USE OF SPECIAL CONDUCTORS.

By Major KENELM EDGCUMBE, R.E.(T.), M.I.E.E.

(*Abstract of paper read before the* Institution of Electrical Engineers.)

(*Concluded from page* 250.)

In interconnectors and ring mains the normal flow of power may be in either direction. In the ring main, fig. 9, the interconnector between the sub-stations S S_1 and S S_2 cannot be controlled by overload relays since it may carry an overload due to a fault between the generating station and S S_1, for example. Nor can reverse relays be used, since the flow f current may be in either direction under quite normal conditions. A simple solution is, however, possible on the following lines. If the ring were open at R_4, power would, under all conditions of load or faults, flow in a clockwise direction, and overload relays with discriminating time-lags installed at R_1, R_2, and R_3 would afford the desired protection in precisely the same way as with independent feeders. If, on the other hand, the ring were open at R_1 the flow of power would always be in a counter-clockwise direction, and overload relays with discriminating time-lags could be installed at R_4, R_5, and R_6. If, now, the ring be completely closed the following conditions hold good no matter on which section the fault occurs: (1) The fault current will always flow through R_1 and R_4 in an outward direction. (2) The relays R_2 and R_3 should be responsive to a clockwise flow of power alone. (3) Relays R_5 and R_6 should be responsive to a counter-clockwise flow of power alone.

If, therefore, overload relays are installed at R_1 and R_4 with reverse relays at R_2, R_3, R_5, and R_6, they can all be so set as to be inoperative except under fault conditions. In fig. 9 the arrows show the direction of flow to which the various relays should be responsive, and the figures in circles indicate suitable short-circuit time settings on the assumption that a minimum interval of half a second is required between successive relays.

When considering a more extensive system involving a ring main, several sub-stations, and two generating stations, it might be considered that the time settings of the relays are somewhat long, and, although in most cases they might very probably be reduced owing to the discrimination afforded by the current settings, in other cases the times might even have to be increased if the circuit breakers were slow in action. To avoid leaving a heavy short-circuit on the system for so long a time, the arrangement already described whereby, should the voltage fall to a predetermined value (say, 70 per cent. of the normal), the time

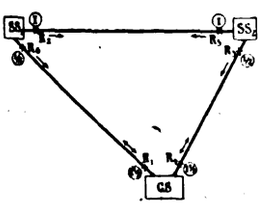

Fig. 9.—Protection of a Ring Composed of Single Feeders.

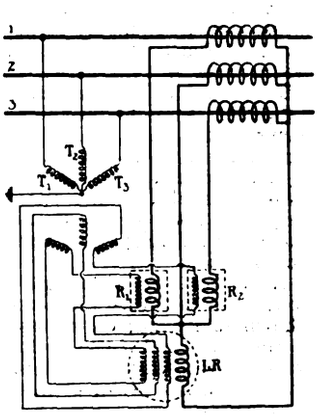

Fig. 10.—Feeder Protection by Combined Overload and Leakage Reverse Relays.

settings are reduced to a lower figure, may usefully be applied to these four relays. By accelerating the time-lags by one second in this way, the maximum possible interval during which a short-circuit could be held would be 1½ seconds.

The reverse relays should be unaffected by a fall of voltage, and be responsive not only to overloads, but also to leakage. Fig. 10 shows such an arrangement. The relays R_1 and R_2 have their current and potential windings connected to phases 1 and 3 respectively, and will consequently respond to overloads or to short-circuits between any of the phases. The leakage relay L R has its current winding in the common return of the current transformers, and is provided with three pressure windings each fed from one of the single-phase potential transformers T_1, T_2, and T_3, the primaries of which are connected in star and earthed. If the insulation of the three mains is perfect, the potential transformers will have equal voltages applied to their primaries, and the resultant flux due to the pressure windings on the leakage relay will be zero. If, however, phase 3, for example, goes to earth, transformer T_3 will have a reduced voltage applied to it, whereas that of T_1 and T_2 will be increased. As a result, the balance will be upset, and there will be a resultant pressure flux in L R in phase with the voltage between line 3 and earth. The leakage current will also be practically in phase with this voltage and will, therefore, cause L R to operate. By this means, relays R_1 and R_2 will deal with overloads whilst relay L R deals with a leakage to earth, and each relay discriminates correctly as regards direction. With such reverse and leakage relays at the sub-station ends of the feeders, overload and leakage relays (fig. 2) may be employed at the generating station ends, but it is often preferable for the sake of uniformity to employ the same relays throughout, and the connections shown in fig. 10 are equally applicable to the outgoing ends.

In many cases the interconnectors forming the ring may be run in parallel, and, in that case, a simple solution is offered by the use of differential relays, fig. 5. A moderate time-lag of, say, ½ sec., is sufficient for all relays. At the generating station ends pure overload relays may be substituted for the differential reverse relays.

In the case of large consumers, the connections amount to what is practically a sub-station, and can be dealt with accordingly. Where the consumer is merely tapped off a feeder his installation should be controlled by overload or, better still, by combined overload and leakage relays with very short time-lags. When a consumer is tapped off a pair of parallel feeders and is able to take power from either feeder at will, reverse relays connected as in fig. 10 afford complete protection if installed at both ends of the section, whether the parallel feeders are independent or form part of a ring main. This arrangement has the further advantage of embodying leakage as well as overload protection.

The protection of generators must be touched upon owing to the effect which it has upon the current capacity of the earthing resistance. Various excellent systems are available, one of the latest being the Merz-Beard, in which the two ends of each generator winding are led through a ring transformer to the secondary of which a relay is connected. The reverse relay, compensated for voltage, forms one of the simplest and most direct methods of generator protection. Most isolating devices, the Merz-Price or Merz-Beard, for example, are only sensitive to an earth or a fault between phases, and will not operate on the occurrence of a short-circuit between turns, or of a mechanical breakdown, or a mistake in paralleling. A reverse relay, on the other hand, will operate under all fault conditions. The fear is sometimes expressed that a heavy cross-current may bring out the generator breaker if controlled by reverse relays. Experience shows, however, that with reasonable current settings and a time-lag of a fraction of a second, such fears are quite groundless. It may be pointed out that although the circulating current between the machines is often considerable, it is very much out of phase with the voltage, and consequently has little tendency to operate the relays. On the other hand, if an actual mistake is made in paralleling, and a generator is connected to the bars, either when dead or when out of phase, the relay will act and prevent damage. In a number of stations, generators are still protected by means of overload relays. Since existing current and potential transformers can in almost all cases be used, the change from overload to reverse-relay control should most certainly be made. Certain patterns of reverse relays can be arranged to operate with an exceptionally heavy forward current accompanied by a fall of pressure. In the case of generator protection this affords a means of isolating the generator in the event of a serious busbar fault. In the author's opinion, it is of even greater importance that the field should be promptly opened than that the generator should be removed from the bars, and the simplicity of having the trip coils of the field and main circuit breakers in series across the relay contacts has much to recommend it.

It is usually possible to connect the neutral points of all the generators to a common bar which is earthed through a resistance. A possible disadvantage of this arrangement is that if the triple harmonic of the wave form is very pronounced a current will circulate between the machines; such circulating currents may be objectionable in their effects upon measuring instruments, &c., and they can be eliminated either by earthing only one generator at a time or by connecting a part of the resistance between each neutral point and the earthing bar, as shown in fig. 11. If the resistances R_1 and R_2 are each made equal to about 15 per cent. of R_3, the triple-frequency current will usually be reduced to perfectly negligible dimensions. Unless a separate resistance is provided for each a switch must be inserted in each earth connection so that dead generators can be disconnected from the earthing bar. If this is not done the dead generators will be "charged" in the event of a fault on the system.

If it is desired to benefit by leakage protection on systems in which the neutral point is not available, those involving delta-wound generators or transformers, for example, it becomes necessary to form an artificial neutral point. The best arrangement is probably a zig-zag connected three-phase

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transformer as shown in fig. 12. Each limb carries two similar windings connected in adjacent phases, one end of each being starred and the remaining ends connected, through earthing resistances E R, to the lines. The small figure on the right shows the relative phase relationships of the six windings. Under normal conditions the current taken is merely the magnetising current of the transformer, but should an earth develop, for example, on the lower phase, a voltage is induced in the windings on limbs 1 and 2 (connected between the faulty phase and earth) by the other two coils on those limbs, which are connected to healthy phases. The current flowing to earth through the fault is limited by the earthing resistance to any desired value.

It is of considerable advantage to have a resistance which is a maximum at the outset, subsequently falling in value so as to equalise the current rush to some extent. An earthing resistance possessing these features is the carbon-powder pattern due to Mr. Brazil, which consists of a number of fireclay troughs containing the powder between carbon terminals. The troughs are mounted one above the other and grouped as may be necessary to give the required resistance

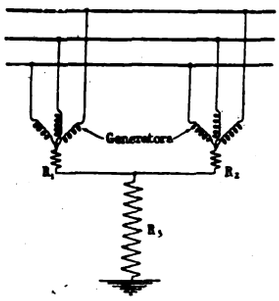

Fig. 11.

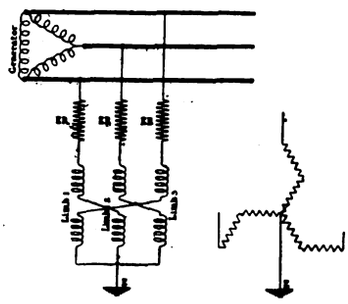

Fig. 12.

Fig. 11.—Neutral Point Earthing.
Fig. 12.—Delta-connected Generator Earthed Through Zig-zag Connected Transformer.

and current-carrying capacity. One of a pair of such resistances, installed at the London and South-Western Railway Co.'s generating station, and each designed to pass 325 amperes at 11,000 volts, after 20 seconds (2,000 K.V.A.), is illustrated in fig. 13.

The flexibility of such resistances will be gathered from fig. 14, in which the curves indicate the growth of current in a single unit when 550, 650, and 750 volts, respectively, are applied to its terminals. The increase of current during a given time is roughly proportional to the square of the applied voltage; and by choosing still lower terminal voltages, resistances can readily be designed capable of being left in circuit for an indefinite period. With such a resistance, a dead earth, even on or near the busbars, will at no time allow the current to exceed that required to operate the relays, so that not only is the shock to the system reduced to a minimum but the breaker opens the circuit at minimum current. The Brazil resistance may be regarded as practically indestructible, in respect of both burnouts and insulation breakdowns, and can be run red hot for an indefinite period, if need be, without danger. It is, moreover, extremely compact. No particular precautions are necessary as regards its installation, and an important feature of the construction lies in the ease with which the units can be regrouped or extended.

In lieu of a resistance in the earth circuit the use of a reactance has been proposed, but such an arrangement suffers from serious disadvantages. The use of a reactance is only permissible when combined with sufficient ohmic resistance to limit the earth current to a small value, that is to say, on systems working with a more or less "floating" neutral. In a modern station running with an earthed neutral the use of a reactance cannot be regarded as a practical proposition.

Whilst it is impossible to lay down any hard and fast rules as regards the current-settings of the relays or the best value for the earthing resistance, since each case must be considered upon its merits, the table below may serve as a guide. In calculating the setting on the lines of column 2, allowance must be made for the distribution of the fault current between parallel feeders, should such exist. In applying the third column it will often be found that the generator protection entails a larger current than the feeders. With differential overload generator protection the current-setting cannot be reduced to a very small value for fear that a want of balance should cause it to operate with a heavy forward current. In this connection the relays might advantageously be given a percentage bias control.

When "straight-through" current transformers are used, as should be the case wherever possible, the value of the current passed by the earthing resistance should not be less than 100 amperes. With an earthing resistance having a negative temperature coefficient the figures given in the last column may be taken as being the initial current. If the resistance has a positive temperature coefficient they must be approximately doubled.

The necessary current for operating the trip coils of the circuit breakers may be derived from any of the following sources: (1) A.C. supplied by a potential transformer. (2) A.C. from a current transformer in the circuit affected. (3) D.C. from a battery or dynamo. (4) D.C. from an A.C.-D.C. machine upon a principle suggested by Mr. F. Ayton.

The first method is to be deprecated unless an entirely independent source of A.C. is available. The application of method 2 is, in point of fact, far from satisfactory. All things considered, this method should only be adopted when no other is possible.

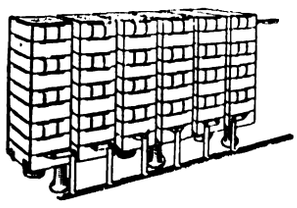

Fig. 13.

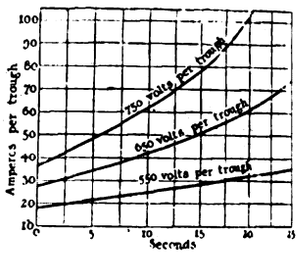

Fig. 14.

Fig. 13.—2,000-kw. 11,000-volt Brazil Earthing Resistance.
Fig. 14.—Growth of Current in Brazil Earthing Resistance.

When method 3 is available, it is by far the best, an accumulator battery being the ideal arrangement. The current derived from an exciter is not to be recommended, since, on the occurrence of a severe fault, the exciters are apt to become unstable.

For sub-stations and other situations where there is no available source of D.C., Mr. F. Ayton, some years ago, suggested to the author a system which might perhaps be called "momentum tripping." The method consists in driving a small D.C. generator from an A.C. motor, the generator serving as a source of energy for actuating the circuit breakers. In order that there might be no possible lack of D.C., even in the event of the failure of the A.C. supply, the set was to be provided with a very heavy flywheel. Calculation shows that the weight of the flywheel required to give an ample reserve of power is by no means excessive. At the same time, ingenious as this proposal is, a storage battery undoubtedly forms the best flywheel.

If accurate time and current settings are to be obtained, it is essential that the current transformer should have the required ratio curve over the working range, and it is advisable for relays and current transformers to be tested in combination.

A method recommended by the Protective Devices Committee of the American Institute of Electrical Engineers, is shown in fig. 15; C T represents the current transformer and R the relay coil. The testing current is applied through a variable resistance V R, to the terminals of the current transformer (which is, of course, dead) at the points P P, which may conveniently take the form of testing sockets. The current flowing through the ammeter A M, is the resultant of that through the relay and the exciting current of the transformer. But the resultant of these two quantities (multiplied by the ratio of the transformer) is equal to the corresponding primary current. Thus it is easy to calculate what current to pass through A M in order to reproduce in the relay R, the current which would flow through it under working conditions for any desired current in the primary.

The current is adjustable by means of the variable resistance V R, and the stop watch W is, preferably, so arranged as to be started by the closing of the testing circuit, and stopped again by the operation of the relay, so that the interval between these two events can be accurately measured.

Form of protection.	Current-setting of relays.	Minimum current in earthing resistance.
Overload as in fig. 2	150% of feeder capacity	150% of capacity of largest feeder
Overload as in fig. 10	150% " "	150% " " "
Differential reverse relay as in fig. 5	70% " "	80% " " "
Differential reverse relay, biased as in fig. 7	20% " "	25% " " "
Leakage relay as in fig. 2	80% of earthing resistance current	20% " " "
Leakage relay as in fig. 10	80% " " "	40% " " "
Merz-Price or Merz-Beard generator protection	50% of generator capacity	70% of capacity of largest generator.
Reverse relay generator protection	25% " "	35% " " "

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This method not only deals with the time and current settings of the relay, but also tests the secondary wiring for short-circuits and continuity and the current transformer for a short-circuit or an earth. After testing a current transformer at a heavy overload in this way, care must be taken to demagnetise it thoroughly by gradually reducing the current to zero.

Protection of current transformers against over-pressures is of considerable importance. The current transformer feeding a relay is, from its position at the end of a line, particularly exposed to damage by surges and steep-fronted waves. The current transformer is the first reactance which such a wave meets as it rushes in from a feeder. In order to avoid a breakdown between turns, the use of straight-through current transformers is to be recommended wherever possible, but on the score of accuracy this cannot well be done if the setting of the relay operated by it is less than 100 amperes. Incidentally, this forms an added reason why measuring in-

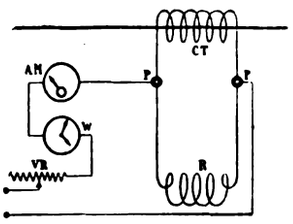

Fig. 15.

Fig. 16.

Fig. 15.—Connections for the Combined Testing of Current Transformer and Relay.
Fig. 16.—Current Transformer Protected Against Damage by Over-pressures.

struments should not be fed from the same current transformers as the relays, since the former have to be accurate from the lower limit of their range upwards, whereas, with the latter, accuracy of ratio is usually immaterially below, say, half load.

Where multi-turn current transformers have to be employed on lines liable to surges—and few can be considered immune—it is advisable to bridge the primary winding by a non-inductive resistance which forms a by-pass for the surge, and thereby relieves the strain between the turns of the winding. Fig. 16 shows such a resistance as applied to a tank-type current transformer. So long as the value of the resistance is adapted to the impedance of the current transformer the accuracy of the latter is not appreciably affected.

Conclusions.

The points which the author has endeavoured to make may be summarised as follows:—

1. In any scheme of protection, continuity of supply should be the first consideration, simplicity the second, and adaptability the third.
2. The neutral points of generators and step-up or step-down transformers should be earthed through a resistance having a negative temperature coefficient.
3. When the neutral point is not available the system can be earthed through a zig-zag transformer and an earthing resistance.
4. In a large number of cases special conductors are out of the question, and any and every part of a distribution system can be protected by overload, reverse or leakage relays in accordance with one or other of three alternative methods as follows: (*a*) For independent single feeders, combined overload and leakage protection with graded inverse time-lags (fig. 2). (*b*) For independent parallel feeders, differential reverse relays with short inverse time-lags (fig. 5). (*c*) A single interconnector between two generating stations can be treated as an independent feeder and protected at each end as in (*a*) above. (*d*) For a ring main consisting of single feeders, combined overload and leakage reverse relays with graded inverse time-lags (fig. 10). (*e*) For interconnectors or ring mains composed of parallel feeders, differential reverse relays with short inverse time-lags (fig. 5). (*f*) Any of the above arrangements can be supplemented by minimum voltage protection at the sub-stations where this seems advisable. (*g*) For the protection of generators running in parallel, voltage compensated reverse relays with short time-lags are effective against all faults, and may be relied upon not to act prematurely.
5. All overload relays must have similar time/current curves, with a definite minimum, independent of the overload.
6. All reverse relays must be compensated for a fall of voltage down to 2 or 3 per cent., and may, in some cases, be required to operate with a heavy current in either direction at zero voltage.
7. Current transformers should be of the straight-through type whenever possible, and should otherwise be protected by a non-inductive shunt of ample current-carrying capacity and specially adjusted to the transformer characteristics.

CONFERENCE OF MANUFACTURERS.

(*Concluded from page* 254.)

Prices and Profits.

The final resolution dealt with on Feb. 10th related to prices and profits, the proposer being Mr. Max Muspratt, of Liverpool, and the seconder Sir Algernon F. Firth, Bart. The view expressed in both speeches was that economic conditions must really be left to right the position, and that artificial aids would not improve the situation. The resolution, upon which there was no discussion, was:—

"That this conference considers that the present high prices of manufactured goods are inevitable so long as demand throughout the world remains so greatly in excess of supply.

"No attempt to fix prices or restrict profits by Government action can improve the situation from the national point of view. If prices are fixed below the world price the home market will be depleted unless export is restricted, while any attempt to restrict export will raise the price of the goods which the country must import from abroad, for it can only pay for these goods with the value of the goods which it exports.

"The only remedy is for the Government to remove as far as possible all restrictions upon trade, and to encourage the greatest possible development of production and distribution through normal channels. High profits are at once the fund from which plant and working capital may be increased, as also the greatest incentive to development, and development of production is the only sure way of reducing prices.

"The conference realises that the conditions now existing are without precedent, and that the peak of prices is probably higher than ever before in the world's history. This condition must inevitably be followed by a reaction, with the probable consequence of depressed trade, an aspect of the question which should receive the most serious consideration of all manufacturers and producers.

"Meanwhile, in order that the public may be enlightened as to the circumstances prevailing in other countries, this conference strongly recommends the Government to publish monthly comparative statements, showing the current prices of the chief commodities in the principal countries of the world; these prices being converted into English currency values at parity, in order to show clearly the relative burdens borne by individual consumers in this country and in other countries."

The first resolution dealt with on the second day (Feb. 11th) was on nationalisation.

Sir Adam Nimmo, who was a member of the Sankey Coal Commission, and issued a minority report, warned his hearers that the move for nationalisation of mines was the first step in a general labour policy for the nationalisation of all the leading industries of the nation, and he urged employers in other industries not to stand aside and watch the result of this particular fight. They should all come to the assistance of the mining industry and fight the movement now, as if it were successful in the case of the mines it would be carried on in relation to other industries, such as railways, shipping, banking, insurance, and so on. Nobody could understand the dictum of Mr. Justice Sankey that the system of private control had broken down, and that it stood condemned. That statement was unsupported by any argument, and it should not be accepted until the whole of the evidence upon which it was based had been investigated. His own contention was that nothing in the history of the country could be pointed to as indicating that the system of private control had broken down. It was the business of the Government to govern, and to look after the general interests and welfare of the people. State conduct of business was not new in the history of the world, but they could not point to a single instance in which it had been successful. The intervention of the State in the coal industry had led to a more or less general paralysis of the industry, and the owners had been prevented from carrying out developments which were essential to the progress of the industry and the other industries of the country. He hoped, therefore, that there would be a plain declaration by the Government that it would not nationalise the mines, because if that were done he believed it would pave the way for the men to arrange with the employers some system whereby they could work the mines in the most efficient manner possible.

Mr. Arthur Pollen, managing director of Linotype, Ltd., seconded the resolution.

Mr. G. W. Mullens (Cold Rolled Brass and Copper Association) moved the following addition to the resolution:—

But the conference recognises the importance of educating our workers and of associating them with us in the responsibilities of industry and will welcome every well thought out experiment to this end, such experiments to be made direct between employers and employed, and may be in single shops or collectively in trades.

He moved this, he said, in order to make some constructive proposal instead of merely saying "No" to the nationalisation proposal. It would go a long way towards removing the suspicion of the workers if the employers showed that in the place of nationalisation they were prepared to co-operate with labour in the manner suggested.

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Mr. Philip H. Lockhart (W. & A. Bates & Co.) seconded the amendment, and recommended employers to establish more works committees under the Whitley scheme. If they did that, they would be surprised at the change in the spirit of their workpeople.

Mr. Bremner (British Engineers' Association) said that the conference displayed the remarkable degree of apathy which existed among employers as compared with the interest, enthusiasm, and energy displayed by labour. Manufacturers would have to co-ordinate their efforts under well equipped and highly skilled leadership. He himself had been greatly disappointed at the results of his own efforts at organisation in this direction, but there was no hope for them unless they did unite and work together.

Lord Gainford suggested that State ownership as well as State control should be embodied in the resolution. The miners were as opposed to State management as the owners, but they wanted State ownership. Then their plans were to manage the mines largely themselves. The Pit Committees which it was proposed to set up had 87½ per cent. of the representation as miners.

After a little discussion it was agreed to adopt Mr. Mullens's addition as a separate resolution.

The resolution on nationalisation was then carried in the following terms:—

That this Conference pledges itself to oppose in the national interest any attempt to impose State ownership or management on any branch of industry.

Transport.

Mr. Marshall Stevens proposed a resolution dealing with transport. He said that since the resolution had been drafted the Ministry of Transport had sent a letter to the Federation stating that it was proposed to set up an inquiry into the details of railway rates, both passenger and goods. That was what the traders of the country had been asking for for years, because it could be shown that merchandise traffic, as such, did not show a loss. The railway accounts did not distinguish between goods and passenger traffic, but their goods rates even before the recent interim revision were the highest in the world, and the Committee of the Federation which had been going into this matter had evidence which would enable them to answer the 15 questions in the letter from the Ministry, almost at once. The matter would be gone into very carefully and a reply forwarded within the time stated, viz., March 15th.

Mr. T. Major (British Empire Producers' Association) seconded the resolution.

Mr. F. Ley (National Association of Iron and Steel Manufacturers) emphasised the importance of the portions of the resolution referring to delays, and instanced cases on the north-east coast where works had to be shut down for considerable periods because of the accumulation of finished steel which could not be transported. There were thousands of tons lying there, and in addition there was the loss entailed by reduced production and loss of wages to the workpeople who had to stand off. He moved an amendment urging upon the Ministry of Transport the establishment of a three-shift day, including Sundays, as a means of reducing the arrears which had accumulated.

This amendment was carried as a separate resolution.

The original resolution was then put and carried in the following form:—

1. That this Conference views with the gravest possible concern the delay in re-establishing efficient working of the railways, and considers that this is largely due to over-centralisation of control in the Ministry of Transport, and the uncertainty as to the future position of the railways.

The Conference considers that it is of the greatest importance that the railways should not be permanently subject to bureaucratic or political control, and urges the Government to reappoint as quickly as possible the Select Committee of 1918 to consider the whole question of the future of the railways.

2. While not wishing to question the necessity of making some increase in railway rates, this Conference desires to protest against the action of the Government in fixing the new increases upon an estimated deficit which circumstances apparently make it impossible to justify by definite figures. This policy has resulted in throwing upon the rates during this critical period, when the cost of living and consequent social instability is increasing almost daily, an estimated deficit which is probably to a large extent due to abnormal and transitory conditions.

This Conference considers that the deficit on the working during the reconstruction period should have been placed to a suspense account; the Government should then have made a careful inquiry into the whole question, giving due consideration to the conditions and requirements of different classes of traffic, and fixed the increase of rates on this basis, with an addition to make good the estimated deficit over a period of years.

3. That this Conference welcomes the decision of the Ministry to proceed immediately with the general revision of rates which has been recommended by the Rates Advisory Council and the invitation which has been extended to the trade organisations affected to submit their views upon the questions involved.

Fuel.

Lord Gainford moved a resolution in connection with the question of fuel supply. This was considerably modified during the course of the discussion, and we give it as it was finally passed:—

That this Conference views with alarm the chaotic condition into which the Government has allowed the coal policy of the country to drift. This has arrested normal development and has most seriously impeded the resettlement of the industry. As a further consequence, the distribution and quality of coal for industry is unsatisfactory. The Conference is convinced that the distribution of the coal required for industry ought to be allowed to follow its natural course in satisfaction of industrial requirements.

In the course of his speech, Lord Gainford complained of the inconvenience which the coal trade had suffered by the imposition of the 6s. increase followed by the 10s. reduction on household fuel and the further increase in the price of household coal. Another serious difficulty had been the increase granted by the Government to the minimum wage, the result being that in many cases the miners were quite content with the minimum wage, and made no very great attempt to send to the surface a quantity of coal in proper relationship to their capacity. Whilst the number of men employed in mines was increasing, the output per man was decreasing, and viewing the whole of the position, he believed that if all Government control was taken off the industry the employers and the men would be able to devise a plan of working which would work amicably. If this were done, he foresaw the possibility of some home industries being short of coal on account of the temptation of the high export price to send coal out of the country instead of supplying it here, but to prevent that he would limit the amount of coal which could be exported. It was, however, impossible to carry on an industry for long under artificial restrictions as to price. The Central Committee of the Mining Association had come to the decision that it was right and proper for a central body to be appointed to consist of owners, miners and representatives of the consuming public in order to place the industry on a sound economic basis.

Mr. W. T. Layton (Federation of Iron and Steel Manufacturers), who seconded the resolution, spoke of the difficulties which the iron and steel trade are experiencing in the matter of fuel, and the manner in which the output of steel is being hampered by the shortage, which difficulties had been accentuated by transport difficulties.

As already stated, the resolution was finally agreed to as set out above.

The following resolutions were also agreed to, but the speeches of the movers and seconders brought out no new facts. We therefore give the terms of the resolutions only:—

Education.

1. That as industrial progress depends on the development of education among all classes of workers, both manual and mental, this Conference welcomes the awakened national interest in the subject, and urges manufacturers to give their practical assistance in the working of the Fisher Act. The Conference, however, regrets that one of the most important requirements of a satisfactory educational scheme, namely, the adequate remuneration of the teaching profession, has not yet been fulfilled.

2. That this Conference fully approves of the efforts being made to introduce university men, and men of similar educational training, into industry.

Research.

That this Conference appreciates the work of the Department of Scientific and Industrial Research in stimulating the work of industrial research, and strongly urges all manufacturers, either individually or collectively by trades, to organise and maintain research facilities.

Housing.

That this Conference welcomes the assistance which is offered to public utility societies by the Housing (Additional Powers) Act, 1919, and urges all manufacturers and producers to consider whether they cannot take advantage of the provisions of the Act, in order to contribute to the solution of this pressing problem.

GAS v. ELECTRICITY.

As reported in the Electrical Review of February 20th, the members of the South Midland Centre of the Institution of Electrical Engineers and the Midland Junior Gas Association took part in a debate upon "The Uses of Gas and Electricity for Heating and Power" at Birmingham University on February 5th.

Dr. E. M. Smith, chief chemist of the Birmingham Gas Department, opening the debate by discussing the utilisation of fuel for the generation of power, said neither industry could, with justice, suggest that there was not room for the other. Nor could either industry suggest that the one or the other should not endeavour to improve its efficiency. In a comparison between the two industries as to the general application of a particular form of power, the questions which presented themselves might be placed in three divisions:—(1) A prospective consumer might ask which was the cheaper form of power; (2) which was the more economical form and which, if extended, would give the greater national return; and (3) which particular form of power was best suited to his needs, taking everything into consideration. Sir Dugald Clerk and others, in a recent report, stated that at present the gas works of the United Kingdom used 20 million tons of coal per annum, producing town gas, tar, and other by-products, with a thermal efficiency of from 70 to 80 per cent. Even regarding gas as the only useful product the consumer received as inflammable gas, at least 50 per cent. of the heat value of the coal. The electric generating stations in the United Kingdom delivered 7.6 per cent.—the actual power lost accounting for 92 per cent. of the total heat. At the best electric generating stations the loss was 88 per cent. Electricians promised for future super-stations a delivery of 17.6 per cent., a loss of 82.4. At present the best existing gas

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practice delivered over 60 per cent. of the heat in the coal used to produce it. In the near future the thermal loss should be reduced to 25 per cent. Except where temperatures above 1,700 deg. were required electricity was extremely wasteful. As to lighting and power production electricity promised results which compared more favourably with gas; but even in this domain the highest over-all efficiency attained by electricity fell behind. Again, the prospective economies in the production of gas, and the advantageous use of the incandescent mantle rendered any point as to monopoly claims, so far as electricity was concerned, quite unjustifiable. There were many considerations, if a just estimate were to be made of the part which gas played in the national economy, and apart from the uses of gas for heating, lighting, and power purposes the question of by-products, which were produced in large quantities, must be considered. The ammonia industry depended largely upon the gas industry, while from gas residuals, fertilisers, high explosives, &c., were obtained, and the indications were that there would be further developments in that direction. By-products from tar included dyes, medicine, scents, &c., as well as fuel oil. It was the practice of progressive gas undertakings to wash the power gas for benzol for motor spirit, and at one of the Birmingham gas works a thousand gallons of benzol were produced. It now appeared that experiments for the production of alcohol from coal gas would be successful, and if that anticipation were realised, it would be obtained in equal quantities to the present quantities of benzol. Lastly, there was the production of cyanide, which was of importance in the work of the colonial gold mines. Dr. Smith, in conclusion, expressed the hope that the debate would have the effect of enabling them better to appreciate the necessity of both industries, from a national point of view, and instructing them upon some matters of value to both.

The speaker for electricity, Mr. F. FORREST, M.I.E.E. (chief assistant engineer, Birmingham Corporation Electric Supply Department), said that in considering any national power supply undertaking the power must be such that it could be economically generated by any of the natural power resources of the country—coal deposits, oil wells, waterfalls, &c. Gas could be generated only from carbonaceous material, and therefore could only make use of the resource they were most anxious to conserve. Electricity, on the other hand, could be economically generated from any of the sources mentioned, or it could be produced by means of waste heat from other manufacturing processes. The Water Power Resources Committee, in a recent report upon the water power available in the Scottish Highlands, after nine sources of power had been investigated, calculated the yield at 183,500 E.H.P., working continuously with a 100 per cent. load factor corresponding to an output of 1,200,000,000 B.O.T. units per year, or more than double the present output of all the power stations in Scotland. Moreover, Sir Dugald Clerk had stated that if this country's available water power were used for power purposes, it would be followed by a saving of 26 million tons of coal per annum, and enable them to increase their ten million H.P. of industrial load to 13 million H.P. without any increase in fuel consumption. Referring to the steam turbine, the speaker said the consumption running light was only about 8 or 10 per cent. of the full load consumption, whereas in the case of the gas engine the light load consumption was about 30 per cent. of the full load consumption. The initial capital cost of turbine plant amounted to only 70 per cent. of the capital cost of gas engine plant. Mr. Forrest stated that the cost of labour necessary to run a large gas engine plant was much greater than that required to run a turbine plant of equal output, which was absolutely constant. Even in isolated cases where it could be shown by calculation that the cost of generating power by gas engines would be less than if turbines were used, experienced engineers had adopted the turbine for its reliability and general convenience. Attention was being given by electrical engineers to the question of gas firing of boilers. They wished to combine the efficiency, reliability, and convenience of the steam turbine with some form of by-product recovery plant if it could be shown that such a combination was sound.

The next phase of the debate was in relation to the industrial application of the two agents, and the case for gas was presented by Dr. C. M. WALTER, of the Industrial Research Laboratory, Birmingham Gas Department. He pointed out that the industrial applications of gas and electricity covered such a huge field that, when comparing the two, one was bound to find that for certain industrial operations one or other was particularly adapted for the work. As examples, they might take the welding of small components and sheet metals, for which electricity was especially adapted; and again, the carburising or reheating of large masses of metal where gas must inevitably be the heating agent. Comparing the costs of the two agents, the speaker said that prior to the war the cost of carrying out work in the electric furnace was at least three times as great as in the case of the gas furnace. Gas furnaces for forging and reheating were now designed on recuperative principles with efficiencies as high as 40 per cent.; the electric furnace remained at its old figure of 50 or 60 per cent. The electric furnace would be confined to the more specialised industries, and to small work which was carried out in laboratories.

Mr. F. J. MOFFETT, consulting electrical engineer, Birmingham, said that to utilise gas for heating, combustion must take place, and only a fraction of the total heat units in the gas was utilised in heating the charge, the remainder of the heat being carried off by the waste gases and excess air. The efficiency of conversion of electrical energy to heat was practically 100 per cent. When heat was produced by combustion there were usually certain impurities present, such as sulphur and carbon, which were liable to be absorbed by the charge, but in the conversion of electric into heat energy no such impurities were present. To compare a gas heated furnace, therefore, on the same basis with an electric furnace, the former should be designed so that the charge was enclosed in a container. The efficiency of a furnace might be defined as the ratio of the heat units usefully employed to the total heat units in the gas used or in the electrical energy supplied. In an electric furnace the losses could be confined very closely to those due to radiation and conduction, and the average working efficiency could be taken at 75 per cent., while that of a gas furnace was 25 per cent. A valuable feature of the electric furnace was the high temperature attainable. The temperature of the arc was about 3,500 deg C., and the limit in practice was the fusing point of the refractories lining the shell. For certain processes a temperature higher than could be reached by the combustion of fuel was required, and the electric furnace was the only solution. With a fuel heated furnace there was a point at which the components of the gas ceased to combine with the oxygen of the air. The highest temperature in a combustion furnace without recuperation was from 1,500 deg. C. to 1,800 deg. C. The electric furnace was particularly suitable for steel melting and refining, for the reduction of iron ore, and for the preparation of elements like phosphorus and aluminium, in which electrolytic action was necessary. He protested against the distorted view of some gas and electrical engineers that their interests were always opposed. There was, on the contrary, plenty of room for co-operation.

The case for gas domestic appliances was submitted by Mr. R. J. ROGERS (fittings superintendent, Birmingham Gas Department). His contention was that for cooking and heating in such appliances, gas was the more efficient and economical. The thermal value obtained from one unit of electrical energy on complete conversion to heat was 3,420 B.TH.U., while taking the basis of one cubic foot of gas as giving 470 B.TH.U., 7.27 cu. ft. of gas was required to provide the same as one unit of electricity. Taking Birmingham prices, with electricity at 2.66d. per unit and gas at 3s. 10d. per 1,000 cu. ft., the cost of gas would be .33d., as against 2.66d. for electricity. Electrical water heaters gave 90 per cent. efficiency, and the gas-heated apparatus in the form of a geyser, 85 per cent. efficiency, though some geysers gave higher efficiencies. The cost by electrical appliances was 7¼ times more than with gas. Regarding room warming, if the efficiency of electric heaters was conceded to be 100 per cent., it would be seen that electric heating cost six times as much as gas fires, giving 75 per cent. efficiency. In addition to the excessive cost of fuel, the drawbacks to electricity for cooking were: High cost of installation, high and uncertain cost of upkeep, difficulty of management, lack of facilities for hot-plate work, and slowness of operation. At the Southampton docks, national kitchens were provided, and in addition to the existing gas appliances electric cooking stoves and tea urns were fitted; but experience showed that the latter were scarcely ever used.

The case for electricity was put forward by Mr. N. B. ROSHER, O.B.E., M.I.E.E., consulting engineer, Birmingham, who said that lifts, vacuum cleaners, boot and knife cleaning machines, sewing machines, and fans could only be efficiently worked by electricity, and last year 600,000 electric vacuum cleaners were sold in America. If gas were used economically, *i.e.*, with only the bare minimum of air required for combustion, the temperature would be about 3,500 deg. F. To avoid that, the temperature (and therefore the efficiency) had to be reduced by the admission of ten times the amount of air actually necessary for combustion. In a lecture given by an independent authority (Mr. A. H. Barker) at University College, London, the efficiencies of various ovens were given as follows: Coal-fired oven, 3 per cent.; gas cooker, 11 per cent.; electric cooker, 21 per cent. Mr. Rosher considered the more modest figure of 19 per cent. to be more correct for the electric cooker. A unit of electricity, no matter how or where it was generated, contained 3,410 heat units, whereas 1,000 cu. ft. of gas might contain anything from 450 to 650 heat units. The loss in cooking, according to Mr. Barker, was as follows: Totally enclosed oven (electric), loss equals 10 per cent.; ventilated oven (coal), loss equals 15 per cent.; freely ventilated oven (gas), loss 20 per cent.

Mr. R. G. MARSH (fittings engineer, Birmingham Gas Department) spoke upon the transmission and distribution of power from the gas point of view, and said that at the present price ruling in Birmingham gas was cheaper than electricity. If they took the instance of a manufacturer requiring 50 H.P. to drive his workshops, and assumed a load factor of 50 per cent., allowing 26 cu. ft. per H.P.-hour, during a year of 3,000 hours with gas at 3s. 6d. per 1,000 cu. ft., his annual gas bill would be £341. Allowing for costs of attendance a further £50 per annum, and for oil, spares, &c., a further £50, and for interest and depreciation 10 per cent. on, say, £600, the cost of the engine, another £60, his total bill would come to £501. For the same power the cost of energy alone at 2½d. per unit for a 50-H.P. motor would be

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£780; that was allowing nothing for attendance, oil, depreciation, or interest in respect of the motor.

Mr. W. W. Wood, A.M.I.E.E. (General Electric Co., Birmingham), speaking on behalf of electricity, pointed out that energy could be efficiently and conveniently transmitted over practically any distance. An American company had during the last five years transmitted 1,600 million H.P.-hours a distance of 240 miles, with an average efficiency of 87½ per cent. The load factor was 50 per cent., so that the maximum load was well over 70,000 H.P. The extensive use of the electric motor was not on account of efficiency alone, but depended greatly on its convenience.

There was a brief discussion during which the chairman (Mr. E. C. R. Marks, M.I.M.E.) expressed the view that it was most important that municipal gas and electricity undertakings should be under the administration of a joint committee.

The debate was wound up by Dr. C. C. Garrard, M.I.E.E. (General Electric Co.), and Dr. Smith (Gas Department), and the proceedings concluded with a vote of thanks to the chairman.

LEGAL.

Direct U.S. Cable Co., Ltd., *v.* Western Union Telegraph Co., Ltd.

In the Chancery Division, Mr. Justice Peterson on February 16th continued the hearing of this action, adjourned from November last for the production of evidence and documents from America, concerning the dispute between the two companies in relation to a 99 years' lease of a trans-Atlantic cable at an annual rental of about £60,000. The plaintiffs (an English company) under the covenants of the lease of their cables to the defendant company undertook to repair the lines and maintain through communication, power being reserved to the lessees to determine in the event of 18 months' continuous interruption.

Mr. Mangham, K.C. (for the defendant company), on the hearing being resumed, said that he proposed to take the evidence from America as to the breaks in the cable in shallow water in America, as he understood that some point was going to be made of the new repairs of the shallow water section of the cable on the United States side. He proposed to produce evidence as to breaks which had occurred between Rye Reach and Halifax, but inconvenience and complications arose from the fact that he did not know what was the real issue between the parties.

Mr. Romer, K.C. for the plaintiffs, said that his contention was that the plaintiffs were stopped from relying upon the smaller breaks in the cable. He complained that the other side had failed to make repairs which his company were led to believe they would do. It was not until after the action had been started that they became aware of the fact that certain breaks had not been repaired.

Mr. Patrick William Reib, superintendent in charge of the station at Rye Beach, in the State of New Hampshire, was called, and in his examination by Mr. Mangham said that in the course of his duties he became aware of the loss of insulation in the Halifax cable due to breaks or faults. One of the breaks complained of, he said, occurred about 428 nautical miles from Rye Beach on January 7th, 1917, and another occurred on August 8th, 1917, close to Halifax. These were both repaired shortly afterwards. On December 2nd of that year there was an interruption, which was repaired on the 11th and communication was re-established. As to the first fault, they were able to work through, but with great difficulty, but on January 7th, 1918, there was complete interruption, and he localised it at about 325 nautical miles from Rye Beach. Then on the 9th another break occurred 93 miles from Rye Beach, and from that date to July 29th, 1919, the cable could not be used. Between January 5th, 1918, and July 29th, 1919, it was not possible to use the cable between Halifax and Rye Beach.

Witness then gave details of the repairs carried out from time to time by the company's ship.

In cross-examination, witness said as to the breaks in the Bay Robert section the repairs were carried out by a French cable ship, but with that exception they were always repaired by his company's ships. The French ship, while repairing other cables, broke the defendants' cable by mistake and repaired it. The breaks in the shallow water cables were frequently caused by dredgers and other ships fouling them. A great many breaks in Halifax Harbour had occurred from this cause.

Mr. Joseph Brown, superintendent in charge of the Halifax cable station, also gave evidence as to the condition of the cables between Rye Beach and Halifax and Halifax and Bay Robert and the breaks spoken of by the previous witness, as well as to the time occupied in carrying out the repairs.

Mr. Reginald Carlton, president of the Western Union Telegraph Co., of New York, gave evidence as to the general organisation of the Western Union Co. He said that the superintendent reported directly to him, and amongst the most important matters reported to him were the repairs of cables, the expenditure in relation to which was very heavy. There were three repairing ships leased to the company.

After describing the company's system of cables and the details of the repairs done by the ships in the control of the company, the witness said that there were seven breaks in 18 months, the whole of which were repaired by two of the company's ships. During 1918 they had no ship to repair in the Halifax Rye Beach section without sacrificing other much more important work.

The cross-examination of the witness by Mr. Patrick Hastings, K.C., was directed to showing that the Western Union were desirous of leaving an interruption to continue for 18 months so that they might be in a position to put an end to the contract.

The hearing was adjourned.

On the case being resumed, on February 17th, further evidence from America relating to breaks and the action of the defendants in relation to the repairs was given, and the further hearing was adjourned until February 23rd.

Damages for Tramway Passenger at Dublin.

In the High Court of Ireland, Dublin, last week, before Lord Justice Dodd and a special jury, M. McNamara, schoolboy, sued by his father, the Dublin United (Electric) Tramways Co. to recover £1,000 damages for personal injuries. Judgment was given for £875, with costs, but a stay of execution was granted to enable the King's Bench Division to pronounce on the verdict, a condition being that meantime the company should pay £5 a week to the mother of the plaintiff towards his maintenance.

The case for the plaintiff was that as he was riding on the upper deck of a tramcar the trolley pole left the wire, struck him on the head, and inflicted injuries which seriously affected his health, inflammation of the brain developing.

Evidence was given by the conductor and the driver of the car and also by the driver of a passing car, that the trolley did not strike the boy at all. The conductor stated that shortly after the car had stopped, as a consequence of the trolley leaving the wire, he went on the top of the car to collect fares. He saw the boy sitting there with his hands to his head. The conductor asked him what was the matter, and he made no reply. When the boy was getting off later on he made no complaint. He believed that the trolley did not strike the boy at all. The driver of the passing tramcar, who saw the trolley leave the wire, said that the trolley did not fall straight down, but swayed round in a lateral direction. It was shown that the car was only going at the rate of 5 or 6 miles an hour.

Mr. G. M. Harris, general manager of the tramway system, told the Court that the car on which the accident occurred was properly equipped, and that it was constantly in use since the accident, as before it. No repairs had since been done to it. A trolley on leaving the wire invariably jumped upwards. The suggestion made on the previous day that the tramway tracks were defective was nonsense. Even if they were, it could have no effect on the trolley. Trolleys occasionally left the wires everywhere, and sometimes no explanation could be given of it, and so far as electrical science had gone, no means had yet been devised to prevent it. In cross-examination, Mr. Harris's attention was drawn to the fact that on the Dublin and Lucan Electric Tramway a steel bar had been placed along the top of the car to protect passengers from being struck by the trolley. Mr. Harris said that he was aware of that. The Dublin tramcars had no such arrangement, and he did not see the slightest use in it.

Mr. Grosart, manager of the Dublin and Lucan Tramway, said that he had examined the trolley and the equipment of the car in question, and found all in proper working order.

In his summing up, Mr. Justice Dodd said the Tramway Co. could not be held responsible if they could not have reasonably anticipated the accident, and their witnesses said they had never known such a thing to have happened in their experience. Even if the car was going fast it did not constitute negligence, unless the driver could reasonably have anticipated that the speed of the car would have resulted in the trolley falling.

Hodges *v.* Webb.

(The Electrical Trades Union Dispute.)

Mr. Justice Peterson, on Friday, February 20th, in the Chancery Division, delivered a reserved judgment in the case heard in the previous month in which Mr. Sidney Dumas Hodges sought an injunction to restrain the defendant, Mr. William John Webb, the London secretary of the Electrical Trades Union, or his agents, from interfering or attempting to interfere with his employment, and the right to dispose of his labour as he willed.

Mr. Hughes, K.C., and Mr. H. G. Purchase appeared for the plaintiff, and Mr. Cunliffe, K.C., with Mr. R. H. Hodge represented the defendant.

The plaintiff is a member of the National Association of Supervising Electricians, and was engaged in October last in the capacity of foreman electrician on a contract at Delectaland, Watford. His case against the defendant was that because he would not join the Electrical Trades Union, the workmen were called out on strike, in consequence of which his employers, in order that they might carry out their contract, had to discharge him. On behalf of Mr. Hodges, it

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was contended that the defendant had tried to coerce the plaintiff to abandon his membership of the N.A.S.E., and join the other union, that he had conducted a malicious vendetta against plaintiff, and that the case came within the decision of Valentine and Hyde bearing upon the same points.

The defendant's case was that he was entitled to do what he had done under the Trade Disputes Act, as his action was entirely the outcome of a trade dispute, and much evidence was taken to prove that a dispute did actually exist at the time when the defendant did that of which the plaintiff complained.

Mr. Justice PETERSON, in the course of his judgment, which occupied over an hour in delivery, said that the National Association of Supervising Electricians, which was formed in 1914, was at first in the main an educational institution, and under its rules its members were prohibited from taking part in trade disputes. In 1918, however, it was registered as a trade union, but it failed to obtain recognition by the Trade Union Congress, and it was apparent that the Electrical Trades Union considered there was ground for believing that the N.A.S.E. was under the influence of, and had the sympathy of, the employers. Under these circumstances the E.T.U., rightly or wrongly, objected to its members working with members of the N.A.S.E. The E.T.U. at the beginning of 1919 had withdrawn all its members employed by a firm because the firm employed members of the N.A.S.E., and the strike remained still unsettled. It was, said his lordship, an acute and burning question between the employers and the workmen in the industry. The London section of the National Federated Electrical Association—the employers' federation—had passed a resolution declining to yield to the policy of the E.T.U. He was of opinion that the defendant did ask the plaintiff to join the E.T.U. When he, plaintiff, refused to do so, he said he would call the men off the job, and that they would not return until he was dismissed. His lordship said he did not believe the allegation that the defendant had made use of a threatening gesture, and he was satisfied that the only effective reason for calling out the men was the refusal of the plaintiff to join the E.T.U. He did not think it would be fair to draw the inference that the men were withdrawn from their work because the defendant was annoyed at the observations made by the plaintiff.

It was the sole duty of a judge, in a case of this kind, to consider whether a complaint was lawful or unlawful. After the passing of the Trade Disputes Act in 1906 it was impossible to argue that if an authorised trade union official called out the members of his union in furtherance of a trade dispute, he was liable to be sued merely on the ground that he interfered with the business of the employer or the employment of any person. In his view, there was a trade dispute in this case, and whether the trade union was right or not appeared to be immaterial. There was a trade dispute between the employers and the workmen, and he was unable to hold that defendant had used such coercion against Messrs. Tyler & Freeman, the employers, as to render him liable in damages to the plaintiff. Coercion was a word of ambiguous import. The pressure used in this case was not coercion which constituted ground for action. If it were, there would be few strikes in which employers or workmen, or both, could not say that they had been coerced. The question was whether the defendant had employed unlawful means, and that question was not to be solved by saying that defendant's words amounted to a threat. No legal exception could be taken to a strike, and it was not an illegal act to intimate that under certain circumstances a strike would take place. It could not be unlawful pressure to protest, after due intimation, and say that a strike would take place. He was not prepared to hold that defendant could be made liable in damages to the plaintiff for saying that he intended to do that which he was by law entitled to do. It might be called a threat by some people, but whether it was a threat or a warning, it was in fact a statement that defendant would adopt lawful means for the purpose of giving effect to the union's lawful policy. The conclusion at which he had arrived, his lordship said, was that the defendant endeavoured to persuade plaintiff to become a member of the Electrical Trades Union, and that while doing so he pointed out that if he (plaintiff) persisted in his refusal to do so he would inevitably be exposed to difficulties in the future. He did not think that after making the observation in question the defendant used threats towards the plaintiff. He did not consider the question whether, if it was a threat, defendant was liable to be sued for threatening to give effect to the policy of the union in a trade dispute between employers and the union. In his view that was a question of fact which it was not necessary to answer. The action, therefore failed, and would be dismissed with costs.

Judgment was accordingly entered for the defendant with costs.

BREACH OF THE FACTORY ACTS.

AT Sunderland Police Court on Friday, Messrs. Wm. Gray & Co., Ltd. (the Wear Shipyard), Pallion, were summoned in respect of five alleged breaches of the Factory Act. Mr. W. B. LAUDER, for the prosecution, said the case was brought because of defendants' neglect to observe electricity regulations on December 16th, with the result that a youth named Robert Allan Black was killed. By the regulations an authorised person to supervise the undertaking of certain repairs to an electric cable used for supplying light to a ship in course of construction had to be over 21 years of age. Black was only 16 years of age, and he had an assistant only 17. A mishap occurred, and through some means while Black was coupling two electric wires he was killed by shock. Defendants, who said they had no knowledge of what was being done and did not consent to or connive at it, were fined £5. Convictions were recorded without penalty on two other counts alleging that inadequate precautions had been taken.

TRANSFORMERS FOR ELECTRIC FURNACES.

AT Newcastle-upon-Tyne, on February 9th, Mr. J. L. Thompson's paper on the above subject, an abstract of which appeared in our issue of January 30th, was read and discussed before the NORTH-EASTERN CENTRE of the INSTITUTION OF ELECTRICAL ENGINEERS.

Mr. V. STOBIE thought it was the first time that the subject had been dealt with publicly. He had not known any breakdowns due to tappings, the troubles they had had were on the H.T. side, and due to radial, rather than axial stress. The corner windings broke down sometimes, due to abrasion consequent upon movement inside the transformer; insulation gave way there more quickly than elsewhere. That the stresses were low was hardly the point; it was not the magnitude of the stress, but its repetition that caused the abrasion of the insulation. As to the passage of oil through the ventilating ducts, he knew one case where a transformer had broken down from want of ventilation, and in that case the builders, in order to get greater reactance, had put in some special iron between the windings, and to do so had cut down the size of the ventilating ducts. The interleaving of the L.T. conductors was another illustration of the fact that practice did not always follow theory. Regarding power factor, he mentioned a case where they had 7,500 amperes on one phase of the transformer, and another where they had 10,000 amperes per phase; on one furnace they got 0.93 power factor, without interleaving, and on the other they got 0.92. Referring to the author's suggestions to increase the voltage, the speaker said that personally he always used two electrodes. The practice was to reduce the voltage when the metal was molten, probably to 40 volts across the arc. Regarding the increase of the size of the furnace, he suggested, instead of one four-phase, two sets of two-phase, which saved complication for the steel people.

Mr. TAYLOR said that he had never had a breakdown on the tappings. In the diagram of the connections of the furnace transformer with the H.T. auto-regulating transformer and external reactance the choke coil was shown on the left hand. He suggested that it should be on the other side, so that it might lessen the switchgear needed. He had taken several power factor readings, and got 0.95 and 0.96, but over a period the average was 0.92.

Mr. PARROTT remembered some years ago being called to see a plant where the transformer was blamed because the furnace would not melt; they could not get sufficient energy into the furnace. On examination of the lay-out, he found that they only got about 40 per cent. of the normal voltage that they should have had, and when that was altered, all went smoothly. He thought a suitable arrangement for large work would be to place the plant so that the transformer would be directly underneath the furnace; they could then bring up the leads through the floor, and so get the shortest possible length.

Mr. CLOTHIER explained that years ago it was the practice to design transformer tanks with pockets into which the cables were brought through glands, so that there were no bare conductors exposed. He wished the author would include terminals arranged in that way. He thought that the question of the proper enclosure of conductors applied particularly to the comments made in the paper concerning the failure of tappings. A booster transformer, or an induction regulator for voltage variation, was introduced because the author found a difficulty in insulating his tappings. Surely the remedy was to improve the tappings, and not to foist this extra apparatus on the user. The remarks he had made about the enclosure of the conductors were, he admitted, difficult to apply to the L.T. side. There was no reference to failure of the switchgear; they were told that the troubles of the transformer had been overcome, he might tell them that the switchgear troubles also had been overcome.

Mr. STIGANT, referring to the reinforcement of tappings, especially at the point where they were brought out, said his recent experience was that in certain directions manufacturers were inclined to take the view that when they were taken out at the centre it was not so necessary to reinforce them. He thought they should be as strongly reinforced at the centre, as at the end, because they were still likely to get high stresses and so damage the insulation. Numerous ventilation ducts should be avoided; it was far more important to provide a smaller number of ducts of a larger size so that they would get a substantial body of oil circulating through rather than have a larger number of ducts of a smaller size which were always liable to facilitate sludging.

Mr. CARR, Mr. PORTER, and Mr. DAVIDSON also took a brief part in the discussion, and Mr. THOMPSON replied.

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NEW PATENTS APPLIED FOR 1920.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by MESSRS. SEPTON-JONES, O'DELL AND STEPHENS (successors to W. P. Thompson & Co., of London), Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

3,866. "Word-counter and speed-tester for telegraph circuits." L. L. RAVENSCROFT. February 9th.

3,879. "Electric switches." J. A. CRABTREE. February 9th.

3,889. "Time-limit relays, circuit-breakers, &c." B. H. LEESON, J. MIRREY and A. REYROLLE & Co. February 9th.

3,891. "Electric rivet-heaters." R. F. WOODBURN. February 9th.

3,897. "Sparking plugs." A. SAUSER. February 9th.

3,906. "Sparking plugs and their relation to cycle of engine." A. BUCHANAN. February 9th.

3,914. "Protective arrangements for alternating-current electric circuits." R. A. R. BOLTON and SIEMENS BROS. DYNAMO WORKS. February 9th.

3,918. "Electric measuring or indicating instruments." BRITISH THOMSON-HOUSTON CO. and R. C. CLINKER. February 9th.

3,922. "Electrically-operated diaphragm horns." A. R. KEARNEY and B. A. QUINT. February 9th.

3,939. "Ignition magnetos for internal-combustion engines." FABRIQUES DES MONTRES ZENITH, SUCCESSEUR DE FABRIQUES DES MONTRES ZENITH G. FAVRE-JACOT ET CIE. February 9th. (Switzerland, April 15th, 1919.)

3,940. "Ignition magnetos for internal-combustion engines." FABRIQUES DES MONTRES ZENITH, SUCCESSEUR DE FABRIQUES DES MONTRES ZENITH G. FAVRE-JACOT ET CIE. February 9th. (Switzerland, June 11th, 1919.)

3,972. "Magneto-electric ignition apparatus for explosion engines." R. E. HEERD. February 9th. (Germany, May 30th, 1919.)

3,974. "High-tension magnetos for four-cylinder internal-combustion engines." SOC. PERFECTA. February 9th. (France, February 8th, 1919.)

3,979. "Portable electro-magnetic appliance for treatment of the hair." C. GRAHAM and P. E. MORGAN. February 9th.

3,987. "Electrical resistance apparatus." P. H. DAWE. February 9th.

4,003. "Carrier for electric lamp, &c., shades, reflectors, &c." A. P. RUTHERFORD. February 10th.

4,012. "Electric lamp." G. A. FENNIMORE. February 10th.

4,016. "Coupling dynamos, &c., to internal-combustion engines." S. L. BAILEY. February 10th.

4,049. "Electric incandescent lamps." L. B. CODD and C. MARTIN. February 10th.

4,058. "Electric heating apparatus." G. F. JOSEPH. February 10th.

4,078. "Electric lamps." A. KONIECZNY. February 10th.

4,085. "Electric switches." BRITISH THOMSON-HOUSTON CO. (General Electric Co., U.S.A.) February 10th.

4,102. "Testing sparking plugs." W. S. WOLFF. February 10th.

4,103. "Apparatus for testing lamps, fuses, sparking plugs, induction coils, &c." W. S. WOLFF. February 10th.

4,104. "Means for supply of electric current to railway, &c., tracks." W. T. JONES. February 10th.

4,117/8/9. "Negative plates for electric accumulators." A. POUCHAIN. February 10th.

4,120. "Negative plates for electric accumulators and manufacture of same." A. POUCHAIN. February 10th.

4,128. "Electric starters and cut-outs for electric lighting plants employing internal-combustion engines." C. C. GARRARD, A. H. RAILING and W. WILSON. February 11th.

4,144. "Combined electric switches and wall plugs and sockets." W. COMPSON, A. E. READ and WALSALL HARDWARE MANUFACTURING CO. February 11th.

4,172. "Trolley-pole heads for electric vehicles." E. FARRELL. February 11th.

4,185. "Arrangement for receiving submarine telegraphy, &c." M. D. DIMITRIEVITCH. February 11th.

4,204. "Electrical apparatus." BRITISH THOMSON-HOUSTON CO. (General Electric Co., U.S.A.) February 11th.

4,214. "Electrical apparatus for indicating and repeating movements at distances." J. L. ROUTIN. February 11th. (France, January 3rd.)

4,225. "Electrode holders for electric arc welding or cutting." C. B. WATERS. February 11th.

4,231. "Distributing devices for high-tension ignition machines." R. BOSCH AKT. GES. February 11th. (Germany, March 9th, 1918.)

4,239. "Measured service devices for telephone systems." AUTOMATIC TELEPHONE MANUFACTURING CO. (February 11th. (United States, February 12th, 1919.)

4,243. "Device for ascertaining direction of submarine sound waves." SIGNAL GES. February 11th. (Germany, November 20th, 1917.)

4,244. "Device for ascertaining direction of submarine sound waves." SIGNAL GES. February 11th. (Germany, June 5th, 1918.)

4,255. "Electric light attachment for rifles, &c." G. F. ROSARIO. February 11th.

4,260. "Electric switches." J. VAVRE. February 11th. (France, March 20th, 1919.)

4,269. "Current-distributor for magneto-electric ignition apparatus." M. STROBEL. February 11th. (Germany, March 2nd, 1918.)

4,273. "Wireless telegraphy and telephony." H. MORRIS-AIREY, A. K. MACRORIE and G. SHEARING. February 11th.

4,274/5. "Transmitters for wireless telegraphy and telephony." A. K. MACRORIE and G. SHEARING. February 11th.

4,280. "Electrically producing gas for internal-combustion engines, &c." T. MCCLELLAND. February 12th.

4,292. "Electric overhead coke conveyers, &c." J. WIGLEY. February 12th.

4,293. "Machine for connecting tidal, &c., energy to mechanical and electrical energy." G. NEWMAN. February 12th.

4,306. "Electric switches." E. WATERHOUSE. February 12th.

4,311. "Mine-signalling systems." AUTOMATIC TELEPHONE MANUFACTURING CO. and H. L. SERJEANT. February 12th.

4,314. "Sparking plugs." P. R. CARTWRIGHT and E. T. GLANVILLE. February 12th.

4,351. "Fittings for arc, &c., lamps." H. BERRY. February 12th.

4,377. "Portable electric lamps." COMPAGNIE GENERALE D'ELECTRICITE. February 12th. (France, May 27th, 1916.)

4,390. "Sparking plugs." J. L. PLATEL. February 12th. (France, September 28th, 1918.)

4,396. "Wireless telegraph receivers." L. B. TURNER. February 13th.

4,411. "Protective arrangements for electric distribution and transmission systems." CALLENDER'S CABLE & CONSTRUCTION CO. and P. V. HUNTER. February 13th.

4,417. "Trolley-wheel head and bearing socket of electric traction equipments, &c." J. K. MALONE. February 13th.

4,426. "Electrical device for recording fires and burglaries and for gas, chemical and water protection." ELECTRICAL CONTRACTION CO. and R. D. ENGLAND. February 13th.

4,431. "Electrical conductors." ETNA LIGHTING & HEATING CO., G. HOOKHAM and H. R. PROSSER. February 13th.

4,454. "Wind power electricity-generating plant." P. BURNS and E. H. JONES. February 13th.

4,455. "Electric alarm for motor vehicles." L. W. APPLETON. February 13th.

4,463. "Protective devices for alternating-current systems." C. C. GARRARD, A. E. MCCOLE and A. H. RAILING. February 13th.

4,467. "Magnetic blow-out devices." T. ZWEIGBERGK. February 13th.

4,470. "Terminal connections for electric conductors." O. IMRAY (R. Bosch Akt. Ges.) February 13th.

4,471. "Releasing devices for armatures of electric-starting motors." R. BOSCH AKT. GES. February 13th. (Germany, February 20th, 1919.)

4,479. "Electrical illuminating apparatus for kinematograph projecting apparatus, &c." G. TEPPATI. February 13th. (Italy, August 27th, 1919.)

4,494. "Controlling devices for alternating-current dynamo-electric machines." BRITISH THOMSON-HOUSTON CO. and H. W. TAYLOR. February 13th.

4,495. "Vacuous electric-discharge devices." BRITISH THOMSON-HOUSTON CO. and J. GRAY. February 13th.

4,501. "Automatic telephone systems." AUTOMATIC TELEPHONE MANUFACTURING CO. February 13th. (United States, May 31st, 1919.)

4,521. "Automatic attachment for turning off electric switches, gas taps, &c." F. C. ENDECOTT. February 14th.

4,523. "Electrical apparatus for heating air used in machines for drying, cleansing or carbonising wool, cotton, &c." E. JENKINS. February 14th.

4,526. "Electric pianos." J. I. HALL. February 14th.

4,529. "Cooling tanks for electrical transformers, &c." E. J. JENKINS. February 14th.

4,531. "Single-phase transformer." L. GUISEPPE. February 14th.

4,544. "Carrier for electric lamp shades, reflectors, &c." A. P. RUTHERFORD. February 14th.

4,546. "Sparking plugs." H. S. COOKE. February 14th.

4,570. "Magnetic deflectors for electric arcs in lamps, searchlights, &c." H. C. GIBSON and J. P. YORKE. February 14th.

4,577. "Incandescent electric lamps, &c." J. T. CALLOWAY. February 14th.

4,583. "Crystal detectors of electric currents." H. M. DOWSETT. February 14th.

4,592. "Flame-proof boxes for switches, fuses, &c." W. T. HENLEY'S TELEGRAPH WORKS CO. February 14th.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1918.

5,918. ELECTRICAL MEASURING APPARATUS. Siemens & Halske Akt. Ges. March 27th, 1917. (114,632.)

7,006. COINFREED TELEPHONE CALL-BOXES. Ges. fur Elektrische Industrie. May 25th, 1914. (115,241.)

7,011. COINFREED TELEPHONE CALL-BOXES. Ges. fur Elektrische Industrie. March 19th, 1917. (Addition to 115,241.) (115,242.)

18,208. ROTATING MAGNETS OF MAGNETO-ELECTRIC IGNITION APPARATUS. Scintilla. November 6th, 1917. (120,902.)

18,626. ELECTRIC VALVE AMPLIFIERS. G. F. Partridge and B. S. Smith. November 13th, 1918. (137,876.)

20,170. AUTOMATIC TELEPHONE SYSTEMS. D. S. Hulfish. December 8th, 1917. (121,471.)

1919.

1,976. ELECTRIC LAMPS OR LANTERNS. J. Y. Fletcher and F. W. Ball. January 27th, 1919. (137,914.)

3,641. ELECTRIC COUPLINGS. W. C. Lea. February 14th, 1919. (137,932.)

4,299. MAGNETIC DEFLECTORS FOR ELECTRIC ARCS IN LAMPS, SEARCHLIGHTS, AND THE LIKE. J. P. Yorke. February 20th, 1919. (137,937.)

7,294. AUTOMATIC COIN-OPERATED TELEPHONE CALLING APPARATUS. T. M. Fletcher. March 24th, 1919. (137,958.)

8,478. SPARKING PLUGS. G. H. Barraclough. April 4th, 1919. (137,967.)

13,028. CONTROL MEANS FOR ELECTRO-MAGNETIC RECIPROCATING DEVICES. Igranic Electric Co. (Cutler-Hammer Manufacturing Co.) May 23rd, 1919. (138,001.)

13,664. MAGNETOS. B. Ames. May 29th, 1919. (138,007.)

13,920. SPARKING PLUGS. H. R. Wilks. June 2nd, 1919. (138,008.)

16,431. SPARKING PLUG FOR INTERNAL-COMBUSTION ENGINES. L. Febbraro. June 30th, 1919. (138,023.)

18,325. STORAGE BATTERY LOCOMOTIVE. Mancha Storage Battery Locomotive Co. August 31st, 1918. (132,233.)

18,933. METHODS OF INDIRECTLY COUPLING A RADIO-TELEGRAPHIC ANTENNA TO A HIGH-FREQUENCY ALTERNATOR. J. Bethenod. July 30th, 1918. (130,614.)

20,149. INSULATING CAPS FOR ELECTRICAL JOINTS. M. Ritsema. September 18th, 1918. (132,779.)

20,313. SPARKING PLUGS FOR EXPLOSION MOTORS. R. Breton. June 4th, 1919. (138,037.)

21,049. ELECTRIC KETTLES AND THE LIKE. A. S. Ford. August 27th, 1919. (138,039.)

21,855. ELECTRIC REACTANCE COILS OR TRANSFORMERS. Electrical Improvements, Ltd., and J. R. Beard. September 5th, 1919. (Addition to 133,135.) (138,043.)

24,121. ELECTRIC IGNITION APPARATUS. American Bosch Magneto Corporatoin. October 1st, 1918. (133,318.)

26,166. MEANS FOR COOLING DYNAMO-ELECTRIC MACHINES. E. F. W. Alexanderson. November 26th, 1918. (135,825.)

A Dutch Ericsson Telephone Works.—The firm of Koopman & Co., of Amsterdam, announce that, with the co-operation of the Almänna Telefon A.B. L.M. Ericsson, of Stockholm, they have formed a group who have taken over the shares in the Electrische Werktuigen Fabriek, of Rijen near Breda. It is proposed to convert the latter into the Nederlandsche Ericsson Telefoon Fabrieken, with a share capital of 3,000,000 florins (pre-war, £250,000). In order to possess a sales organisation for Holland and the Dutch colonies, an agreement has been entered into with Koopman & Co., who have for years past imported telephone plant from Sweden, and who since 1916 have taken over the connections of the Netherlands Bell Telephone Co., in so far as these were not transferred to the Dutch Government.

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THE

ELECTRICAL REVIEW.

VOL. LXXXVI. MARCH 5, 1920. No. 2,206.

ELECTRICAL REVIEW.

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THE IMPROVEMENT OF INDUSTRIAL RELATIONS.

WE have lately dwelt upon the need for the spirit of confidence, and in doing so we pointed out the vastness of the subject of industrial relations. We therefore make no apology for returning so soon to its consideration.

Let us begin, then, by stating boldly our opinion that the relations between the various sections of the industrial world were never better than they are to-day. It is true that—

> Hope springs eternal in the human breast;
> Man never is, but always to be, blest.

We may add to the last line that man never *is*, but always *was*, blest. One hears almost every day some such expression as "those were days, but we did not appreciate them"; "the good old times"; and so on and so forth. Yet there are few who would, even if they could, set the clock back to a former time which may seem, on looking backward, to have possessed advantages. There has always been something capable of improvement about the relations between employers and employed; and much that is in the nature of improvement has been brought about. It logically follows, therefore, that the present condition of things, although itself undeniably capable of further improvement, must be the best that has yet existed.

We hear much about the desirability of the human touch, and this is often coupled with lamentations about the disappearance of the personal contact which formerly existed between the master and his workpeople. If this personal contact was everything that could be desired—we are not denying that in some cases it may have been—why did the employed classes ever begin to realise that their interests would be best served, not by leaving things to the sense of justice of their employers, but by combining together and being loyal to one another?

There has been for a long time a general tendency towards combination, coalescence of groups, and joint action. This tendency has existed among the employers as well as among the workpeople, and so far as it tends to promote progress by the elimination of cut-throat competition, and the consequent acquisition of the wherewithal for research and advancement, combination has much to recommend it. It was stated recently by a correspondent in a contemporary, and we have not seen or heard it seriously denied, that it is more than difficult, it is next to impossible, for an individual to exchange from a position in one firm to a position in another firm in the same line of business. Combination of this character we believe to be wholly bad. It tends—or, rather, it endeavours—to restrict progress. No such endeavour can be permanently successful, but the tendency is wrong. If men find it difficult to get ahead, they will embark in something else which offers, or seems to offer, better chances. It cannot be advantageous to drive good men out of their chosen walk of life, and only the less pro-

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gressive will remain in underpaid positions which offer little or no scope for advancement. And there cannot be effective progress in a profession or industry which is manned by a second-class personnel. There should be freedom of movement, and we should welcome a little more openness in the advertising of positions. Why do so many invite the applicant to reply to a box number? Why do so few state the value set upon the position? Why do so many deny the applicant a reply, even when a stamped and addressed envelope is sent with the application? And on the other side, those who seek advancement might with advantage be equally open. There is nothing to be afraid of, and if everyone could persuade himself to be frank there would be nothing unusual about it.

We do most strongly feel that the spirit of confidence would be promoted as much by candour and frankness as by any other means. All profess to be working for progress. Most people believe that progress is perpetual, and differ from Dean Inge, who says that belief in perpetual progress as a law of nature is a superstition which has no basis in history, science, or religion; civilisation has hardly changed human nature. There has been much in the last half-dozen years to emphasise what truth there is in this proposition, but we venture to think that advancement in the knowledge of nature is entitled to be described as progress. History shows progress in the conditions of living; science shows progress in knowledge. Progress in religion is more difficult to gauge; but duelling has been abolished, and much has been done for the poorest classes by people who are really philanthropists, and not big business men who rightly seek to do away with all causes of inefficiency.

Extremes are almost always wrong, and arise from a limited outlook. The extreme towards which the employer tends is the reduction of expense by every means in his power, and the appropriation of all resultant profit and advantage, even if unemployment should be the result. The extremists on the other side want the profit and advantage arising from the use of machinery and the adoption of more efficient methods to go into their own pockets. The Englishman seems to have an affinity for compromise—a sort of natural aptitude for it—and in this case, as in so many others, the right lies somewhere between the two extremes. When the manifestation takes the form of a coalition government, it is universally damned, but since it is damned for many and various reasons, all of which conflict with one another, this should not be accepted as a sufficient cause for the disregard of the principle involved.

Some of the profits arising out of increased efficiency, and consequent increased production, should go one way and some the other. The antagonism towards payment by results will, we believe, lessen, and finally disappear when it is properly understood. It is a big subject, and we do not propose to tackle it seriously at the tail end of an article. It may be taken that the ideal scheme will not be as simply and easily arrived at as is sometimes supposed. It will not do to increase payment in proportion only to increase in output. Sometimes an increase in output may result in an altogether disproportionate increase in profit—in the case of a gold mine, for example. That portion of individual remuneration which represents the cost of living should be roughly proportionate to output; but the part which represents profit, or saving capacity, should depend largely on the profit earned by the employer, and it is this part which ought to go up or down as profits fluctuate.

The ideal may be difficult of attainment, but it is not impossible, and if diligently sought after, with mutual goodwill, it ought to be achieved.

A German Misrepresentation.

In our editorial columns on December 19th, 1919, under the heading of "Who are the Buyers?" we reproduced a quotation from the annual report of the Berlin A.E.G. The extract was that the directors stated that the demand for the company's products on the part of neutral countries, and of "hitherto hostile countries," shows that German industry "still enjoys its former esteem." We ventured to express doubts as to the accuracy of the assertion in regard to Allied countries, with the exception of reparation work in France for the purpose of expediting the work of industrial reconstruction, and suggested that British firms could produce manufactures equally as good as, if not better than, the Germans'. To our astonishment these comments have been distorted into a confession of "despair," in the course of an article published in a Berlin newspaper on February 10th, by "E. Z.," who has sent us a copy of the paper with words written on it showing that he is E. Zehme, privat dozent (private coach) at the Royal Technical High School at Charlottenburg. We do not propose to discuss his abuse and depreciation of the British electrical industry, or his pointless taunt that we may find a larger export market for a time by marking British goods "Made in Germany." But before attempting to take us to task again, it would be well for this privat dozent to cultivate his knowledge of the English language so as to avoid misrepresentation of facts in the future, unless he is one of the celebrated "twisters" (Machenschaftler), of whom Germany possesses a not inconsiderable number.

The Registration of Engineers.

The Bill which the Institution of Civil Engineers has introduced into Parliament to compel all engineers practising as civil engineers to be registered, and also to prevent any unregistered civil engineer from using the letters "C.E." after his name, has naturally enough created considerable stir among the other engineering institutions. The object behind the Bill, of course, is the laudable one of improving the status of the engineer to that of the legal and medical professions, and to that, in principle, no engineer has any objection. The point in connection with the Bill of the Institution of Civil Engineers, however, is its possible detrimental effect upon the other branches of engineering, which regard themselves as on a par with civil engineering, for a clear line of demarcation between the profession of a civil engineer and other branches of engineering is not easy to draw. For instance, in the original Charter of the Institution of Civil Engineers, granted in 1828, it is stated that the signatories "have formed themselves into a society for the general advancement of mechanical science, and more particularly for promoting the acquisition of that species of knowledge which constitutes the profession of a civil engineer, being the art of directing the great sources of power in Nature for the use and convenience of man, as a means of production and of traffic in states, both for external and internal trade, as applied in the construction of roads, bridges, aqueducts, canals, river navigation and docks, for internal intercourse and exchange, and in the construction of ports, harbours, moles, breakwaters, and lighthouses, and in the art of navigation by artificial power for the purposes of commerce, and in the construction and adaptation of machinery and in the drainage of cities and towns."

This is a fairly comprehensive definition, and it is not difficult to see that it covers many branches of engineering in which there has been specialisation since it was first drawn up; for instance, mechanical engineering, electrical engineering, and municipal engineering, to mention three of the leading branches. It is not, therefore, surprising that the Councils of a number of leading engineering institutions have taken up the question of the principle involved in the Bill of the Institution of Civil Engineers with considerable activity, and interviews, of an entirely friendly character, have taken place with the Council of the Institution of Civil Engineers. There are hopes that an amicable settlement will be reached, although it is clearly understood that the other institutions are determined to oppose the Bill if it is felt that the rights and privileges of their members will be encroached upon by it. The whole question of the

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registration of engineers on lines similar to those which obtain in the case of lawyers and doctors, is a broad and difficult one, and can hardly be dealt with in a sectional manner, because no branch of engineering is likely to rest contented whilst another branch receives at the hands of the Legislature privileges which can equally well be applied to all engineers. However, the negotiations between the parties are being carried on in the most friendly spirit, and if an arrangement can be come to whereby the status of all engineers can be raised to the level in public estimation which it ought to occupy, so much the better, for strife among engineers on this important question ought to be avoided at all costs. Many civil engineers, of course, are also members of the other institutions, and that in itself ought to pave the way for an arrangement to be come to which will avoid the spectacle of engineers fighting each other on this question in the Parliamentary Committee Rooms.

Relativity.

In a letter printed in our "Correspondence" columns, Mr. Carl Hering gently satirises the Einstein theory, which seems to be incapable of statement in the vulgar tongue. As a matter of sober fact, we are not at all sure that Mr. Hering's humorous proposition is not really in accordance with the theory, in which time appears to constitute a fourth dimension—and time is associated with motion. But we may point out that a straight line may be moved without generating a surface, and a plane without generating a volume. Whether a solid may be moved without introducing a fourth dimension we are unable to say, but assuming that the motion of a solid most closely analogous to that of Mr. Hering's plane is expansion or contraction, we again meet with the question whether time is a dimension.

We have endeavoured to provide our readers with a simple statement of the fundamental principles of the Einstein theory (see Mr. R. W. Western's article on "The Principle of Relativity Simply Explained," in our issues of September 26th and October 3rd, 1919, and editorials in our issues of November 21st and January 9th), but it must be admitted that the subject is one of immense difficulty, not only to the man in the street, but even to the expert; Sir Oliver Lodge, at a recent meeting, chaffingly asked Prof. Eddington (a leading exponent of the theory) if he thought he understood it himself!

A remarkable letter appeared in *Nature* of February 12th, signed "W. G.," in which the writer drew an extraordinary parallel between the non-Euclidean geometry of the Einstein theory, and the conditions obtaining in the space behind a convex mirror: the article is most ably written, extremely interesting, and well worth reading. The author quaintly and appropriately winds up with a reference to "Alice through the Looking-Glass": "According to the theory of relativity, if the observer is moving with the velocity of light, time remains unchanged. This must have been the case with the Mad Hatter. With him it was always six o'clock, and always tea-time."

"Read, Mark, Learn and . . ."

We wonder how many of the engineers or managers of the five-hundred-odd electricity undertakings scattered up and down the country could pass even an elementary examination on the provisions of the various Electric Lighting Acts. One might, perhaps, be surprised to find how few had more than a bowing acquaintance with them, to say nothing of those to whom they are little more than a name. Of course, with big undertakings, a good knowledge of the Acts is necessary, otherwise one is sure to land in pitfalls. But with small undertakings, it is surprising how, with luck, an almost complete ignorance may go on, year after year, in unbroken serenity. We say with luck, but as one cannot always rely on luck, it is the more politic course, perhaps, to browse occasionally on the wise (or unwise) provisions, restrictions and regulations that legislators have laid down for the guidance, or coercion, of undertakings in these Acts. Further, there is the chance of becoming aware of privileges hitherto neglected. As a matter of fact, the total volume of these Acts, including the new Act of 1919, is anything but formidable. And in this case, a "little learning" is just the reverse of a dangerous thing. There are many cases that may crop up with consumers, especially with ingenious, litigious-minded consumers, where a manager would feel all the happier for being able to speak with confidence. There are always a certain number of consumers who can be trusted to pull the leg of the undertaking if they get a chance, and a further quota of consumers who, less innocently, are not averse to taking advantage of the company if they get the slightest opening. Anyhow, one can never tell when such knowledge will come in useful. We heard of such a case, where the quoting of an Act, united perhaps with a modicum of bluff, got over an awkward situation. A truculent kinema manager who had come to cross-purposes with the supply undertaking, finding that some offices above his premises were supplied through leads taken into his cut-out, took revenge by disconnecting these, boasting of it, and refusing admittance. The upstairs offices, of course, clamoured straightway for their lighting. The manager of the undertaking, however, remembered that anyone who unlawfully and maliciously tampers with electric wires with intent to cut off the supply is guilty of a "felony." It needed only a telephone intimation to be conveyed to the offices of the kinematograph company that unless admission was given immediately to the undertaking's man in order to reconnect, a policeman and a charge of felony would be the consequence. Admittance was given straightway, merely on the *personal* threat, which the Act allowed. Or, again, perhaps everyone does not know that an undertaking can refuse to give supply to any person or company whose payments are in arrears, whether in respect of premises to which supply is required, or other premises where the same person takes supply. Or on the question of deposits, it is a useful point to know that where a deposit is being overstepped, an adequate deposit can be demanded on seven days' notice, and if it is not forthcoming supply can be discontinued. Also that if an undertaking has to be cut off for non-payment of account, it can charge for the expenses of disconnection. These are only random points out of the many in the Acts concerning the relations of consumer and undertaking, all of which should be known. Properly, of course, not only the manager, but all officials who are brought into contact with consumers, should, as a necessary part of their duties, be required to "read, mark, learn," and have at their fingers' ends, all the chief points of the Acts as regards duties to and of consumers.

Agricultural Exhibition at Darlington.

On Tuesday, June 29th, the Royal Agricultural Society of England will open its annual show at Darlington. We may remind our readers that the scope of this well-known exhibition is a very wide one, and that it affords an excellent opportunity for bringing electrical apparatus to the notice of farmers and other residents in the country, as well as town-dwellers, thus opening a market of unlimited possibilities. Last year, at Cardiff, the local supply authorities took advantage of the occasion to organise a publicity effort on a large scale, with gratifying results, and it is to be hoped that the Electricity Committee at Darlington will not let slip the chance of going one better.

The agricultural implement trials do not yet provide a class for electrical ploughing, except under the head of self-propelled ploughs, for which medals and prizes are offered; but electric motors and electrically-driven machines can be exhibited, though, so far as we can ascertain from the regulations, no explicit provision is made for a supply of electricity for the purpose of showing them in motion—a regettable oversight, which may, perhaps, be only apparent. The directors of so important a show ought to lead the way in a matter such as this, not to wait until the question is forced upon their notice. In addition to agricultural articles, there are many categories under which other electrical appliances may be shown, such as carriages, cycles, industrial vehicles, washing machines, culinary appliances, ice-making machines, domestic appliances and household fittings, driving belts, books, sewing machines, lubricators, &c. All such entries must be made on or before March 20th, but agricultural articles can be entered up to April 1st, on payment of double fees. We hope the electrical industries will be strongly represented.

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A NEW METHOD OF MEASURING HEAVY DIRECT CURRENTS.

By R. E. NEALE.

The usual method of measuring heavy direct currents is by means of a moving-coil ammeter (of the millivoltmeter type) connected to the terminals of a shunt in the main circuit. This method is satisfactory when the measuring instrument is not far from the heavy-current conductor, except that the energy loss in the shunt itself becomes a serious item if very heavy currents are carried. If, however, the measuring instrument be 200 or 300 yards from the heavy-current cable, the pilot leads must be of large cross-section in order that the drop in them may be a minimum, and even then the voltage drop which must be provided across the terminals of the shunt, in order to obtain satisfactory operation, is so high that there is serious dissipation of energy in the shunt. If measurements are to be over yet longer distances, the cost of pilot leads and the loss in the main shunt become almost prohibitive. In order to overcome these difficulties, reliance has been placed in the past upon telephonic communication of instrument readings, or upon the use of repeating instruments of various kinds.

An interesting and entirely novel method of measuring heavy direct currents at a distance has been devised by Ernst Besag, and is now in use at Frankfort-on-Main. The following particulars are from an article in *Elektrotechnische Zeitschrift*. The method depends upon change in the choking effect of a choking coil fed with alternating current, when the iron core of the coil is magnetised by the direct current to be measured as well as by the alternating

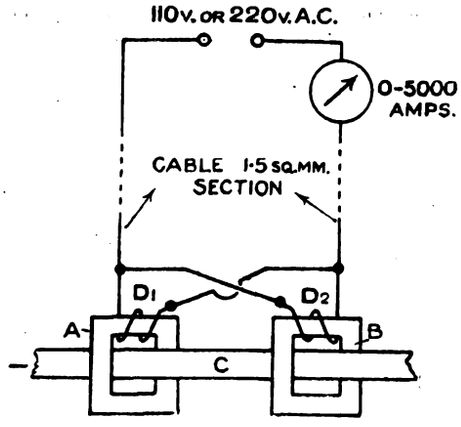

Fig. 1.

current. Referring to fig. 1, the heavy-current conductor, C, is surrounded by two iron ring-cores, on which are wound the coils D_1, D_2. These coils are connected so that there is no resultant effect on the current in C due to transformer effect from the alternating-current windings. The terminals of the latter are connected to the distant station, as shown, and an alternating-current ammeter is placed where the current indications are required; A.C. supply at 110 volts or 220 volts is connected to the measuring circuit, and it is necessary that this supply be of constant voltage, frequency, and wave form, within the limits now usual in turbo-alternator stations.

When there is no current flowing in C, the coils D_1, D_2 exert an almost pure choking effect, and the A.C. ammeter reads practically zero. As the current in C increases, so does the magnetic saturation of the cores A and B, hence the choking effect of D_1, D_2 decreases, and the alternating current in the measuring circuit increases. For each value of the main direct current there is a definite value of the alternating current, hence the A.C. ammeter may be calibrated to read directly the direct-current amperes. By using a pressure of 110 or 220 volts in the A.C. circuit, the requisite current may be kept so low that quite small leads may be used without introducing any appreciable error from the voltage drop in these conductors.

The municipal tramway network of Frankfort-on-Main is supplied principally by turbo-generators in the No. 1 station, but if the capacity of the latter is exceeded the surplus requirements are supplied from a converter station, which is about 2½ km. from the generating station. Hitherto the economical distribution of load between the new plants has necessitated continuous telephonic communication, but the new system of measurement has now been adopted, and there is in the generating station an A.C. ammeter calibrated to read up to 5,000 amperes D.C., and connected to choking coils in the sub-station by a pair of 1·5 sq. mm. leads. The sub-station is similarly equipped with a 5,000-ampere ammeter, indicating the bus-bar load on the generating station. The resistance of each measuring circuit is about 70 ohms, and the town supply of 120 volts, 45·3 cycles is used in the measuring circuit.

The oscillograms reproduced in fig. 2 were obtained by using the power supply (220 volts, 45·3 cycles) in the measuring circuit and by replacing the heavy-current conductor C (fig. 1), for the purpose of this test, by a D.C. winding on each iron core. When the direct current was zero, the A.C. in the measuring circuit was almost exactly 90° out of phase with the impressed voltage. With increasing values of direct current, the alternating current increased as shown, and its phase displacement was reduced, but never fell below about 70°, so that the power consumption in the A.C. circuit remained small throughout. The current values shown in fig. 2 are the values of direct current used in the auxiliary winding of the iron cores, and not the A.C. amperes in the measuring circuit.

Under the conditions obtaining in Frankfort, heavy direct currents may be measured by this method with an error not exceeding ± 2 per cent.

Apart from its value in long-distance measurement, the new method offers the advantage of eliminating shunt losses

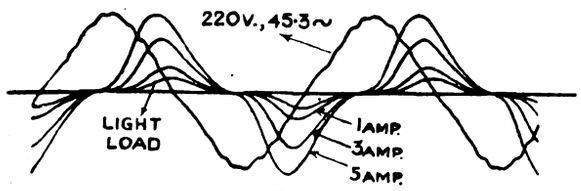

Fig. 2.

which are serious, where heavy currents are concerned, even if the indicating instrument be near the main conductor. Another advantage, which will be more appreciated now that high-tension D.C. is being used so extensively for traction purposes, is that the pilot leads used in Besag's method need be insulated only for 110 or 220 volts D.C., and not for the voltage of the main circuit. Apart from the economy thus effected, operating risks are reduced by eliminating direct electrical connection between the switchboard and the high-voltage D.C. circuit. An important possible application of the new method is to the measurement of the charging or discharging current of cells in a distant battery sub-station.

Alternating current for the measuring circuit is almost invariably available in these days of A.C. generation and transmission, and if it were not immediately available, it would often be worth while to install a small converter in order to make possible the use of this method.

(A possible modification of this method which suggests itself would be to use a single iron core round the heavy D.C. conductor, say, A, fig. 1, and to connect a winding D_1 on this core to a fluxmeter. The fluxmeter being set to zero when no current was flowing in C, the deflection of the instrument should thereafter be proportional to the magnetisation of A, and thus to the current flowing in C. The law would not be linear, owing to magnetic saturation of the iron core, but it would be practicable to calibrate the fluxmeter to indicate directly the corresponding values of the main current. This method would not be applicable to long-distance measurement, owing to the very small E.M.F.'s produced by changes in the magnetisation of A, but it may have its application in certain special cases, and if so, it would offer the advantage of eliminating the A.C. supply required by Besag's method. Errors due to hysteresis and remanent magnetism could generally be minimised by providing a suitable air gap in the magnetic circuit.—Eds.)

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MAGNETIC STORMS AS AFFECTING OCEAN TELEGRAPH CABLES.

(Supplementary Notes.)

By EDWARD RAYMOND-BARKER.

Since the appearance of the article under the above heading in The Electrical Review of December 19th and December 26th, 1919, appreciative letters from observatory and from ocean cable telegraph stations have reached the present writer.

A leading authority at a great cable station, writing on this subject for the first time, has used the following words: "Your suggestion is a good one, and ought to find place with all cable administrations . . ."

Letters, in fact, show that the writer's plea for advisory notices by "wireless" has been endorsed by excellent authority, and, therefore, holds good. That is to say, the proposal is recognised as a good one, that on occasions—fortunately of rare occurrence—of serious magnetic disturbance, especially when this evinces abrupt variations of magnetic force, notice from the Director of the Meteorological Office should be spread abroad by "wireless" as early as practicable to cable stations and especially to cable-repair ships on the high seas.

Owing to the protective action of the cable condensers which, when unshunted, block out all earth currents excepting those characterised by *abrupt* changes in polarity or in potential, a cable station staff intent on maintaining, by auto-transmission and auto-relays or amplifiers, uninterrupted duplex flow of message traffic, might, during the *earlier* stages of a magnetic storm, remain quite unaware of impending trouble, and so would cordially welcome the magnetic observatory's timely intimation.

By the electrical staff on a cable ship, cut off from much information known at the cable stations, and about to cut into a cable just raised, perhaps, through some three miles depth of water (see E.R., December 26th, 1919, col. 1, line 35), magnetic storm data certainly would be very keenly appreciated.

In this connection, it is interesting to note that, as regards the famous magnetic storm of August 11th and 12th last, news to hand from a big station informs us that, at the end of the storm, two, if not three, faults directly due to its effects were found in the cables.

So far, then, this suggestion as to "wirelessed" advisory notices from the Meteorological Office has met with approval; nevertheless, the present writer, apparently, has gone too far in his assumption that magnetic storm *forecasts* would be practicable. In like manner, in his former article, he has gone astray in assuming that the routine information, issued—as Dr. Chree in his I.E.E. lecture has told us—week by week by the Director of the Meteorological Office to the Institution of Mining Engineers, customarily includes *warnings* of approaching magnetic storms.

In a generously informative letter (December 31st) to the present writer, Dr. Charles Chree, F.R.S., Superintendent of Kew Observatory, has shown that "what is issued for the benefit of mining engineers is historical not prophetic information."

"Every Wednesday," Dr. Chree tells us, "the magnetic history of the week ending on the previous Saturday" is sent from Kew Observatory to "certain journals. . . . No journal other than those devoted to mining interests has as yet applied for the information."

Furthermore, Dr. Chree's letter states that the photographic sheet upon which magnetic variations are recorded, serves for two successive days before it is taken from the instrument to be developed, so that, altogether, in the normal course of events, without special arrangements being made, two or three days must elapse on the average before the complete information relative to any particular day becomes available.

However, as Dr. Chree now points out: "If obtaining very early information were considered important enough to make the question of cost immaterial, special arrangements could be made, *e.g.*, an eye-reading instrument would be set up and read at frequent intervals, or a special magnetograph could be set up with arrangements for developing the record at short intervals."

The Rev. Father A. L. Cortie, S.J., Director of Stonyhurst College Observatory, likewise has most kindly found time to write on the same subject about which he makes, *inter alia*, the following observations:

". . . The difficulty of giving warnings is that since the records are photographic, one cannot tell that the magnets have been disturbed until the curves have been developed. We can take eye observations, but no one as a rule thinks of looking through the telescopes until we know that a disturbance is taking place. Pen and ink records on a drum would be preferable for all self-recording instruments. . . ."

From all the foregoing matter, one may draw the following conclusions:—

If ocean telegraph cable authorities thought it desirable to acquire from the Meteorological Office notification of serious magnetic disturbance, and were ready to make good any additional expenditure, magnetic observatories would have it in their power to make special arrangements for early detection of any heavy perturbations that might occur.

Long-range radio systems, Admiralty or Marconi or Tour Eiffel, amongst others, might be utilised to reach distant cable ships known to be at work. As already mentioned in a former article, many cable stations now have their own antennæ, though what their actual transmission range amounts to, the writer is unable to state. Cable stations would, in many cases, be able to verify observatory warnings as to threatening earth-current disturbances, though it must not be forgotten that, as Dr. Chree now tells us, "there are storms and storms. Only some seem to have large accompanying earth currents; those apparently in which there are specially rapid magnetic oscillations are the most disturbing."

Finally, one cannot refrain from suggesting that once it be deemed desirable for the well-being, whether of mining engineers or of the cable telegraph service, to see and appreciate magnetometric conditions at any given moment, at a glance, a spare magnetic *declination* bar might be arranged and set up as a non-recording instrument.

Protected from draughts in a glazed case and with condensed light thrown on to the fixed and the movable half-disk mirrors (*fixed* for zero and *movable* for variations), reflected luminous images or "spots" of considerable size might be projected an extensive radial distance; the movable "spot" being free to sweep the whole length of a long and wide graduated scale. This arrangement would offer the utmost facility for cursory inspection by an observer normally engaged in other work, but always within view of the great graduated scale.

In concluding these few notes, one may be allowed to mention that a detailed and beautifully illustrated description of photographically self-recording magnetometers, as used at Kew and at Stonyhurst College, is given in Gordon's "Physical Treatise on Electricity and Magnetism," Vol. 1 (Samson Low, Marston & Co., Ltd., 100, Southwark Street, London, S.E. 1).

Since the above was written, The Electrical Review, January 16th, 1920, p. 82, under the heading "Wireless Meteorological Information," has published an interesting quotation from an Admiralty notice to

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mariners in the *London Gazette*, January 6th. In it occur the following words: ". . . Negotiations are in hand to extend and unify the system of collecting weather data by wireless from ships at sea all over the world, and, at the same time, to organise the free transmission of weather bulletins *to admit of ships being constantly supplied with reliable weather reports and forecasts wherever they may be . . . .*" (Italics, the writer's.)

Clearly, once the radiotelegraphic distribution of magnetic-storm notices to ships at work on submarine cables has officially been recognised as desirable, it is evident that the necessary organisation for the said distribution of information lies here ready at hand.

THE WORKING CONDITIONS OF MAINS STAFFS.

By WILFRED WELLS.

The notion that he works considerably harder than the average person is a harmless conceit, shared, we suppose, by most men. The number of persons in the world having soft jobs is by no means negligible, but rarely will one find a man who will admit that he has one. Rather, such individuals are mostly zealous in demonstrating to their acquaintances how hard they work, and how exhausting their work is. The relationship between the actual amount of work done by a man and the amount he tells other people he does, is more appropriately represented geometrically by a rectangular hyperbola, than by a straight line passing through the origin. Certainly it is a fact that the central station man, whose hours have been indefinite, and whose relaxations few, has in the past had less to say about the hardness with which he worked than have elementary school teachers, whose hours average under 30 per week, and whose annual leave is something like eight weeks.

There is little doubt, however, that in the earlier days of electricity supply, the lot of the central station man was by no means easy. The imperfections of the generating plant and switchgear of this period made the possibility of breakdown very much greater than is the case at present. And, in addition, the normal running of the station of 15 years ago was not the comparatively uneventful business it is to-day. Especially in these early days was the position of the engineer-in-charge—or the shift engineer, as he was then designated—unenviable, and it is no matter for wonder that only men of the right temperament were able to stand up to the work for any length of time. The successive advances in the design of central-station plant have largely eliminated the likelihood of breakdown and the difficulties of operation, and, with the larger units now in general use, the work of the engineer-in-charge is rather in the boiler house than in the engine room or in the switch room. The worries of the charge engineer are now much smaller, and with an adequate provision of spare plant, and some reasonably good coal, his lot, from the point of view of routine duties, is very much easier. The general adoption of a normal 48-hour week, and the improvement in rates of pay that now, happily, are becoming more general, are, of course, all to the good.

The general conditions of working for central-station staffs vary greatly with the nature of the work. The technical departments can be divided into works, mains, testing, and sales sections. Those in the testing department are in many ways the most fortunate, as their hours are fixed, and when they leave the works they do so with the assurance that they are free till the next morning. Junior members of this department may, of course, consider that the tedious nature of their work is a set-off against this advantage. The superintendent of the testing department, however, in the matter of hours, is much better circumstanced than his colleagues in other departments.

The hours of working amongst the sales or publicity staff are not so well defined, as much of this work must needs be done in the evening. The work of the sales department is, however, not largely of a routine nature, and it seems possible that arrangements can without difficulty be made whereby compensation can be obtained for evening work in the way of leave during the daytime. The fact that the remuneration of the publicity staff usually depends more or less upon the work they put in, is a further compensation for irregularity of hours.

It is when the conditions under which the works and mains staffs work are examined that real hardship is often found to exist. It does not require very much effort to demonstrate that the lot of the station superintendent of a works of moderate size, even where up-to-date plant is installed, is not all that it might be. The story so ably told by "Ann Assette" in recent issues of this journal, although erring perhaps a little on the side of exaggeration, was nevertheless in the main a true picture of the life and career of an engineer connected with the works side of central-station life. In the course of this story, however, little was said of the conditions under which the mains engineer works, the sole reference to the mains department being the mention of a Chief who spent the whole of one Christmas Day in locating a fault. However true to life such a story may have been ten or fifteen years ago, it is hardly applicable to present-day circumstances, and it is safe to assume that the average Chief of to-day, so far from spending Christmas, or for the matter of that, any other day, in locating a mains fault, would be very content to delegate this interesting job to a member of his mains staff.

The normal duties of the mains staff are fairly well defined, and are about the same in all undertakings. The time of this staff is well occupied with superintending maintenance, service, and extension works; and this work, it must be remembered, cannot always be carried out during normal working hours. Important jobs usually have to be carried out during week-ends, and these are just the jobs that require the closest and most lengthy supervision. A considerable number of hours, outside those usually considered to constitute the normal working day, have, in addition, to be devoted to testing. In addition to supervisory duties, the mains staff usually have an appreciable amount of clerical work in the office to be attended to, and in all but the larger undertakings they are expected to keep the system of plans and records up to date. The normal duties, therefore, are usually sufficient to keep the mains engineers fairly busy, although undoubtedly times of stress are more or less balanced by periods of purely routine work, when the supervision and clerical work required are fairly light. The life of a mains engineer is, moreover, a healthy one, and the freedom of movement that must necessarily be assigned to all members of the mains staff, is very congenial even to the most conscientious man who is the least likely to abuse this privilege. If the duties of a mains engineer ended here, it is probable that, as a class, they would be fairly contented with the conditions under which they worked, being quite willing to put in the extra time at week-ends that is often required.

In addition, however, to all the foregoing, there is a further call on the time and energies of the mains engineer that is based upon the principle that at all times the services of one of the mains staff shall be obtainable at short notice to deal with any cable breakdown that may take place. This, from the standpoint

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of the undertaking, is perfectly reasonable, and indeed necessary, and it is sometimes assumed that in this matter the mains engineer is in a similar position to the station superintendent. This is by no means true, owing to the fact that unlike the works, the mains do not require a staff to see that they perform their functions, and that, consequently, if the smallest or most trifling of troubles occurs, there is not necessarily any man at hand to attend to it. As there is always an engineer-in-charge at the works, the difference in this respect between the station and the mains engineer is apparent.

The means adopted for complying with the theoretical requirement of the availability of mains engineers vary very greatly from place to place. Among the larger undertakings it was not unknown for three shifts of mains engineers, jointers, and mates, to be run, thus ensuring that at any hour during the day or night, an adequate staff was available to tackle a fault. In other undertakings, one or more members of the mains staff were required to be in attendance during the evenings, while in the majority of stations it was considered sufficient for one engineer to be at some known place in the town where he could receive a communication either by telephone or by messenger within a reasonably short time. The position of the mains engineer, standing by, on the occurrence of a fault, largely depended upon the arrangements made for his assistance. One engineer obviously cannot tackle a serious fault single-handed; but this obvious fact was often overlooked, with the result that the unfortunate engineer had first of all to hunt round the town for a jointer to render the necessary assistance. It is true that in most works there is a wireman or meter fixer on duty during the evening to attend to complaints of light failure, but it was useless to rely on this man for help, as it frequently happened that when wanted for this purpose he was in the furthermost corner of the district replacing a 5-ampere fuse in a distribution board. The theoretical requirement of the availability of a mains engineer for attention to breakdown is, too, often disregarded during the daytime. In one undertaking in which one engineer was supposed every evening to be in attendance at the works, it was not unusual for the whole of the technical mains staff to be out during the greater part of the day. During the time of the power load, therefore, when the consequences of a breakdown would have been most serious to the most important consumers, it might easily happen that none of the mains staff could be got at for some considerable time, and when they were, considerable difficulty might be experienced in getting a jointer to render the necessary assistance. The number of stations where arrangements are made for the services of an engineer, jointer, and mate to be instantly available during the daytime is probably very small. And yet, it cannot be denied that the shutting down of a large works is more important, if not as spectacular, as 200 yards of one side of the High Street being in darkness. It appears, therefore, that the only sure way of guarding against delay in the clearing of a mains fault, is to provide three shifts of engineers, jointers, and mates, and in any other scheme certain risks have to be run. The three shifts would, of course, entail prohibitive expenditure in all but the large undertakings, and, therefore, we find that risks have to be taken in the smaller works. These risks can, however, be minimised by a little careful arrangement, but at all events, it seems quite clear that the services of a jointer and mate should be instantly available during the evening hours, when the heavy lighting load is on. This availability can only be obtained by the attendance of these men at the works; any other system places upon the shoulders of the mains engineer on duty the additional worry and trouble of having to turn his jointer out, if a fault occurs. It will, of course, cost money to keep a jointer and mate at the works each evening, whilst the standing-by of the mains engineers is supposed to be remunerated by the salaries of these fortunate men. There is little doubt that, in times past, there has been considerable tendency to take advantage of the fact that the mains staff are salaried officials, and to require of them unfair hours of attendance, and also to saddle them with additional trouble to the all-sufficient annoyance of having to clear a cable breakdown.

There is a further aspect of the availability of the mains engineers that requires notice, and that is the fact that they are worried by any little trifling thing occurring outside the works that may require attention after working hours, unless there is a man in attendance to see to such small matters. A lamp-post, for instance, is knocked down in a remote corner of the town; it is reported to the mains engineer, and he, being a concientious man, will probably not be able to rest content till he is assured that somebody has been found to attend to the matter. There are numerous small troubles that are always likely to occur, but which do not need the attention of an engineer, and, seeing that he is not paid for the extra time he puts in, it is hardly equitable that he should be bothered with such matters as do not need his attention. Happy are the mains engineers where there is a capable mains foreman living on or near the works, who is competent to attend to all matters up to, say, and including the isolation of a faulty distributor length, and the question suggests itself why such a man is not to be found in all but the smallest undertakings. Mains engineers might well ask themselves this question, and consider whether it is not sufficient to be called out in the evening or during the night for only such matters as really require their attention, and for no others.

Enough has been written to show that the life of a mains engineer, although it has certain advantages, is not all that it might be, and the restraint upon his movements after a day's work, or, as it has been expressively styled, "being on the dog chain," is not a little irksome. A certain amount of restraint must necessarily always remain, excepting, perhaps, in the largest undertakings, but there seems no reason why it should not be very much less than it has been in many places, it seeming only right and proper that those undertakings which desire a high degree of security against delay in clearing faults should be prepared to pay for what they require.

A Swedish Company's Activity.—A heavy fall in the quotations for the shares of Luth & Rosens Elektriska Aktiebolag has induced Mr. Asel Hultman, on behalf of the directors, to give an explanation of the situation in *Srenska Dagbladet*, of February 20th, although the definite figures for 1919 have not yet been ascertained. He states that although the turnover increased from 26 millions kronor in 1918 to 29 millions last year, the results seem to show a not inconsiderable loss. This is attributed to the large fall in prices of materials and the consequent unfavourable sale prices, and the necessity for writing down the large stocks which the company was compelled to keep; to the replacement of plant, and the constant increases in wages, as it was necessary to maintain operations at the Eskilstuna Works, despite large losses. The reserve funds will be inadequate to cover the latter, and a portion must be carried forward. Mr. Hultman further states that an increased demand for the company's manufactures has been manifested in the home market in the present year (1920), and in the export market the company has succeeded in forming some valuable foreign connections, which, together with former relations, seem to hold out the prospect of yielding considerable orders to the company. The directors have taken measures for expanding the production of standard articles, and that of electrical machinery has more than doubled. Under these circumstances, the hope is expressed that the company's activity will soon again become profitable.

Railway Electrification Catalogues Wanted in Canada.—H.M. Trade Commissioner at Toronto (Mr. F. W. Field) in a communication to the D.O.T., states that Mr. S. B. Clement, chief engineer of the Temiskaming and Northern Ontario Railway (Ontario Government Railway), North Bay, Ontario, wishes to receive from United Kingdom firms interested in the electrification of steam railways, details of the work of this nature which they have done in other countries, together with catalogues and other literature on the subject. It is stated that the electrification of the Ontario Government's railway, comprising a mileage of 342 may be considered at a later date.

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CORRESPONDENCE.

Letters received by us after 5 P.M. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Electrolytic Meters.

Mr. Marshall, in his reply to our letter in the Electrical Review of February 13th, speaks of the relative use of electrolytic meters; this relative comparison should be made by comparing the number of meters in use on D.C. circuits of smaller consumers—say up to 20/25 amperes capacity—which small consumers are now rapidly increasing. This is where the electrolytic meter tells, as indicated in our previous letter; when the supply is to a small consumer using one-watt or half-watt lamps, a motor meter is very apt to refuse to start, hence the increasing use of electrolytic meters of late years. Our output has, in any case, been considerably in excess of even pre-war figures in spite of difficulties as regards supplies of raw material—this latter condition we are aware applies to all—but we mention it as our output would otherwise be far greater.

As regards maintenance cost, apart from filling, this is nil; we have meters still working which were installed 25 years ago; and as regards filling, this is a minute's work, done at the time of reading, perhaps once a year or perhaps not so often.

With reference to the letter from your correspondent "A. W. C.," in your issue of the 27th ult., we would point out that *every* electrolytic meter is not affected by vibration or dampness, as neither of these will affect the Bastian electrolytic meter, nor is it necessary to make a further visit to note whether the meter is working or not. As regards life and maintenance, our letter in reply to Mr. Marshall deals with this.

The Bastian Meter Co., Ltd.,
Albert E. Salisbury,
Managing Director.

London, N.W.
March 1st, 1920.

Your correspondent "A. W. C." writes in general terms on this subject, but inasmuch as his criticisms chiefly concern one type, it would appear that he has no knowledge of another, and is not, therefore, in a position to write with the authority he assumes. From the point of view of the "Bastian Meter" most of his remarks can be adequately met by a plain denial of the faults he details.

This meter is not affected by either damp or vibration. It does not require extra head-room for resetting. Anyone can see at a glance whether it is working.

The question as to who should refill or reset an electrolytic meter may well be left to the discretion of the supply authority concerned.

As regards "life," perhaps "A. W. C." will supply the data on which he bases his rather sweeping assertion.

Jas. Bastian.

London, N.
March 1st, 1920.

I have been following with interest the comments in your correspondence column with reference to Mr. Marshall's recent article on the above. Having had considerable experience under various working conditions with both types, I would like to add that in my opinion the main causes of alleged "failure" in the electrolytic meter lie not so much in the meter itself as in the position in which it is installed, and also the system under which it is read and reset upon consumers' premises. It should be borne in mind that these meters are as a rule subject to electrolysis troubles when placed in a damp atmosphere, and are also more or less apt to be affected by vibration. Care should therefore be taken to see that these conditions are not present when selecting a site for a meter of this class.

I find, however, that taking the question of meters as a whole, and where price has not been the only consideration, the mercury motor type has been found to give the greatest all-round satisfaction; nevertheless I have also found that where a cheap meter is the main object in view, and for very small consumers generally, most of the difficulties mentioned by your correspondents can be overcome by observing the following rules:—

1. Do not install in a position subject to extreme vibration, such as over or near a door that is liable to be "banged," in the vicinity of heavy machinery in motion, or a locality where the atmosphere is subjected to extreme moisture, steam, or fumes of any sort.

2. Always fix in a position where the readings may be taken on a level with the eye of the reader, as some meters are provided with scales with minute unit divisions, and it has been found that unless the eye can be placed on a level with the liquid big errors in the readings are liable to occur. (It should not be difficult to find a suitable site in the average modern small dwelling-house.)

As regards resetting, I have found that the best plan is to make a point of doing this (whether the meter requires it or not) at the reading following the period for which the account is due, and in cases of known "sceptical" consumers or an apparent abnormal consumption, the attention of the consumer concerned or a member of his household should be asked to check such reading before the meter is opened. This allows time for any disputes to be settled, and also does away with any possibility of readings getting "over the top." It need scarcely be added that all readings should be carefully entered upon the consumer's card, which should be hung near the meter.

In cases where there are a large number of small consumers supplied through these meters, it should not be considered a loss to the undertaking, if one or two have to be met occasionally over a disputed account, as the initial cost of a large number would amply compensate for this.

In conclusion, I am sure, however, that any practical suggestions regarding a cheap and efficient mercury motor meter which Mr. Marshall could offer, would be welcomed by the community at large.

J. R. Willingham.

Llanelly.
March 1st, 1920.

Electric Furnace Nomenclature.

We receive a number of inquiries from electrical firms for furnaces for "tempering" steel. In the majority of cases what is really required is a furnace for "hardening" steel.

In view of the activities of our gas friends, we think that it would be well for electrical engineers to acquaint themselves more fully with the correct technical terms.

Hardening and tempering are distinct heat treatment processes; hardening involves heating up to a high temperature, say, anything over 750 deg. C., according to the nature of the steel. Tempering involves reheating after hardening to a comparatively low temperature, generally between 200 and 300 deg. C., according to the nature of the work that the steel has subsequently to perform.

If electrical heating service is to progress, it is, in our opinion, most important that there shall be no uncertainties introduced into our speech or writings by the use of careless terminology.

Automatic and Electric Furnaces, Ltd.
E. P. Barfield.

London.
February 26th, 1920.

The Einstein Theory.

One of your recent editorials on the Einstein theory led me to believe that the following explanation of the fourth dimension might be of interest, if not taken too seriously. It must be conceded that it is at least logical, and that it is a clearer, briefer, and more concise statement than those of Einstein and his followers.

When a point, which has no dimensions, is moved, it generates a line, which has one dimension. When this line is moved it generates a surface, which has two dimensions. When this surface is moved is generates a solid, which has three dimensions. Hence (logically at least) when a solid is moved it should be a case of the fourth dimension. The simple, commonplace, act of throwing a brick at a man would, therefore, seem to constitute a problem in the fourth dimension.

I agree with you and others that it is very regrettable that not even those who profess to understand the Einstein theory can give a clear and simple explanation of at least the underlying principles of it, in plain, every-day English terms.

Carl Hering.

Philadelphia, U.S.A.
February 13th, 1920.

[We refer to this subject in our leading columns to-day.—Eds. Elec. Rev.]

Finland's Water Power.—According to a report by the United States Diplomatic Commissioner at Helsingfors, the water power available for Finland's industries in the many rivers of the country is quite large, but it has been much overrated. It has recently been calculated by an expert, Prof. A. Juselius, that at mean water level it may amount to 3,000,000 effective H.P., but only a fractional part can be put to practical use within the reasonably near future. A large portion of the water power is situated in parts of northern Finland so remote that for a long time to come it will be impossible to build any industrial establishment there. Furthermore, the available water power is restricted both by the stipulations in the water-power laws regarding the protection of the river channel and by agricultural interests. It should also be considered that the water power is not generally produced by high falls, but is gathered from long sloping stretches of the river; consequently the hydraulic works are very expensive. Prof. Juselius has estimated the water power that within a reasonable future will be available for Finland's industries at 900,000 H.P. effective at the shaft of the turbine.

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LEGAL.

Compensation Claim.

At Blackpool County Court, on February 25th, Judge Sturges, K.C., heard an application by Mark W. Kennedy for compensation against Blackpool, St. Annes & Lytham Tramways Co. The judge adjourned the case for three months, applicant to be paid full compensation and to try the work of a switchboard attendant.

Direct W.S. Cable Co., Ltd. v. Western Union Telegraph Co., Ltd.

This action, the hearing of which was adjourned from February 23rd, did not again come before Mr. Justice Peterson, in the Chancery Division, until February 27th, when Mr. Douglas Hogg, K.C., addressed the Court for the plaintiff, and was followed on March 1st and 2nd by Mr. Mark Rome, K.C., for the defendant. He argued that it was impossible to do the repairs owing to the difficulty, during the war, of obtaining repairing ships. The interruptions complained of, he said, were the result of the action of the Admiralty alone. His Lordship reserved judgment.

Atkinson v. Newcastle Corporation.

At Newcastle-on-Tyne Assizes, on February 27th, before Justice Bailhache and a special jury, Albert Edward Atkinson, stained glass expert, brought an action against Newcastle Corporation for damages for personal injuries due to the negligence of employés in charge of a tramcar in June last.

Mr. Mitchell Innes, K.C., for the plaintiff, said the injuries received by Mr. Atkinson were of a very serious character. On the occasion of the Gosforth races, last June, Mr. Atkinson and his wife and friends went there. When they were leaving the Park, plaintiff and his wife and friends were under police direction passed through between two cars. All got through but plaintiff, and while he was passing through, the front car suddenly backed, and jammed plaintiff between the two vehicles. Both plaintiff's legs were severely crushed, the thighbone of one being broken.

Mr. F. A. Atkinson, plaintiff's brother and partner, estimated that his brother's illness had resulted in a loss of work worth £2,100 last year, the profit on which was about £1,500. This year he expected he could have got orders worth £6,000, but would be unable to execute more than half, in consequence of his brother's illness.

The jury found for the plaintiff, and awarded £1,158 14s. damages.

TRANSFORMERS FOR ELECTRIC FURNACES.

At Glasgow, on February 10th, Mr. J. L. Thompson read his paper, an abstract of which appeared in our issue of January 30th, to the Scottish Centre of the Institution of Electrical Engineers. In the subsequent discussion Mr. R. B. Mitchell said it seemed to him that the introduction of reactance is most important and essential in the case of transformers for furnace work. In comparing frequencies of 25 and 50 for furnace work there was, he understood, a considerable difference in the cost of the transformer in favour of the higher frequency. High tension tappings had all along been a source of weakness, and he dared to say would have been discarded if there had been no extra cost involved in the provision of regulating apparatus. He was certain that in spite of the extra cost, these appliances would ultimately be adopted. He accepted Mr. Thompson's statement that units of 8,000 K.V.A. capacity were probable in the future, and the handling of these loads was only one of the problems which the supply engineer would have to face. He trusted that in Glasgow, at all events, furnaces of that capacity would not be located very far away from the power station. Also it was another argument in favour of transmission cables for much higher pressures than, say, 20,000 volts. In this connection did the author think it advisable to build up to 8,000 K.V.A. capacity in one unit, and, if there were disadvantages in not doing so, what were these? In the Glasgow area there was a Scott-connected transformer for furnace work, but he had not heard that there had been any out of balance trouble on account of the connections. As to the advantages and disadvantages of the core and shell types, one usually had a natural preference in the case of ordinary power transformers for the core type on account of the accessibility of the coils. Mr. Thomson seemed to work out a case for the shell type. Had he any data as to the performances of these two types in actual work?

Mr. W. L. Wood said he had witnessed the dismantling of a furnace transformer, when it was found that the insulation of the inner portion of the winding was very brittle and in some places charred, showing that this portion developed a high temperature, and it was suggested that the more liberal use of separators providing a larger cooling surface would lengthen the life of the insulation. It was also noticed that a large amount of sludging had taken place in the transformers.

Mr. A. P. Robertson pointed out that there was enough matter for a paper on transformers for arc furnaces. The conditions were much more severe in the arc furnaces when compared with the resistance furnaces due to the short circuit when the arc was struck. One of the reasons was that the mechanism for moving the carbons was too slow. In the furnaces he had seen the arc was struck by hand, and although it might be only a second or so before the carbons were separated, this gave time for very severe stress on the transformer. If the carbons were to stick together, the transformer might be seriously damaged unless the protection on the H.T. oil break switch was very positive. The contacts of this switch required a good deal of attention, as the switch operated very frequently. The arcing tips should be extra heavy and easily renewable. With regard to the H.T. selector switches, these were often air break switches, which necessitated the use of copper rod between the switches and the transformer terminals. It was not a safe job, and the speaker believed that in more recent jobs immersed selector switches were used and solid conductors run between these and the transformer. The bracing of the L.T. leads must be very strong to keep them apart. During the time the arc was being struck, the L.T. leads vibrated very much. The flexible leads to the carbons were pulled close together and became rigid. The current during this time was very high, and was generally outside the compass of the ammeter. As the current fell, the leads lost their cohesion and became flexible again. The author mentioned that there was a probability in the near future of larger units of 8,000 K.V.A. He (Mr. Robertson) thought the transformer makers should keep in view the weights of these transformers. If necessary, they might be made in two or three smaller units worked in parallel. It was not always easy to move large weights, and the transformer houses were not always very roomy. Although the transformers were not likely to be moved once they were in position, if any repairs had to be done, the easier the units were to handle the less time would be spent in repairs. To put up a power crane for this purpose would be tying up a great amount of capital for very occasional use.

Mr. G. M. S. Sichel asked how the regulation of special transformers compared with the regulation of the ordinary industrial transformer operating at normal. The regulation would, of course, depend on the power factor of the circuit, but for the purpose of comparison they might assume similar conditions. With regard to the author's statement that the low-tension heavy current winding consisted of bare conductors, he recalled a paper read before the Institution some years ago, dealing with the formation of sludge in transformers, in which the statement was made that there was a much greater tendency for sludge to form on bare copper conductors than on conductors having a covering of insulation, and it would appear desirable that the heavy current secondary winding be covered with, say, a single layer of tape, in order to prevent the formation of sludge. The tendency to sludge was aggravated if the temperature at which the transformer was operating was high, and it was reasonable to expect higher temperatures on transformers working in proximity to furnaces than in transformers working under usual industrial conditions. Next, with regard to the protective gear required for furnace transformers; in all wiring diagrams showing the lay-out of furnace transformers the only protection provided appeared to be that afforded by the use of an ordinary time limit fuse or fuses, which shunt the oil switch trip coils; as the behaviour of the time limit fuses did not generally give constant results, he would be interested to know whether the practice of protecting furnace transformers with time limit fuses had, in the past, been found to be satisfactory, more particularly bearing in mind the extremely violent and frequent fluctuations of the current during the melting period. The problem of dealing with conductors carrying one to two thousand amperes was a simple one, but when the current to be dealt with ran into the tens of thousands, they could not solve the problem by simply multiplying the cross-sectional area of the conductors. The factor of self-inductance, which might be negligible when dealing with small currents, became of such importance when dealing with very large currents, that it might easily completely outweigh almost all other considerations. He noted that the author stated there was a limit to the size of furnace transformers that could be built, and it would appear, therefore, that if provision had to be made for dealing with a very large output from furnace transformers, it would be necessary to have several banks of transformers with their own furnaces, and he asked the author to state what would be the best lay-out for electrical furnaces and transformers to deal with a large output, more particularly with regard to the disturbance which would be caused to the supply mains if several banks of furnace transformers were to be switched in simultaneously. Even if some kind of electrical interlock could be arranged between the oil switches controlling the various banks of transformers, there always appeared to be a danger of current rushes taking place simultaneously in several banks of transformers during the melting period. The same effect on the supply mains would be produced by furnace transformers in different works in the same district switching in simultaneously, and the effect on the supply mains and generating plant might be very serious.

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Mr. Thomson, in his reply, said Mr. Mitchell's point on reactances would depend on the type of furnace. There were several types, each of which required special treatment. As to variable reactance, the booster in itself had a certain amount of reactance, and when short circuited it was a kind of reactance coil of low reactance value. With reference to tappings, in general it was found that the customer wanted the cheapest possible job. If he got the furnace to work with an equipment which cost £2,000 he would not pay £2,500. He did not see that it would always be possible to have these furnaces near large power stations unless it was impossible to transmit power at a high voltage. When he said 8,000 K.V.A. he did not suggest that that power should go into one unit. Internally choked insulation was generally due to heavy overload on the transformer for long periods. The ventilation of the winding was certainly essential, and the more ventilation they had the longer would be the life of the transformer. He agreed with Mr. Robertson that the switch-gear should be strong and positive in action. The working of smaller units in parallel would be more beneficial, would possibly give a greater reliability of supply, and the makers would not mind because they would get a bigger share of the cost. He could not give the figures asked for by Mr. Sichel at the moment, but the regulation was much higher on the furnace than on the power transformer. As to bare copper conductors and sludge, he had said that bare copper conductors tended to sludge the oil, but that tinned copper conductors did not. Mr. Sichel agreed that the lay-out of large furnaces could not be taken from small furnaces and multiplied. Each individual case must be thought out, and the best possible arrangement adopted. With regard to equipment and method of starting up in the case of batteries of furnaces, in most of such cases the starting period did not coincide, and the labour was reduced by staggering the starting times. It all depended on the size of ingot the customer wished to get. He thought the weight of an 8,000 K.V.A. transformer would be about 30 tons, but he did not agree to 8,000 K.V.A. transformers. He would have smaller units in parallel so that the weight would not be more than about 8½ tons, which would be easily handled by a hand-operated crane.

THE MICROSCOPE IN THE ENGINEERING INDUSTRIES.

The symposium and general discussion on "The Microscope: Its Design, Construction, and Application," which was held in the rooms of the Royal Society on the afternoon and evening of January 14th, was a function of first rate importance, and it will probably prove to be a landmark in the industry and application of one of the most important branches of optical science, so far as concerns British practice. The meeting—due to the initiative of Sir Robert Hadfield, who presided—was organised by a Joint Committee of the Faraday, Royal Microscopical, Optical, and Photomicrographic Societies, and of the Optical Committee of the British Science Guild. Some 40 papers were read or presented, and during the afternoon an exhibition was held which illustrated the development of the British microscope, the new types of standardised or special research instruments now being placed in the market by English makers, many devices and adaptations designed to fit the instrument for particular uses, of which methods of illumination call for special mention, and finally a large number of exhibits, impressive in their cumulative effect, illustrating recent applications of the instrument in the various sciences and industries, including metallography and metallurgy, engineering, physical and bio-chemistry, the textile industries, paper making, food preparations, and the manufacture of drugs.

The subjects discussed readily fell into some three or four groups. It is only possible to indicate here quite briefly the opinions put forward, and the general conclusions reached. The full Report of the proceedings, when it appears, will call for the close consideration not only of physicists and opticians directly interested in the subject, but also of engineers and manufacturers generally, to some of whom the possibilities of microscopy will, perhaps, come as a revelation.

On the general design and the future of the instrument important contributions were made by Mr. J. E. Barnard, President of the Royal Microscopical Society, and by Prof. F. J. Cheshire, President of the Optical Society, and Prof. A. E. Conrady, who are jointly responsible for the Department of Technical Optics at South Kensington. In the mechanical design of the microscope, perhaps, the most important consideration is rigidity. In this respect we can learn much from some of the early English models, but the great desideratum is to regard the subject from the engineering angle rather than from the scientific instrument standpoint. The matter is further complicated by the necessity for mass-production, without which the industry cannot economically be carried on. Mr. Barnard gave the key to the solution of the mechanical problem, when he said that what the maker must aim at is something of the optical bench type, stiff, strong, simple, and easy of adjustment. The latter requirement—the coarse and fine adjustment—is one that has given considerable trouble, and this particularly in the type of microscope of interest to the engineer, who wants to be able to place on the stage and move a heavy weight of metal without straining the instrument. These and analogous difficulties are now being realised and met, and the instruments described and exhibited by Mr. Conrad Beck, Mr. Watson Baker, Mr. Powell Swift, and Messrs. Watson & Sons, and such a microscope as Dr. W. Rosenhain's design, go far to meet present-day requirements.

Prof. C. H. Desch and others remarked on the fact that not sufficient use was being made of some of the modern extremely hard non-ferrous alloys which are far more durable than brass for an instrument of precision like the microscope, that is calling for constant wear and tear in the adjustable parts.

Much attention was given to the matter of illumination, and as the source, the "Pointolite" lamp—a tungsten arc *in vacuo*—was generally admitted to be the most satisfactory for high illumination, although for some purposes a larger area of source is desirable. In a new illuminator exhibited, suitable for metallographical work, an annular electric lamp surrounds the objective, and clearer images are claimed than with the vertical illuminator. For both transparent and opaque objects the mercury vapour lamp was favoured, and this has the advantage of emitting light of small wave length, favourable for increased resolving power.

Round this important question of resolving power much discussion centered, but the subject is somewhat beyond our scope, except to say that progress is to be sought either in the discovery of some artificial or natural crystal, such as fluorite (a specimen of which was shown) of high refractive index, from which objectives could be made, or else in the employment of ultra-violet light, or even light of still higher frequency. In the latter direction some results of extraordinary interest have recently been obtained by Mr. Barnard in elucidating the minute structure of bacteria, and the results of their application to metallography are keenly awaited, for they are likely to teach us much concerning the action of mechanical work on metals, and similar operations which improve physical quality by increasing the fineness of grain-structure. In the meantime, we were shown some record magnifications, up to 8,000, of steel sections, by Sir Robert Hadfield and Mr. T. G. Elliott. Magnification, of course, is not resolution, but, nevertheless, in bringing out the detailed structure of the pearlite in the specimens examined, results of considerable interest were achieved.

The relative virtues of achromatic and apochromatic objectives for high-power work must not detain us now. It was decidedly surprising to hear of the favour given to the former in many quarters, on account of the flatter field which they give.

This sketch of the symposium can fitly conclude with a brief reference to a very useful paper by Mr. S. Whyte on the "Use of the Microscope in Engineering Works." The first use is in the examination of raw materials, such as stampings, in which flaws like incipient cracks or laps of oxide cannot otherwise be detected. A more general use is in arriving at the best heat-treatment temperatures for high-speed steels. It is useless to buy expensive high-grade steel alloys, unless the optimum use be made of them, and this cannot be properly ensured unless the steel be micro-examined after hardening. Another direction in which the microscope can be invaluable to the engineer is in helping to locate causes of failures, for example, the inclusion of slag, of a point of weak design, or a file mark, all of which may set up "fatigue" fractures, and to discover the processes by which these failures develop. Some excellent photomicrographs accompanied this paper of Mr. Whyte's, and added much to its usefulness and suggestiveness.

Electrical Trades Benevolent Institution.—The Cardiff Local Advisory Committee, consisting of Messrs. W. A. Chamen, M.I.E.E. (South Wales Power Co.), R. Howard Fletcher, M.I.E.E. (consulting engineer), W. E. Hobbs (General Electric Co., Ltd.), J. P. MacTaggart (English Electric Co.), and A. McWhirter, M.I.E.E. (President of Cardiff Contractors' Association), are making a determined attempt to secure additional members for this Institution. A meeting was held in the new offices of the G.E.C., at Cardiff, which were kindly lent by the directors for the occasion. The Committee realised the difficulty of getting the younger members of the industry to attend a meeting with the object of getting new members by "speech-making," but a good attendance and considerable success were obtained by arranging a concert, and during the interval Mr. Chamen, in a few remarks, brought home to those present the necessity of supporting the Benevolent Institution. Three of the staff of local companies have offered to act as collectors in their respective firms, and it is expected that some 25 to 30 new recruits will be obtained. A collection was taken, which yielded good results. Cardiff Committee is fortunate in having such good musical talent available without calling on anyone outside the electrical industry. The first half of the programme was given by members of different firms, whilst the second part was provided entirely by the G.E.C. "Magnet" Concert Party. A unanimous wish was expressed for another such gathering to be held in the autumn.

Chemistry and the War.—Prof. Francis, the Dean of the Faculty of Chemistry in Bristol University, addressing the Rotarian Club on Monday, said that the ammonia future of Europe lay with Germany, who was in a position to supply essential fertilisers to the whole of Europe. The safety of our Empire depended on our establishing an industry such as Germany's. It would take us a generation to compete on even terms with the German chemical industry. Our research and industry must be fostered, as success would be to the country with the largest supply of highly trained chemists.—*The Times.*

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BUSINESS NOTES.

French Company Notes.—To carry on the electric lamp and heating apparatus business, styled "Halle aux Lampes et Chaleur Electrique," at 17, Rue Dieu, Paris, MM. Brianne et Andoux have formed themselves into a company, with a capital of 185,000 fr.

The Société Auxiliaire du Gaz et de l'Electricité has been established at Paris: capital, 185,000 fr.

For the manufacture of electrical apparatus of all kinds, Théory et Cie has been established as a company at Paris, with a capital of 900,000 fr.

Lançon et Cie is the title of a company formed at Paris, with a capital of 50,000 fr., for the manufacture and repair of electric material.

The Société de Production et de Distribution d'Energie, formerly called the Electricité de Reims, has raised its capital from 4,000,000 fr. to 10,000,000 fr., and issued, besides, 6,000,000 fr. of 6 per cent. bonds, repayable in 25 years from 1927.

The Société Hydro-Electrique de la Haute-Bourne has reduced its capital from 1,000,000 fr. to 500,000 fr. Its second station at Goule-Noir, of 3,000 H.P. capacity, is advancing towards completion.

The Secteur de la Rive Gauche de Paris company has decided to reduce its capital from 9,000,000 to 3,000,000 fr., and to increase it by 600,000 fr. by the issue of new shares. This company recently took part in the re-arrangement of the Paris supply by agreements with the Union de Electricité and other Paris companies.

At the last meeting of the Etablissements P. Godot et Ch. Tournaire, the liquidation of the company was decided upon, but since then it has been decided to reorganise the concern and resume business.

L'Appareillage Electrique Industriel (Ch. Cheveau et Cie) are raising their capital from 300,000 to 500,000 fr.

A Trade Commissioner on Advertising.—The views of H.M. Senior Trade Commissioner in South Africa (Mr. Wickham) on publicity and advertising in South Africa, are published in the *Board of Trade Journal* for February 26th. Among other things, he says that the outlay on advertising should never be based on existing sales, but on potential sales. "Advertising to produce future sales is in the nature of capital expenditure. To keep the cost of advertising strictly within the bounds of what the existing turnover will bear, to expect to pay for it out of the profits on present sales, is to miss the whole point and aim of advertising. Estimate the value and profits of the turnover which it is hoped may be secured in that market, and then calculate on that basis what outlay on advertising can be afforded. It will not infrequently involve spending more for a year or two on a market."

Calendars.—We have received from the British Thomson-Houston Co., Ltd., of Rugby, one of their large sheet calendars for 1920. There are 12 large monthly sheets, on each of which the dates of the preceding and following months are printed in smaller form. Each sheet has particulars of the company's branch offices, a view of the works, and illustrations of B.T.H. manufactures.

The Star Electrical Engineering and Manufacturing Co., Ltd., of 134, Victoria Street, Grimsby, have sent us a wall calendar, with monthly date slips beneath a coloured picture of a maiden seated, by moonlight alone, in pleasant reflective and anticipatory mood.

Electrolytic Ore Treatment in France.—As a result of the report of the mission sent to the U.S.A. to study the electrolytic treatment of zinc ores at Anaconda, the Société de Penarroza has decided to erect a factory in France to utilise this method. Mixed ores containing lead and zinc will be used, and a zinc works and lead works will be established.—*Economic Review.*

Staff Dinner.—A staff dinner was held at Pinoli's Restaurant, on February 26th, to celebrate the twenty-fifth anniversary of Messrs. Evershed & Vignoles, Ltd. Over 90 members of the staff participated, with Mr. Vignoles in the chair. The guests of the evening were Messrs. Vignoles, Vines, and Gregory, all directors of the company. Considerable enthusiasm was displayed at this reunion after five years of war. Mr. Vignoles, in his reply to the toast of "Our Guests and the Firm," proposed by Mr. Shepherd, welcomed the members of the staff who had returned to the firm after their period of service with the Forces. He outlined the history of the firm from the early days of its career. Mr. Vines, who also replied to the toast, thanked the staff for their loyalty, and prophesied continued success and increased prosperity to the company. The toast, "The Committee," was proposed by Mr. Sparrow and replied to by Mr. Short. A concert, under the direction of Mr. Blundell, followed the dinner, and numerous items were rendered by members of the staff.

A Manchester Century.—Messrs. Thomas Hudson's executors, of Manchester, who are hardware merchants, but who are also doing a large wholesale trade in electrical material, completed a century of business last week. The event was commemorated by paying each member of the staff a month's remuneration in place of the usual weekly amount on Friday last.

Liquidations.—Bonecourt Surface Combustion, Ltd.—Meeting called for March 30th, at Parliament Mansions, Victoria Street, S.W., to hear an account of the winding-up from the liquidator, Mr. E. J. Pilcher.

Cosmos Consolidated, Ltd.—Meeting of creditors, Friday, March 12th, at 4B, Frederick's Place, Old Jewry, E.C. 2.

Catalogues Wanted.—H.M. Consul at Liége has organised a Special Catalogue and Sample Exhibition Room at the Consulate offices, and is anxious to receive from British manufacturers and others interested, all publicity matter connected with their products. Catalogues of fittings and accessories suitable for the heavy industries of the Meuse Valley, the coal mines, leather and woollen industries of Verviers, are specially mentioned.

A similar catalogue and sample room will shortly be opened at Charleroi.

Reunions and Socials.—The employés of the Woking Electric Supply Co., Ltd., were entertained on February 20th at a dinner given by the directors at the Popular Restaurant, Woking. The chair was taken by Mr. E. G. Nicholson, the secretary of the company, supported by Mr. F. Woods, the resident engineer, and Mr. A. McIntosh, mains and meter superintendent. Over 50 sat down. A first-class entertainment was provided by Mr. E. H. Gregson. During the evening, the chairman proposed the toast of "The Directors and Company," and reminded those present that it was the first occasion on which the employés of the Woking Electric Supply Co. had ever met together at any social function. It was not a good thing, he said, for the various sections of the company to carry on their duties each practically oblivious of the others. The company had been in existence as an electricity supply concern since 1889, and was, therefore, among the oldest of its kind in this country or the world. The total revenue in 1900, the earliest date of which there were available records, was £4,000, and if they multiplied that amount by 10, they would get the approximate revenue of the company for 1919. Mr. F. Woods, in responding, paid a tribute to the loyalty of the employés. The toast of "The Returned Service Men," was proposed by Mr. A. McIntosh. Of those now in the company's employ, no less than 42 per cent. had served in H.M. Forces during the war. Mr. G. Gore responded for the Navy, and Mr. S. Ashley for the Army. The latter expressed thanks to the company on behalf of his colleagues and himself for the help given to their dependents during their absence. Mr. A. M. Dallen responded on behalf of the Air Force.

A reunion of the Edinburgh, Glasgow, and Dundee staff of Wood & Cairns, Ltd., wholesale electrical factors, was held in the Windsor Rooms, Hillside Crescent, Edinburgh, on Saturday, February 21st. All the directors were present, and after a successful whist drive, the company sat down to dinner, finishing off the evening with dancing.

On February 21st, at the Stationers' Hall, Mr. and Mrs. Howard Marryat entertained a very happy party, consisting of employés of Marryat & Place with their wives, to the number of about 240, "to welcome our soldiers home." The toast of "Our Soldiers," was put from the chair by Mr. Marryat in suitable terms, and replied to by Lieut. C. G. Gwinnell. Mr. Huddle, an old employé, in a witty speech, proposed "The Firm." Miss Carrie Herwin and Mr. Edward Halland, who contributed to the musical programme, were greatly appreciated. Mr. Huddle, in the course of his speech, said that persons in his position were usually expected to whitewash the "bosses," but he could truthfully say of Mr. Marryat that he did not require whitewashing. He gave an interesting account of the firm's expansion from its single office at 57, Hatton Garden. He had seen many changes during 28 years. He believed he installed for the firm one of the first motors in London. It was in the neighbourhood of Hatton Garden. He remembered wiring the offices at present occupied at 28, Hatton Garden. The firm was on a much larger scale now. It had branched out from 57 to its offices at 28, Hatton Garden. There was the lift department at 57A, and the works at Shepherd's Bush, and, during the war, another works had been started in Hatton Garden, of which Mr. Dewhurst had charge. The lift work was now being carried on by Marryat & Scott, and that department was making rapid strides. For their lift safety devices there was a big field, and he looked forward to the day when the lift department would be able to give a dinner like that one.

Copper and Lead Prices.—Messrs. F. Smith & Co. and Messrs. James & Shakespeare report, March 2nd:—"No change in prices quoted last week."

Wages and Working Conditions of London Electricians.—We are glad to publish the following letter from Mr. Leonard G. Tate, general secretary of the National Federated Electrical Association, which indicates that at last the Federation and the E.T.U. have composed their differences:—

"Agreement has now been arrived at as between the London members of the National Federated Electrical Association and the London District Committee of the Electrical Trades Union as to rates and working conditions.

"The agreement, which was signed by both parties on Friday, the 27th ult., makes the rate now payable to a fully qualified electrician 2s. 3d. per hour, and assistant over 21, 1s. 9d. per hour; the men to get from home to job and from job to their homes in their own time, if the job is within the agreed-upon area—namely, 12 miles from Charing Cross, and within 12 miles of the employer's office.

"A Joint Committee has been set up to adjudicate on any disputes that might arise as between the parties, also as to the interpretation of the rules, and to consider, for submission to the parties, any further rules that might be suggested.

The signing of this agreement will, it is hoped, do away with the friction that has existed for many years between the members of the E.T.U. and their contractor-employers."

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Bankruptcy Proceedings.—Walter Henry Mellon (late trading as H. B. Wallis & Co.), electrical engineer, 37, Elliott Road, Chiswick, late 43, Turnham Green Terrace, Chiswick, Middlesex.—This debtor came up for his public examination on February 24th, at Brentford, before Mr. Registrar Sills. He said that his liabilities were £384 and his assets £155. For some years he was a comedian, earning £3 to £4 a-week, but he took up with electricity, and commenced business in Charndon Road, Chiswick, with £50 which he had saved. In June, 1917, in partnership with Mr. W. R. Vallance, he took 43, Turnham Green Terrace, as H. B. Wallis & Co., each partner putting £50 into the concern: he was to draw £1 or £2 a week and have a share of the profits: his partner only took a share of the profits. Another shop, 49, Turnham Green Terrace, was taken, but afterwards it was taken over by Mr. Vallance, as he could not manage both. His health was bad, and this caused him to neglect business, which was the cause of his failure. The hearing was adjourned.

Re W. H. Howard, electrical engineer, lately carrying on business as The Holborn Electrical Co., 5, Featherstone Buildings, Holborn.—An application for an order of discharge was made on February 27th, at the London Bankrupty Court, by this bankrupt, who failed in November, 1911. Mr. D. Williams, Official Receiver, reported that the applicant commenced business without capital, in 1900, with another person, at 60, Red Lion Street, Holborn. The partner retired three years later, and the bankrupt continued the business alone, both as "The Holborn Electrical Co." and as "Howard & Co.," and taking premises successively at 18, Red Lion Street, 49, Lamb's Conduit Street, 1, New Oxford Street, 5, Featherstone Buildings, 64, Red Lion Street, and again at 5, Featherstone Buildings. When he left each of the said premises rent was owing, and was not afterwards paid. Three years before the bankruptcy the applicant sued the landlord of 1, New Oxford Street for damages and trespass in connection with repairs to the roof of the building, but judgment was given in favour of the landlord. During the action, the business fell away, as the bankrupt was unable to give it proper attention, and he closed it down in April, 1911, since which date he had been employed as a canvasser for an electrical supply company. In 1909 his solicitor obtained judgment for the costs of the action, and in May, 1911, obtained an order for payment of the bill by monthly instalments of £2; the bankrupt was unable to keep up the payments, and to escape committal to prison for default, he filed his petition. The liabilities amounted to £560, and no assets were disclosed or recovered. The bankrupt attributed his failure and insolvency to want of capital, general falling away of business during the last three years of his trading owing to competition by electrical supply authorities; also to the adverse result of the before-mentioned action and consequent liability for costs. The offences reported by the Official Receiver were (1) insufficiency of assets to equal 10s. in the £ on the amount of the liabilities; (2) omission to keep proper books of account; and (3) trading with knowledge of insolvency. Mr. Registrar Franoke upheld the report, and imposed a suspension of two years, remarking that if the bankrupt had applied earlier, he would have been free a long time since.

46½-Hour Week for Berlin Metal Workers.—The *Economic Review*, quoting *Deut. Allg. Ztg.*, states that the Union of Berlin Metal Manufacturers, in granting the extra wages and bonuses to their employés, proposed that the workers, on their side, should pledge themselves to a net working week of 46½ hours, including those factories where at present the working hours are less than this. The Metal Workers' Union agreed that the question should be referred to an impartial arbitration court, whose award should be binding on both parties. The Court decided in favour of the 46½-hour week.

Lead.—Messrs. James Forster & Co. report (February 28th):—

> We have to record a drop of about 15s. per ton on the week, but in the absence of any likelihood of an increase in imports in the near future, we can scarcely look for any substantial decline in values. Controlled lead has not been on offer for some weeks past, and in view of the fact that nearly all the metal in Government stores has already been disposed of, for delivery spread over the next few months, assistance from this quarter cannot be relied upon.

Messrs. G. Cawson & Co. say:—

> There is a good deal of talk of using substitutes for lead, and no doubt something will be done in this direction which will tend to influence the consumption unfavourably. Meanwhile supplies continue abundant, and lead is regularly going into store so that although Government stocks are being gradually reduced, private stocks are steadily increasing; no actual figures, however, are obtainable. France seems to be arranging to cut herself adrift from other countries, and to become self-supporting for her lead supplies. If she eventually manages to do this, it will make a great difference in the demand in this country. Reports from America continue favourable, and prices there seem to be well maintained. The position in Mexico, however, is gradually improving, and we can now look with more confidence for a steady increase in supply from that country.

German Engineering Industry: Reported Critical Situation.—According to resolutions which have just been adopted at a general meeting of the Association of German Machinery Construction Works, held in Berlin, this industry is confronted with the solution of exceptionally difficult conditions as a result of the development of circumstances during the past 15 months. On the one hand, the makers are severely hit by the increases in the prices of raw and semi-finished materials which they use in the production of machinery, while, on the other, they are frequently bound to execute old orders which were accepted at fixed prices, and which were undertaken in the early period after the revolution. The enormous rise in the prices of materials, combined with the long period required for effecting delivery, has placed the industry in an extremely difficult situation. The Association mentions that the industry, with a turnover of many milliards of marks, finds employment for about 1,000,000 workmen and staff. As a result of the great economic importance of the industry, the makers expect reasonable consideration on the part of the suppliers of raw and semi-finished materials in the matter of future prices, and due judgment on the part of customers in regard to the prices and other conditions of delivery required by the machinery makers. It is considered that the industry, dependent upon syndicates for the delivery of materials for conversion into finished machinery, cannot exist unless supplementary additions are made to the prices fixed in the old contracts and unless reserves are made in the prices for new orders with an extended period for delivery. The Association submits that official circles must also understand these facts. An urgent request has been addressed to the Government asking that the exports of machinery, which have scarcely been resumed, should not be jeopardised by the levying of duties on machinery sent to other countries.—*Financial Times*.

Mather & Platt, Ltd.—Foreign Trade.—In the course of his speech at the annual meeting of Mather & Platt, Ltd., the chairman, Mr. Loris E. Mather, said he had recently returned from a three months' visit to the United States. He visited many engineering concerns, and was able to study many methods there which might be usefully employed on this side. They had at Park Works a plant, for its size, as well designed and as up-to-date as any to be found across the Atlantic. During the year they had brought into use the four additional bays given over to aeroplane manufacture, the benefit of which would only be felt this year. Considerable further extensions were in progress, which they hoped to have completed and in occupation by the end of this year. The trade prospects abroad were encouraging, in spite of fluctuating exchanges, difficulties in shipment, and the impaired purchasing power of countries which had suffered from the war. They had always had extensive and close trade connections with France, and at the outbreak of war they had large amounts owing from French clients. It was most gratifying to be able to state that the misfortunes of war had not prevented their French clients from meeting to the full these liabilities. Their business in Russia had suffered temporary eclipse, and they had incurred heavy losses which had been provided for in the accounts, but it was right to add that the probity of their clients had been unquestioned, and losses were due to the extinction of government in Russia, and collapse of Russian exchange. They were already resuming business in Poland. It would be the settled policy of the board to help their old and trusted clients abroad to restore their pre-war producing power. It was only by restoration of the producing power of all countries that trade could regain its old prosperity, and they meant, so far as they prudently could, to take their due share in helping towards this end. The abounding prosperity of India and the removal of restrictions of various kinds had brought about a remarkable increase in the volume of orders they were receiving from that country. One of their directors had recently been in India: another was now in the Far East, where big developments were taking place. They must, however, always look to the home trade as having the first claim upon them, and here there was a large volume of work already placed upon their order books. One of their greatest difficulties this year would be to satisfy their customers at home and abroad in giving them deliveries in reasonable time. They could not obtain the materials needed in their manufactures as quickly as they would like, due to the heavy demand on all sides and delays caused by strikes, but they were doing their utmost.

Claiming Pre-war Debts.—Some notes have been prepared by the Clearing Office for the assistance of British creditors in filling up their forms of proof. Copies of the notes may be had on application to the Controller, Clearing Office (Enemy Debts), Cornwall House, S.E. 1.

Canadian Electrical Union Demands.—According to the *Electrical News* (Canada), representatives of unions of the various electrical workers organisations met in Toronto recently and prepared a programme of demands which, it is understood, they will present to the Provincial Government. These demands include a licensing system for both contractors and workers; a uniform wage for the province; certain changes in the installation of distributing systems; certain amendments to the Workmen's Compensation Act and representation upon provincial and municipal hydro-electric commissions. It is proposed to inaugurate a licensing system under which employés shall serve a four-year apprenticeship before they receive a certificate of qualification and become regular journeymen.

Trade Announcements.—Mr. Wm. Carr has commenced business as an electrical engineer at 35, Marshall Avenue, Bridlington.

Mr. W. J. Cannon, electrical engineer and contractor, has opened new show-room premises at 8, Dalby Road, Cliftonville, Margate.

Mr. L. O. Heyes has retired from the firm of Heyes & Co., electrical engineers, of Douglas Side, Wigan, and the business will be continued by Mr. W. A. Heyes.

Messrs. H. W. Jones, Ltd., electrical engineers, of Eccles, Lancs., have removed to new premises at Monton Road, Monton.

Mr. F. Stanford has resigned his appointment with Messrs. Stegman & Co., with whom he has been for 25 years. He has opened up business as an electrical engineer at 5, Crieff Road, Wandsworth, S.W. 18.

The Warrington Electrical Co., Ltd., have changed their address to Knutsford Road Works, Warrington. Telegrams: "Power, Warrington."

Mr. W. G. Perry has resigned his position as power engineer with the South London Electric Supply Corporation, Ltd., and has started in business at 199, Westminster Bridge Road, S.E. 1, under the style of W. G. Perry & Co., Ltd., electrical contractors.

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Book Notices.—"Five-figure Logarithms and Trigonometrical Functions." Price 1s. 6d. net. "Mathematical Tables." Price 4s. 6d. net. By W. E. Dommett and H. C. Herd. London: J. Selwyn & Co., Ltd.

"Science Abstracts, A and B." Vol. XXIII, Part 1, No. 265. January 13th, 1920. London: E. & F. N. Spon, Ltd. Price 2s. 3d. each.

"Memorandum on Solid Lubricants." *Bulletin* No. 4 of the Department of Scientific and Industrial Research (28 pp.). London: H.M. Stationery Office. Price 6d. net.—Contains much useful information regarding the nature and application of such substances as graphite, white lead, soapstone, &c.

Circular No. 83 of the U.S. Bureau of Standards, "Specifications for the Manufacture and Installation of Railroad Track Scales." (35 pp.). Washington: Government Printing Office. Price 5 cents.—The object of this publication is to provide railroad engineers with data to enable them to secure scales adequate to meet modern requirements.

"Quin's Metal Handbook and Statistics," 1920. London: Metal Information Bureau, Ltd. 3s. 6d. net, post free. This is the seventh year of publication of what is a very useful book, in which are tabulated statistics and 1919 price records of copper, tin, spelter, lead, silver, antimony, arsenic, nickel, and iron and steel. Among other features, we notice a list of the licensees under the non-Ferrous Metals Act.

"The Examination of Materials by X-Rays." Reprinted from the *Transactions* of the Faraday Society. London: The Society. Price 12s. 6d.

"*Proceedings* of the Physical Society of London." Vol. XXXII, Part II, February 15th, 1919. London: Fleetway Press, Ltd. Price 4s. net.

The Rubber Age (published monthly). No. 1. March, 1920. London: 43, Essex Street, Strand. Price 1s.

Plant, &c., for Sale.—Slough and Datchet Electric Supply Co., Ltd., has for disposal one three-crank compound Davey Paxman engine direct coupled to two Siemens D.C. generators, and two switchboard panels; Colne Corporation Electricity Department invites offers for a Green's economiser and a 2-H.P. driving motor; Messrs. Campbell & Lamond have for disposal premises suitable for joinery or other works requiring extensive floor space, situated at Calder Green, Renfrewshire. For particulars see our advertisement pages to-day.

Catalogues and Lists.—Messrs. James M'Millan & Co. (formerly the Ericsson-Bell Telephone Co.), Clun House, Surrey Street, Strand, W.C. 2, sole agents of the Elektrisk Bureau, Ltd., of Christiania, Norway.—Lists Sections I to VI inclusive. Section I is devoted to magneto telephones and also special instruments for mining, diving, and high-tension work; Section II presents a series of central-battery telephones; Section III deals mainly with intercommunication sets; Section IV—portable sets—includes a four-line artillery telephone; switchboards and accessories are dealt with in Section V, and the last list is a general catalogue of parts and accessories. The lists are profusely illustrated, and cover a wide range.

The Rockingham Engineering Co., Beulah Road, Thornton Heath, S.E.—Leaflet giving illustrations, details, and prices of electric organ-blowing sets.

Messrs. J. Hopkinson & Co., Ltd., Britannia Works, Huddersfield.—Catalogue 800, 398 pp. An extremely useful and comprehensive list of all classes of boiler gear. It is divided into 13 sections, and is illustrated by numerous photographs and line drawings. The first section presents information regarding materials and specifications. Then follow divisions dealing with mountings, safety valves, high and low pressure valves for steam, water, and air; boiler-feed and check valves and injectors; blow-off valves and pipes; water gauges and fusible plugs; pressure gauges, siphons, and cocks; isolating valves, reducing and surplus valves, expansion joints, steam dryers and traps and automatic exhaust valves, cocks, whistles, thermometers, &c. The catalogue concludes with a complete index of contents and code words.

Messrs. Greenwood & Batley, Ltd., Donington House, Norfolk Street, Strand, W.C. 2.—Leaflets Nos. 53, 54, 55, 56, and 60. Illustrated price-lists of "Bipol" accumulator batteries for motor-cycle lighting, lanterns, &c.

Mada Engineering Co., Ltd., 12, Bevington Hill, Liverpool.—Illustrated leaflet (8 pp) dealing with the "Remca" patent electric riveter.

The General Electric Co., Ltd., 67, Queen Victoria Street, E.C. 4.—New "Osram" billheads (or invoice forms) and postcards. The G.E. Co. states that it will be pleased to supply quantities of these, overprinted with name and address, to members of the trade. "Conveying and Transporting Machinery" (74 pp). This publication, printed on art paper and profusely illustrated by photographs, indicates the wide field covered by Fraser & Chalmers conveyors, &c. The first part describes belt conveyors, pulleys, and idlers. Then shipping plants are dealt with, and photographs of actual installations are given. The Fraser & Chalmers coal-handling plant at Durban is fully described, and photographs of the boiler-house conveyor at Marylebone and the Brancepeth Colliery conveying plant are presented. Grabs and grab transporters are given several pages, and the photographs include three of the transporters built for the Admiralty.

H. C. Slingsby, 142, 144 and 146, Old Street, E.C.—List No. 153. An eight-paged booklet illustrating and describing steel-back extension ladders, with details of tests. Also tower ladders, ladder carriers, and step ladders.

The India-rubber, Gutta-percha, and Telegraph Works Co., Ltd., Silvertown, E. 16.—Illustrated leaflet dealing with "Silvertown" dry and inert cells.

Building Products, Ltd., Columbia House, 44-46, King's Road, Sloane Square, S.W. 3.—Booklet (16 pp.) dealing with "Bareau," a water-proofing material for cement concrete. Contains details of tests, instructions for use, &c.

Messrs. Higgs Bros., Dynamo Works, Sand Pits, Birmingham.—"Monthly Magazine" for March (20 pp.). The body of this booklet is devoted to a stock list of motors and dynamos. An insurance scheme has been formulated by the firm, and details are given. The remainder of the magazine contains "Hints and Tips" on brushes, and one or two anecdotes truthfully described as "chestnuts."

Messrs. Robinson & Hands Electrical Co., Ltd., 54, Barwick Street, Birmingham, have issued a new illustrated and priced catalogue in conjunction with their exhibit at Castle Bromwich Fair, dealing with electrical accessories, the four main lines being lampholders, fuseboards, tumbler switches, and accumulator switchboards, all of which are of British make throughout.

Leoline Edwards, 81, St. Margaret's Road, Twickenham.—Leaflets describing "Quidos" electric lamp bed foot-warmer and food-warmer and portable fireproof safes.

A French Supply Combination.—A scheme for the electrical transmission of power from the Alps to the district of Lyons has been inaugurated by the formation of a combination of 10 existing companies, under the title of the Société de Transport d'Energie des Alps, of 49, Rue de la Bourse, Lyons, with a provisional share capital of 2,000,000 fr. The representatives of the 10 companies form the first board of directors.

LIGHTING AND POWER NOTES.

Aberdeen.—Extensions.—On the recommendation of Mr. J. H. Rider, the Dee Village Works are to be extended, and for this purpose power is being sought to acquire new property.

Balla (Co. Mayo).—Lighting Scheme.—It has been decided to install electric lighting by a private scheme, and Mr. McEllen has applied to the County Council for the necessary permission.

Barnstaple. — Proposed Extensions. — The Town Council has appointed Mr. J. S. Highfield to prepare a report on the undertaking, in order that extensions to meet the greatly increased demands may be carried out. Applications from prospective consumers are constantly being received, but the load is already at the maximum. Electric lighting is to be installed in the buildings being erected under the Barnstaple housing scheme.

Barrow.—Loan.—The Electricity Commissioners are to be asked by the Town Council for sanction to borrow £35,000 for electricity works purposes. This includes £8,451 for anticipated extensions, £5,000 for transformers and switchgear, and for over-expenditure on previous loans.

Bedford.—Increased Revenue.—The Town Council has received applications for supplies of electricity which will bring in an additional revenue of £5,000 a year.

Bradford.—Repaired Turbine.—After being out of commission for a long time, in consequence of the breakdown during the latter part of last year, the large turbine has again commenced to run, the repairs having been completed.

Braintree.—Electric Lighting.—The East Anglian Electricity Co. has prepared an electric lighting scheme for the town, and a petition in favour of its adoption is to be presented to the Urban District Council.

Chelmsford.—Return to Gas.—Chelmsford is in future to have gas for street lighting, the Town Council having refused to renew the contract with the Electric Lighting Co., as gas produced at the municipal gas works will be cheaper. Chelmsford was the first town in England to use electricity for public lighting.—*Daily Mail.*

Chester.—Industrial Development.—With a view to providing information for those seeking industrial sites, the Mayor has invited the city electrical engineer (Mr. Britton) to draft a scheme for the industrial development of the city and district.

Chesterfield.—Faults.—It was reported to the Electricity Committee that there had been a great many interruptions of the electrical supply. Most of these occurred in the Ashgate Road section, and were attributable, it is believed, to one of the mains having been penetrated by a pick during the re-laying of the Post Office telephone cables.

Continental.—Germany.—It is stated that a conclusion has been reached in connection with the lengthy investigations concerning the canalisation of the River Neckar for the double purpose of providing a great navigable waterway and the utilisation of the water-power. The estimated expenditure on the basis of former peace prices is put at 150,000,000 marks, of which the sum of 35,000,000 marks is intended for the construction of 26 hydro-electric works to yield a total of 50,000 KW.

Derry.—Price Increase.—The Corporation has increased the charge for electric lighting by 50 per cent.

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Dublin.—Stock.—The Corporation is considering the issue of 3½ per cent. City stock to raise the sum of approximately £69,000 for the purpose of extending the electricity undertaking.

Edinburgh.—Mains Extensions.—The Town Council has approved the recommendations of the Electricity Committee for the laying of cables between Portobello and M'Donald Road, at an estimated cost of £52,000, and the extension of mains to Granton, costing approximately £20,000.

Gillingham.—Extensions.—The report of Mr. C. H. Wordingham upon the electricity undertaking, together with his recommendations, has been adopted, and extensions are to be proceeded with.

Halifax.—Loans.—The Tramways and Electricity Committee has decided to make application for sanction to borrow the following amounts in connection with the electricity undertaking:—Motors, £10,000; transformers, £10,000; and mains, £20,000.

New Plant.—A recommendation has been made by the Corporation electrical engineer for tenders to be placed at once for a 10,000-kw. set, with the necessary condenser, at an estimated cost of £77,800. This will form part of a scheme to cost £170,000, which the Corporation has already approved.

Year's Working.—The recently published accounts for the year ended March 31st, 1919, show in the summary a deficiency of £1,269. The total expenditure was £112,843, against an income of £111,574.

Hemsworth.—Application for Supply.—The District Council is approaching the Yorkshire Electric Power Co. with regard to obtaining a supply of electricity for the district.

Hove.—Bulk Supply.—The Corporation is applying to the Brighton authorities for a statement of terms upon which a bulk supply can be obtained from the Brighton undertaking. When the Hove Corporation took over the private company, which previously supplied the greater part of the district, it intended to extend the plant to meet the demands of the whole area, but owing to circumstances this was not proceeded with, and the present plant is inadequate.

Hull.—Inadequate Supply.—Several large firms in this district have been requested to reduce their demand by 50 per cent., and consequently a large number of men are practically out of work. The reason given is that a heavy lighting load has been experienced owing to the prevalence of thick fogs.

India.—Cauvery Power Undertaking.—The present output of the Sivasamudram station is 21,500 h.p. The mining companies in the Kolar goldfields have, however, recently intimated that their demands will be greatly increased, and it is, therefore, contemplated to extend the plant to a total capacity of 27,000 h.p., with a reserve of 3,600 h.p.

Kingswood.—Electric Lighting.—The Bristol Corporation has agreed to supply electricity to residents of Kingswood subject to an agreed annual minimum payment of £4 for three years. The Urban District Council has consented to this arrangement.

Lancaster.—Proposed Price Increase.—The Town Council has appointed a Sub-Committee to investigate the position of the electricity undertaking with a view to increasing the charges, which are considered inadequate.

Leicester.—New Power Station.—The City Council is to apply to the Electricity Commissioners for sanction to a scheme involving the erection of a power station at Aylestone Road. The cost of the new works, which will have a capacity of 10,000 kw. in the first instance, is estimated at £600,000.

Liverpool.—School Lighting.—After a debate upon the respective merits of gas and electricity, the Education Committed decided to employ electricity for lighting five special schools, although the initial cost will be greater.

London.—The Coal Problem.—A conference of representatives of electricity undertakings in Greater London was held recently to place the following requests before the Coal Controller:—(1) That the rebate to be paid under the Coal (Pit-mouth) Prices Order, 1919, be paid directly by the Controller; (2) that special steps be taken to secure an adequate supply of coal for power stations and other public utility services; (3) that the order relating to acceptance of colliery weights be rescinded and payment made for weights actually received; and (4) that coal be properly graded and charged for according to quality.

St. Pancras.—The Electricity Committee recommends the purchase of two motor converters, together with the necessary mains and switchgear, at an estimated cost of £14,150. Inquiries are to be made with regard to a site for a proposed new sub-station to house these converters. The women employés in the meter repairing department applied for an increase of 5s. per week, which was granted, but at the same time steps are to be taken to replace the female staff by men, preference to be given to disabled ex-service men.

Mexborough.—Mains Extensions.—The Urban District Council has applied for permission to lay cables through the parishes of Denaby and Conisborough, with a view to supplying them with electricity. The Doncaster District Council has referred the matter to the respective parochial Committees for consideration.

Northallerton.—Year's Working.—At the annual meeting of the Electric Light and Power Co. it was announced that the profit for 1919 was £460, as against £342 for the previous year.

Perth.—Electricity Supply.—The Corporation electrical engineer is to lay a temporary cable to supply electricity to residents in Craigie, who recently petitioned the Town Council for a supply.

Preston.—New Station.—It is announced that the building of a large central station at Preston will be commenced next year on the south bank of the Ribble, opposite the entrance to Preston Dock, where a large dam is to be constructed. The output of the station will be sufficient to meet all industrial requirements for a large part of the county.

Salford.—Loan.—The Electricity Committee has recommended application for sanction to the borrowing of £144,344 with which to effect certain developments. The proposed expenditure includes £47,340 for generating plant and £42,000 for boiler-house plant. The feeder mains to sub-stations will cost £19,700.

Stoke-on-Trent.—House Lighting.—The Finance Committee would not approve, on the grounds of excessive cost, a proposal of the Electricity Committee to supply electricity to the Trent Vale housing site.

Sunderland.—Extensions.—The Town Council has adopted the Electricity Committee's scheme for the extension of the undertaking, at an estimated cost of £127,068. Owing to the inadequacy of the present supply, many consumers have been asked to cut down their demands by 10 per cent. The new plant will include two new boilers, a cooling tower, and an additional sub-station. A proposal to make inquiries with a view to obtaining a bulk supply was defeated.

TRAMWAY AND RAILWAY NOTES.

Accrington.—Fares Revision.—The Tramways Committee is considering the whole question of fares on local routes. A communication has been received from the Haslingden Town Council urging the necessity of an increase of fares between the two towns.

Blackpool.—Track Renewals.—The track mileage involved in the permanent way renewal scheme is equal to 18 miles of single track. The borough engineer's estimate of the cost of relaying the permanent way, including the doubling of the line between Dickson Road and the Gynn is £254,343. In addition, £52,177 is proposed to be spent on new works, making a total of £306,520. The proposed reconstruction work will, it is anticipated, be spread over a period of three years. An outlay of £104,620 is estimated for the year ending March, 1921; £105,867 in 1921-22; and £43,856 in 1922-3. The cost of renewing the track is estimated to average £14,274 per mile, as compared with an average cost of £7,322 per mile for the original track.

Continental.—Italy.—The Department of Overseas Trade (Development and Intelligence) states that "His Majesty's Commercial Counsellor at Rome quotes *La Tribune* as stating that the work of the Commission for the electrification of the railways, appointed by the Minister of Transport, is proceeding actively, both as regards the system to be adopted and the continuation of the works in hand in Liguria, Piedmont and part of Lombardy. In these districts the Railways General Management is continuing the electrification on the three-phase system, of the line between Turin and Genoa of about 400 km., and by means of a private undertaking, the lines Turin-Milan and Milan-Voghera for another 200 km., in order to complete, as soon as possible, the principle links of this railway system. With regard to central Italy, a meeting was held recently, under the presidency of the Minister of Transport, of the various public bodies and companies interested in the utilisation of the electric power in the Umbro-Tuscan-Emilian district, in order to co-ordinate available and utilisable power for local requirements and railways. The Commission approved, from the technical point of view, plans for two thermo-electric stations, using national fuel, at Tavernelle di Perugia and Torre del Lago respectively, capable of producing about 20,000 kw. The plans have been commenced for the linking up of Rome and Naples and the Southern Provinces. A programme has also been drawn up for the extension of steam traction by oil fuel for those lines where it will take some time to provide hydro and thermo-electric power, that is to say, largely in Sicily, Calabria, Basilicata and Puglia."

Edinburgh.—Rail Repairs.—The Tramways Committee is utilising a petrol-electric motor workshop for the repair of worn and broken rails by electric welding.

Glasgow.—Extensions and Renewals.—Reports on work in progress and in prospect have been submitted to the respective Departmental Committees of Glasgow Town Council by the officials in charge. So far as the tramways are concerned, the

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general manager reports as follows on work in prospect, the figures showing the estimated cost :—

Renewal of Track (£100,000).—This work is at present being proceeded with.

Building 30 New Cars (£30,000).—This work is being carried out as quickly as supplies of materials will permit.

New Car Depôt (exclusive of price of ground, £70,000).—The schedules for this work are in course of preparation.

Tramway Extensions (£600,000).—This subject-matter has been remitted to a Special Sub-Committee, which will report thereon at an early date.

Great Northern Railway.—Parliamentary Bill.—The G.N.R. Bill passed its second reading on March 1st. The Association of Urban District Councils and the Metropolitan Water Board opposed Clause 47 through Parliamentary representatives. This clause will enable the company to purchase gas, electricity and water from any local authority in the vicinity of the railway, and to use such supplies on any portion of the railway or the company's property, whether beyond the area of the supply authorities or not.

Halifax.—Collision.—Through the swerving of a trailer-lorry into a section power-box at the bottom of Pye Nest Park, the supply was cut off on the King Cross section, on February 21st, and much inconvenience was caused.

India.—Electric Railway.—Messrs. Hoare, Millar and Co. have prepared a scheme for a circular railway for Calcutta. The Railway Board has decided that a preliminary investigation into the feasibility of the scheme should be made by a Committee composed of representatives of the Port Trust, the Eastern Bengal Railway, the Calcutta Corporation, and the Government of Bengal, under the chairmanship of a member of the Railway Board.

Keighley.—Reply to Criticisms.—In answer to criticisms levelled at the Corporation tramway service, the chairman of the Committee said that the debt on the undertaking had been reduced by £7,000, and there had been no call made upon the rates by the undertaking, though 22 out of 84 municipalities running tramways had had to do so. The revenue in 1914 was £9,800 ; this year it was hoped to realise £16,500. The foreign firm which guaranteed to maintain the railless trolley vehicles was broken up by the war, and this prevented the overhead equipment scheme being completed.

Liverpool.—Carriage of Parcels.—The tramway manager is to report on a scheme for the conveyance of parcels and goods by tramcar.

London.—Accident.—Owing to motor failure, an L.C.C. tramcar ran backwards down a steep hill near Clapham Common, on February 23rd. At the base of the incline it collided with another car, and both were badly damaged. A woman was killed and four other passengers slightly injured by jumping off the car.

Municipal Tramways.—Finances.—Some interesting figures are given by the *Birmingham Post* showing the position of British municipal tramway undertakings. Statistics compiled by the Municipal Tramways Association show that no less than 20 per cent. of the concerns are running at a loss, the deficit being borne by local rates. It is stated that the extra rate involved was as much as 10d. in the £ at West Ham. Tramways that contributed to the rates prior to the war—such as Belfast, Birmingham, Bradford, and Glasgow—have been compelled to reduce, and in some cases abolish, their aid to local rates. Many others, however, as Leeds, Blackpool, Manchester, and Newcastle-on-Tyne, have been able to increase their contributions.

Plymouth.—Fare Increase.—Fares on all routes are to be increased by 50 per cent.

Stalybridge.—Fare Revision.—The Tramways Committee has informed the Stalybridge, Hyde, Mossley and Dukinfield Tramways and Electricity Board that it has been compelled to revise the fares with a view to increasing them, on account of the abnormal increase in working costs. The loss on the tramways last year was £3,000, and, if extra revenue was not collected, it was estimated that the loss next year would be from £10,000 to £11,000.

TELEGRAPH AND TELEPHONE NOTES.

Australia.—The Commonwealth Post Office made a net profit in the last financial year of £524,645, an increase of £137,263 on the working of the previous year. The telegraph department made a profit of £63,133, against £28,116 last year, and the telephone department made a profit of £222,174, against £121,844. The main increase in revenue was derived from the telephone services ; with the exception of Western Australia, where there was a loss of £13,697, against a loss of £25,020 in 1917-18, the telephone branch showed a profit in every State. Victoria stands head and shoulders above the other States with regard to the profitable working of its telephone system. The telephone exchanges in this State for the last financial year showed a profit on the year's working of approximately £60,000, over £18,000 in excess of the profits derived from the same source in South Australia, and more than double the profits earned by the telephone exchanges in New South Wales during the same period. There was a loss on the working of some of the Victorian country exchanges, but as a set off against this the metropolitan network of exchanges with 29,749 subscribers, made a profit for the year of £66,000. The actual revenue for the year from the Melbourne exchange networks was £343,896, but against this had to be written off a sum of £138,166 for direct working expenses, as well as the cost of administrative expenses, depreciation and interest, and a proportion of the cost of pensions and retiring allowances. The Sydney exchanges, which earned the sum of £465,099 during the last financial year from a total of 39,296 subscribers, yielded a net profit on the year's working of only £35,500. Only three States, Victoria, New South Wales and South Australia, showed a profit on the working of the telegraph branch for the past financial year. But the profits earned by these three States were sufficiently in excess of the losses in the three other States to yield a net profit for the Commonwealth as a whole of £63,133. Western Australia showed a loss on the working of all three branches of the postal department.

Eastern Cable Delays.—The Eastern Telegraph Co. announces that owing to the interruption of the British Pacific cable between Australia and Canada and the Commercial Pacific Cable Co.'s cable between the United States and the Far East, all traffic carried by those two routes will now have to pass over the Eastern Co.'s system, and consequently additional delay may be expected.

France.—The Société Radiotechnique de Pologne (Radiopol) is the title of a company formed at Paris for the installation and working (in Poland apparently) of every system of telegraphy, including wireless. Its capital is 6,000,000 marks. Its founders include the Marconi Co., of London ; the Société Française Radioelectrique : the Compagnie Générale de Télégraphie Sans Fil ; the Compagnie Générale de Radio-télégraphie ; the Société Polonaise de Construction et d'Exploitation des Procédés Radio-techniques ; and the Banque du Commerce et de l'Industrie.

Italy.—A portion of the programme now under consideration for the commercial expansion of Italy abroad, and more particularly in the East, is the establishment of three telephonic lines, namely, a line 2,000 km. long, linking Rome with Constantinople ; a second, from Rome to Otranto, and thence to Valona, Salonica, and Athens, 1,500 km. long ; and a third line from Rome, 2,600 km. in length, to one or more Danubian ports. Arrangements allowing of the use of Bell's multiplex telephone are also mooted. The laying of a second submarine cable from Otranto is also spoken of, the existing one dating so far back as 1850.

New Wireless Service.—A new channel of communication between the Old and New Worlds was opened on March 1st by the inauguration of a direct wireless service for commercial and general purposes, between Great Britain and the United States. This service is being conducted jointly by the English Marconi Co. and the Radio Corporation of America over a route operated entirely by these wireless companies. Messages are being accepted for New York, Greater New York, and South America, up to 4d. less per word than the existing cable charges. The messages are being transmitted on the British side from the high power Marconi station at Carnarvon, which is in direct communication by private wire with the Marconi office in London and the Central Telegraph Office. The Carnarvon station is equipped with high-speed automatic transmitting gear, and the receiving station is arranged for duplex working so that trans-Atlantic messages can be transmitted simultaneously in both directions. The messages are received on the American side of the route at Belmar, New Jersey, which in turn is in direct communication by private wire with the telegraph office of the Radio Corporation in Broadway, New York City.

New Zealand.—Representatives of the newly-formed New Zealand Wireless Institute waited upon the chief engineer of the Post and Telegraph Department, recently to inquire about the prospect of securing licences to enable amateur workers to operate wireless apparatus. New Zealand is still subject to War Regulations in this matter, and the Department is unable at present to grant licences except to ships. A Bill has been prepared to extend the powers of the Department, and will probably be submitted to the next session.

Trades Telephone List Directly.—Tenders are invited by the Postmaster-General, says *The Times*, for the right to publish an authorised classified trades list of telephone subscribers for London, to be issued every six months, beginning next October.

West Indian Cables.—A Committee is to study the question of wireless telegraphy as regards the West Indies, and to inquire into the cable system of that section of the Empire, says the *Times*. An experiment in wireless telegraphy was made some 10 years ago, when British Guiana granted a licence to the West India and Panama Telegraph Co., to establish and maintain a wireless station in that colony for communication with the adjoining island of Trinidad. This arrangement continued until August, 1915, when an Imperial wireless station was set up in British Guiana. Jamaica also possesses her wireless station, and steps were taken last year to allow the stations—controlled by the Admiralty—in Newfoundland, Nova Scotia, Bermuda, Jamaica, and British Guiana to be used for commercial point-to-point messages.

Wireless Telephony.—Successful wireless telephonic tests have been carried out between Madrid and Chelmsford, and conversation was carried on without appreciable difficulty.

An attempt is shortly to be made to speak from Chelmsford to America and Australia by wireless telephony.

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On February 29th, for the first time intelligible wireless telephonic messages were received at the Waxholm Wireless Station, 12 miles from Stockholm, from England and Germany. The English message was distinctly audible.

Wireless telephonic messages are transmitted every evening from Chelmsford, at 8 p.m., for experimental purposes, and it is reported that such a message has been picked up by a ship at sea, 600 miles away, with an ordinary commercial receiver. It is requested that the reception of such messages be reported to the Marconi Co., and most of the acknowledgments received give technical observations of considerable value.

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the Electrical Review *in which the "Official Notice" appeared.)*

OPEN.

Aberdare. — March 20th. Urban District Council. Reconstruction of existing tramways: also new tramways. Mr. E. M. Lacey, 12, Victoria Street, S.W. 1.

Australia.—Melbourne.—April 12th. City Council. Two 2,000-kw. rotary converters; H.T. switchgear, 6,600 v.; D.C. switchgear, 600 v. (January 30th.)

Bedford. — March 31st. Electricity Department. Twelve months' supply of electricity meters and H.T. and L.T. cables. (See this issue.)

Belfast.—March 10th. Electricity Department. Stores, including meters, cables, electrical accessories, lamps, carbon brushes, &c. (February 20th.)

March 22nd. Electricity Department. Coal-handling plant. (February 20th.)

Belgium.—March 27th. Municipal authorities of Liége. 5,000-kw. turbo-alternator for the central electricity generating station. Tenders to the Bureau des Adjudications des Services Industriels, 3, Rue Saint Etienne, Liége, whence particulars may be obtained.

April 9th. Municipal authorities of Haccourt (Province of Liége). Concession for the electric lighting of the town.

Bristol.—March 22nd. Board of Guardians. Electric lighting installation at Eastville Institution. (See this issue.)

Edinburgh.—March 29th. Electricity Supply Department. Condensing plant for Portobello station. Specification No. 23. (February 27th.)

Gellygaer. — March 21st. Urban District Council. Transformer plant, H.T. and L.T. switchgear, 11,000 v. and 500 v. overhead line material. (February 27th.)

Halifax. — March 12th. Tramways and Electricity Committee. One 1,000-kw. turbo-alternator, with condenser. (February 27th.)

Lincoln.—April 8th. Electricity Department. Pipework, and motor-generator and switchgear for St. Swithin's power station. (See this issue.)

London.—Great Central Railway. March 17th. Stores for 12 months, including electrical line construction, electrical apparatus, wires, cables, lamps, &c. Specifications from Mr. W. Williams, Stores Superintendent, G.C.R., Gorton, Manchester.

H.M. Office of Works. March 12th. Electrical accessories for 12 months. (February 27th.)

Macclesfield.—March 15th. County Asylum. Electrical goods for six months. Mr. W. G. F. Tingay, Clerk.

Margate.—March 15th. Town Council. Electric light installation, Municipal Buildings. Borough Surveyor, 13, Grosvenor Place.

Merthyr Tydfil. — March 9th. Board of Guardians. Electrical fittings for six months. The Workhouse Master.

Mountain Ash.—March 20th. Urban District Council Electricity Department. Transformer plant, H. and L.T. switchgear, three-core and four-core armoured cables and overhead line equipment. (See this issue.)

New Zealand.—Dunedin.—April 26th. City Council. (*a*) electric car bodies; (*b*) car trucks; and (*c*) car equipment. Documents may be consulted by British firms interested, at the Department of Overseas Trade (Development and Intelligence), 35, Old Queen Street, S.W. 1 (Room 49).

April 31st. Auckland Harbour Board. Electric cranes. Mr. R. B. Burnett, Secretary, Quay Street, Auckland.

Plymouth. — March 18th. Electricity Committee. Turbo-alternator, converter and booster. (February 27th.)

South Africa.—April 24th. Oudtshoorn Municipality. Time for receipt of tenders extended from March 24th to April 24th.

Swadlincote.—March 11th. Swadlincote and Ashby Joint Water Committee. Electric motors and turbine pumps. Mr. A. J. Mason, Engineers, Council Offices, Swadlincote.

Wakefield.—March 8th. Electric lighting installation at the Lofthouse Wesleyan Chapel. E. Howroyd, Secretary, Lofthouse.

CLOSED.

Australia.—P.M.G.'s Department, N.S.W.:—

Two 100 straight line units and associated apparatus for Chatswood telephone exchange, £1,850: two ditto for Mosman exchange.—Automatic Telephones (Aust.), Ltd.

Victorian Railways Department:—

Two electrically-operated "Q R" truck traversers, £2,408.—Johnson and Sons, Pty., Ltd.

Brunswick (Victoria) City Council:—

1,327 yd. and 1,295 yd. of three-core, 19/18, S.W.G., H.T., lead-covered, underground cable, £2,280.—W. T. Henley's Telegraph Works Co., Ltd. —*Tenders.*

Bavaria.—It is stated that the A.E.G. has been given the contract for the Munich-Landshut section in connection with the projected Bavarian State electricity works, and the Bergmann Co. that for the Sanding-Edelhausen section.

Government Contracts.—The following Government contracts were placed during January, 1920:—

Admiralty (Contract and Purchase Department).

Conduit tubing and fittings.—Barton & Sons, Ltd.; Brotherton Ediswan Tubes & Conduits, Ltd.
Conversion of steam crane.—Ransomes & Napier, Ltd.
Copper wires.—British Insulated & Helsby Cables, Ltd.; London Electric Wire Co. & Smiths, Ltd.
Electric capstans.—Douglas & Grant, Ltd.
Electric hoists.—Cowans & Sheldon, Ltd.
Insulating materials.—Abbott, Anderson & Abbott, Ltd.; H. Clarke & Co.; Micanite & Insulators Co., Ltd.; Mica Manufacturing Co., Ltd.; Siemens Bros. & Co., Ltd.; R. Whiffen.
Switch boxes.—Palmer's Shipbuilding & Iron Co., Ltd.
Phosphor bronze screws and nuts.—Automatic Standard Screw Co., Ltd.

Ministry of Munitions.

Carburetter spare.—S. Wolf & Co., Ltd.; Zenith Carburettor Co., Ltd.
Electric fittings.—C. A. Vandervell & Co., Ltd.
Electrical plant. General Electric Co., Ltd.
Train lighting spare.—Chloride Electrical Storage Co., Ltd.

War Office.

Electrical installation, Cambridge Cottages, Woolwich.—G. Weston.

India Office: Stores Department.

Baudot apparatus.—Elliott Bros.
Telephone apparatus.—Automatic Telegraph Manufacturing Co., Ltd.
Cells.—Fuller's United Electric Works.
Telephone exchanges.—Relay Automatic Telephone Co., Ltd.
Generating sets.—Laurence Scott & Co., Ltd.

Post Office.

Telegraph and telephone apparatus.—Automatic Telephone Manufacturing Co., Ltd.; Creed & Co., Ltd.; C. Lange; Peel Conner Telephone Works, Ltd.; Siemens Bros. & Co., Ltd.
Telephone and telegraph cable.—B.I. & Helsby Cables, Ltd.; Connollys (Blackley), Ltd.; W. T. Glover & Co., Ltd.; Hackbridge Cable Co. Ltd.; W. T. Henley's Telegraph Works Co., Ltd.; Siemens Bros. & Co., Ltd.; Union Cable Co., Ltd.; Western Electric Co., Ltd.
Channels and covers.—McDowall Stevens & Co., Ltd.; Falkirk Iron Co., Ltd.
Telephone cords.—London Electric Wire Co. & Smiths, Ltd.
Earthenware ducts.—Jas. Oakes & Co.
Insulators.—Bullers, Ltd.; Doulton & Co.; J. Macintyre & Co., Ltd.; Taylor Tunnicliff & Co., Ltd.
Electric lamps.—British Thomson-Houston Co., Ltd.
Solder.—E. Austin & Sons; B.I. & Helsby Cables, Ltd.
Spindles for insulators.—F. W. Cotterell, Ltd.; Guest, Keen & Nettlefolds, Ltd.
Cable gear, H.M. Telegraph Ship "Alert."—Telegraph Construction & Maintenance Co., Ltd.
Laying conduits.—Bagshot: Greig & Matthews. London-Manchester (Loughborough-Derby, Section IV): Kettle & Son, Govan: R. & C. Murray, London-Manchester (Old Stratford-Loughborough, Section VII): J. F. Hodge & Co. Kingston-Richmond: J. Mowlem & Co. London-Southampton (Section IV): J. A. Ewart, Ltd. Widnes: Hodge Bros. (contractors), Ltd. Bolton (West): W. Pollett & Co., Ltd. Streatham-Norbury: Greig & Matthews. Burgh Heath: Greig & Matthews. Langside: Greig & Matthews. London-Southampton (Section III): W. Dobson, Finsbury, Shoreditch and Holborn: D. R. Paterson, Ltd. Kensington, Paddington and St. Marylebone: O. C. Summers. N. Camberwell, &c.: O. C. Summers. Chelsea (South Parade): G. I. Anderson, Faversham: Greig & Matthews, Littlehampton: Foot & Milne, Ltd. Hammersmith (N.E. area): D. R. Paterson, Ltd. Willesden Junction (Victoria Road): G. I. Anderson, Hove: Laing & Co.
Manufacturing, supplying, drawing-in and jointing cable.—Derby-Leicester: Siemens & Co., Ltd.
Repairing batteries.—Grimsby Automatic Telephone Exchange: D. P. Battery Co. G.P.O. (West): Pritchett & Gold and Electrical Power Storage Co., Ltd.
Telephone Exchange equipment.—"Toll" (London): Western Electric Co., Ltd. Northampton: Western Electric Co., Ltd. Harrow: Siemens Bros. & Co., Ltd. Hove: Western Electric Co., Ltd. Cambridge: Western Electric Co., Ltd.

Crown Agents for the Colonies.

Electric cranes.—Ransomes & Napier, Ltd.
Electric light fittings for railway carriages.—J. Stone & Co., Ltd.
Insulators.—Bullers, Ltd.
Electrolytic meters.—Reason Manufacturing Co., Ltd.
Switchboards, &c.—British L.M. Ericsson Manufacturing Co., Ltd.
Telegraph line material.—Siemens Bros. & Co., Ltd.; Bullers, Ltd.
Telephone material.—British L.M. Ericsson Manufacturing Co., Ltd.
Copper wire.—F. Smith & Co.; Shropshire Iron Co., Ltd.

Glasgow.—Tramways Committee:—

D.C.C. wire.—London Electric Wire Co. & Smiths, Ltd.
Control system of telephones.—Western Electric Co., Ltd.
Core drying oven.—A. Smith & Co.
Stoneware ducts.—Doultons.
12 miles copper trolley wire.—T. Bolton & Sons, Ltd.

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It was reported that the following firms had intimated increases on their contract prices, viz.:—Bolckow, Vaughan & Co.: Shanks and Co.; Johnstone & Boath; and P. & W. M'Lellan.

Electricity Committee. Recommended :—

One set of 1,500-kw. mercury-vapour rectifiers, at £11,600.—Brown, Boveri and Co., Ltd.

London.—St. Pancras.—The Electricity Committee has received a communication from the Brush Electrical Engineering Co., Ltd., suggesting that the order for the second 3,000-kw. turbine set, for which space has been provided by the disposal of the Browett-Lindley engines at the King's Road station, should be placed at once, as there is a large demand for power-house plant at the present time, and the moulders' strike having made deliveries very difficult, some time must necessarily elapse before castings for new orders can be taken in hand—and then only in rotation. Their present price for this plant, as compared with that of the first set, is as follows, the contract conditions remaining the same :—

Description.	Prices May 16th, 1918.	Present Prices.
3,000-kw. set (duplicate of plant already ordered)..	£18,400	£23,600
Entry and connecting pipes	300	400
Wet-air filter..	400	450

The Committee recommends the acceptance of the tender of the Brush Electrical Co., Ltd., at £24,450, for a second 3,000-kw. set, and that the order be placed forthwith.

Shoreditch.—Electricity Committee. Supply of cable :—

2¼ miles ·25 sq. in. three-core E.H.T., 11,000-volt plain lead-covered cable, £5,917; 1 mile ditto ·15 sq. in., £1,940; 570 yds. ·118 sq. in. armoured ditto, £654; 1 mile 19/·05 sq. in. armoured three-core L.T. 600 v. cable, £572; 2 miles 7/·064 ditto, £892; 1,000 yds. 1 sq. in. plain lead-covered single-core 660 v. cable, £1,250; 1¼ miles ·75 sq. in. ditto, £2,012; 500 yds. ·5 sq. in. ditto, £321; 300 yds. ·25 ditto, £106; ½ mile 19/·083 sq. in ditto, £152; ½ mile 19/·064 ditto, £112; 1 mile 19/·052 ditto, £166; 2 miles 7/·064, £226.—Union Cable Co.

The tender is based on the price of electrolytic wire bars at £130 per ton, and English lead at £53 per ton. Seven firms tendered; the above was the lowest.

Rhondda.—Urban District Council. Messrs. Clough, Smith & Co., Ltd., Westminster, have been awarded the contract for the erection of overhead mains.

Salford.—Tramways Committee. Accepted :—

Armature and field coils.—Manchester Armature Repair Co., Ltd., and Metropolitan-Vickers Electrical Co., Ltd.
Cable connectors.—L. Andrews & Co.
Insulating varnish.—Griffiths Bros. & Co. (London), Ltd.
Insulating tapes.—R. W. Blackwell & Co., Ltd.
Steel tires.—Hadfields, Ltd.
Trolley-wheel bushes.—Fleming, Birkby & Goodall, Ltd.
Cast-iron and steel-backed brake blocks.—National Rail & Tramway Appliance Co., Ltd.
Gears and pinions.—British Hele-Shaw Patent Clutch Co., Ltd.
Car axles.—J. Baker & Co. (Rotherham), Ltd.
Two armatures for D.K. 110 motors, £180.—English Electric Co., Ltd.
E.H.T. switchgear, £1,754; additional E.H.T. switchgear for Trafford and Blackfriars sub-station, £252. Metropolitan-Vickers Electrical Co., Ltd.
Two new water-tube boilers, superheaters, economisers, mechanical-draught plant, mechanical stokers and steel flues, at Frederick Road station, £8,459.—Babcock & Wilcox, Ltd.

Switzerland.—Quoting from the *Journal de Genève* the *Economic Review* states that the Swiss Federal Railway Council has ratified the agreements concluded in December, 1919, with Brown, Boveri et Cie., the Oerlikon Engineering Works and the Winterthur Locomotive Works, for the delivery of seven electric locomotives, and has authorised the necessary credit of Fr.5,515,000. The deliveries must be made by the end of January, 1921. The agreements concluded with the Société Industrielle Suisse de Neuhausen and the Schilleren Wagon Factory, for the delivery of 200 covered and 100 open wagons, were also approved.

FORTHCOMING EVENTS.

Royal Institution of Great Britain.—Saturday, March 6th. At Albemarle Street, W. At 3 p.m. Lecture on "Positive Rays" by Sir J. J. Thomson, President R.S.
Monday, March 8th. At Albemarle Street, W. At 3 p.m. Lecture on "Modern Development of the Miner's Safety Lamp," by Sir John Cadman.
Friday, March 12th. At Albemarle Street, W. At 9 p.m. Lecture on "The Thermionic Valve in Wireless Telegraphy and Telephony," by Prof. J. A. Fleming, F.R.S.

Anglo-French Society.—Saturday, March 6th. At the Æolian Hall, New Bond Street, W. At 5.45 p.m. Lecture in French on "The Channel Tunnel," by Baron E. B. d'Erlanger.

Association of Engineering and Shipbuilding Draughtsmen.—Tuesday, March 9th. At the Liverpool University. At 7.30 p.m. Lecture on "Elementary Calculus," by Mr. S. Clowes.
Thursday, March 11th. At the Grammar School, Chesterfield. At 7.30 p.m. Lecture on "The Principles and Design of Centrifugal Fans," by Mr. F. Clements.

Association of Engineers-in-Charge.—Wednesday, March 10th. At St. Bride's Institute, Ludgate Circus, E.C. At 7.30 p.m. Paper on "The Solidification and Crystallisation of Metals," by Mr. L. Aitchison.

Edinburgh Electrical Society.—Wednesday, March 10th. At the Philosophical Institution. At 7.30 p.m. "Questions and Answers" Night.

Royal Society of Arts.—Wednesday, March 10th. At John Street, Adelphi, W.C. At 4.30 p.m. Paper on "Gas in Relation to Industrial Production and National Economy," by Mr. H. M. Thornton.

Institute of Metals.—Thursday, March 11th. At 4 p.m. At the Institution of Mechanical Engineers, Storey's Gate, Westminster, S.W. Annual General Meeting. Friday, March 12th. At 10.30 p.m. Annual dinner.

Institution of Electrical Engineers.—Thursday, March 11th. At the Institution of Civil Engineers, Great George Street, S.W. At 6 p.m. Paper, on "Notes on Operating a By-product Producer Gas Plant for Power and Heating," by Mr. W. H. Patchell, and "Production of Power from Blast Furnace Gas," by Mr. S. H. Fowles.

(**North-Midland Centre**).—Tuesday, March 9th. At the Hotel Metropole, Leeds. At 7 p.m. Ordinary meeting.

(**Scottish Centre**).—Tuesday, March 9th. At Prince's Station Hotel, Edinburgh. At 7 p.m. Paper on "The Protection of Alternating Current Distribution Systems Without the Use of Special Conductors," by Major K. Edgcumbe, R.E.

Junior Institution of Engineers.—Friday, March 12th. At 39, Victoria Street, S.W. At 7.30 p.m. Lecturette, "Chain Helice Pumps," by Mr. F. A. Simpson.

International Motor Boat and Marine and Stationary Engine Exhibition at Olympia.—March 12th to 20th. 11 a.m. to 9 p.m.

NOTES.

Batti-Wallahs' Society.—At the luncheon on March 15th, Mr. F. Pooley (secretary and treasurer) will be the chief speaker.

The Electricity Commissioners.—It is reported that one or more of the Electricity Commissioners in the near future will undertake a tour of investigation in the provinces with a view to examining on the spot various propositions which have been prepared under the provisions of the Electricity Supply Act, and drawing up a report thereon.

Coal Conservation.—On Friday next, March 12th, the annual public meeting of the University College, London, Engineering Society, will be held in the Botanical Theatre, at the College, at 5.30 p.m. An address will be given by Sir Dugald Clerk, F.R.S., on "Coal Conservation," to which visitors are welcomed.

L.C.C. Tramway Staff Reorganisation.—In connection with the reorganisation of the L.C.C. Tramways Department, the Highways Committee recommends the following classification of the technical and clerical staff of the department under the direction of the Committee, the alterations in the fixed staff of the tramways department to take effect as from January 1st, 1920, the salaries being based on pre-war conditions :—

Traffic Branch.—Traffic manager, £1,200 by £50 a year to £1,500; development superintendent, £500 by four annual increments of £25 and four of £50 to £800; operation superintendent, £600 by £50 a year to £800; divisional superintendent (north), £300 by £25 a year to £400; divisional superintendent (south), £300 by £25 a year to £400; publicity assistant, £300 by £25 a year to £400; traffic statistics assistant, £300 by £25 a year to £400; time tables assistant, £250 by £12 10s. a year to £300; motor school superintendent, £255 by £15 a year to £300.

Electrical Branch.—Electrical engineer, £1,200 by £50 a year to £1,500; assistant electrical engineer, £600 by four annual increments of £25 and two of £50 to £800; power station engineer, £500 by four annual increments of £25 and two of £50 to £700; distribution engineer, £500 by £25 a year to £700; assistant distribution engineer (north), £350 by £12 10s. a year to £400; assistant distribution engineer (south), £350 by £12 10s. a year to £400; assistant power station engineer, £400 by £20 a year to £500; repairs superintendent, £300 by £20 a year to £400; boiler house superintendent, £300 by £20 a year to £400; sub-station superintendent (north), £250 by £12 10s. a year to £300; sub-station superintendent (south), £250 by £12 10s. a year to £300; mains superintendents, £250 by £12 10s. a year to £300; boiler house charge engineer, £250 by £10 a year to £300; charge shift engineers, £250 by £10 a year to £300; sub-station repairs inspector, £200 by £12 10s. a year to £250; senior technical assistant, £400 by £25 a year to £500; technical assistant (grade 1), £300 by £20 to £400; technical assistant (grade 2), £250 by £12 10s. to £300; technical assistant (grade 3), £200 by £12 10s. to £250.

Rolling Stock Branch.—Rolling stock engineer, £1,000 by £50 a year to £1,200; rolling stock superintendent, £400 by £25 a year to £600; superintendent (central car repair depôt), £400 by £25 a year to £600; cartage superintendent, £255 by £15 a year to £300; technical assistant (grade 2), £250 by £12 10s. a year to £300; rolling stock inspector, £230 by £10 a year to £280.

Permanent Way Branch.—Permanent way engineer, £800 by £50 a year to £1,000; assistant permanent way engineer, £300 by £25 a year to £400; principal technical assistant (from August 1st, 1921), £500 by £25 a year to £600; senior technical assistant (until August 1st, 1921), £400 by £25 a year to £500; building superintendent, £400 by £25 a year to £500; technical assistant (grade 2), £250 by £12 10s. to £300; technical assistant (grade 3), £200 by £12 10s. to £250.

General Branch.—Chief clerk, £600 by £50 a year to £800; tramways accountant, £600 (personal to the present holder of the position); stores superintendent, £400 by £25 a year to £600; assistant stores superintendent, £260 by £15 a year to £350; claims superintendent, £300 by £25 a year to £400; printing shop superintendent, £250 by £10 a year to £300; superintendent of women checkers, £200 by £12 10s. a year to £250.

Secretariat.—Principal technical assistant, £500 by £25 to £600; technical assistant (grade 1), £300 by £20 to £400.

The proposed scales of salaries are subject to the appropriate temporary percentage additions, plus war bonus, making the total annual remuneration at the present time (February, 1920) on these scales as follows :—

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Traffic manager and electrical engineer, £1,400 to £1,780; rolling stock engineer, £1,180 to £1,400; permanent-way engineer, £960 to £1,180; assistant electrical engineer, £810 to £1,050; operation superintendent and chief clerk, £752 10s. to £960; development superintendent, £650 to £960; power-station engineer and distribution engineer, £690 to £930; tramways accountant, £702 10s.; principal technical assistants, £650 to £754 10s.; rolling stock superintendent, superintendent (central car repair depôt), and stores superintendent, £654 to £752 10s.; assistant power-station engineer and senior technical assistant (electrical branch), £570 to £690; building superintendent and senior technical assistants (other than electrical branch), £558 to £650; assistant distribution engineers (north and south), £510 to £670; repairs superintendent and boiler-house superintendent technical assistants (grade 1: electrical branch), £460 to £570; divisional superintendents (north and south), publicity assistant, traffic statistics assistant, technical assistants (grade 1: other than electrical branch), assistant permanent-way engineers, claims superintendent, £430 to £558; motor-school superintendent and cartage superintendent, £360 5s. to £430; assistant stores superintendent, £376 to £490; sub-station superintendents (north and south), mains superintendent, boiler-house charge engineer, charge shift engineers and technical assistants (grade 2: electrical branch), £330 to £450; time tables assistant, technical assistants (grade 2: other than electrical branch), and printing-shop superintendent, £264 10s. to £430; rolling-stock inspectors, £337 to £405; sub-station repairs inspector and technical assistants (grade 3: electrical branch), £330 to £390; technical assistants (grade 3: other than electrical branch), £301 to £354 10s.; and superintendent of women checkers, £280 10s. to £341 10s.

Submersible Motors. — We have from time to time referred to the submersible electric motor pumps that rendered such goood service to the Navy and in marine salvage operations during the war period. Some interesting experiments were recently carried out in Cheshire with a view to demonstrating the possibilities of this apparatus for mine work. According to the *Colliery Guardian*, a manufacturing firm was considering the use of the water draining into an abandoned mine shaft. The shaft in question was awkwardly situated, and contained a quantity of *débris* of all kinds, rendering the use of ordinary pumps practically impossible. The firm approached the Admiralty, and was referred by the latter to Submersible Motors, Ltd., who, after inspecting the scene of operations, undertook to carry out the work. It was desired to lower the water to a depth of about 160 ft. from the ground level with a view of ascertaining what was the daily inflow. The plant used consisted of two 4-in. submersible motor-pumps, each of which had a rated output of 370 G.P.M. at 80 ft. total head. The delivery side of one pump was coupled to the suction side of the second pump, thus forming the equivalent of a two-stage centrifugal pump capable of a lift of 160 ft. For supplying the electric power a portable generating plant was used consisting of a three-phase alternator and exciter coupled to a paraffin engine. The whole set, together with the necessary switchgear, mounted on a wheeled truck, can be readily moved about and is of weather-proof construction. A suitable headgear was erected and the motor-pumps, connected by flexible electric cables to the generating plant, were lowered into the shaft, the bottom pump being 160 ft. from the surface, and the second one about 80 ft., several obstructions being encountered on the way. Armoured flexible rubber hose was used for the pipe line. The daily flow of water into this pit being found insufficient, it was decided to make a further trial at some other pits nearer the company's factory. Here were three shafts linked together by workings, the water level standing 11 ft. from the surface, and it was desired to lower the water to about 300 ft. In this case the supply of electric power was obtained from the company's works. Four 6-in. submersible motor-pumps were used, each having a normal duty of 740 G.P.M. at 75 ft. head. They were coupled in pairs, the first pair being lowered to a depth of 310 ft. and the second pair to 150 ft. No flexible 6-in. hose being available for the pipe line, steel tube was used, and considerable difficulty was experienced in lowering this, owing to the numerous obstructions in the shaft. After pumping continuously for five days the water level was lowered to 160 ft., and after a further seven days to 275 ft. Delivery was then throttled to maintain a constant level at this depth, and readings taken of the inflow. Altogether the plant was running for 37 days, one pair of pumps running for 24 days on end, and on 19 of these days for the whole of the 24 hours. The total quantity of water pumped was 33,623,604 gals. Great difficulty was experienced in raising the pumps and pipe line, which constantly caught in brickwork and stagings, necessitating several descents in the "bo'sun's chair" down the pit to free it, one as low as 240 ft., all other methods having failed. This was a perilous undertaking, owing to the rotten state of the brickwork lining, and none of the local miners being willing to go down, it was, therefore, left to the Submersible Co.'s engineer and his assistant to do this. The whole operation was entirely successful, and credit is due to the Submersible Co.'s engineer, Mr. Mackenzie, and his assistant, Mr. Chalk, for the successful manner in which they overcame the numerous difficulties encountered on this novel undertaking, which demonstrated clearly the use which can be made of these submersible motor-pumps in places where the use of ordinary pumping plant would be impracticable or costly.

The Electric Smelting of Iron Ores.—In *Chemical and Metallurgical Engineering*, Vol. 20, No. 12, an abstract was given of an exhaustive report by Dr. Stansfield (Bulletin No. 2, 1919, British Columbia Department of Mines) on the commercial possibilities of electric smelting of iron ores in British Columbia. The report says:—

"The possibility of the commercial operation of an electric smelting plant for the production of pig iron from iron ore depends on an adequate supply of electrical power at a moderate price. A large amount of power is needed, the amount varying somewhat with the richness of the ore, the grade of iron to be produced, and the kind of furnace employed. Under usual conditions the consumption of electrical power for each long ton of pig iron ranges from one-third to one-half of a H.P.-year. For foundry iron production from rather low-grade ores, and in a simple pit furnace, more than two long tons of iron per annum cannot safely be reckoned upon. For a daily output of 50 tons of pig iron some 8,000 or 9,000 E.H.P. will be needed, and if provision is made for the production of ferro-alloys and steel in electric furnaces, 10,000 to 15,000 H.P. will be required."

At the time of Dr. Stansfield's visit to Vancouver the probable cost of power worked out at about $15 per E.H.P.-year, and at this price electric smelting seemed commercially feasible. When his report was nearing completion he was given to understand that the charges for electric power would be nearly twice the figure assumed in his calculations, and under this changed condition his conclusion is that the electric smelting of iron ores by existing methods is scarcely possible, and the only remaining opening, unless cheaper power can be obtained, is by developing a new process.

It appears, however, that there is ample undeveloped power going to waste—a fact which is applicable to this country as well—and Dr. Stansfield was furnished with estimates showing that 340,000 H.P. at three accessible points could be developed for smelting purposes at about $10 per H.P.-year. Such costs would be lower than for ordinary users since the load factor would easily approach 90 per cent.

In the Swedish furnaces at the time of Dr. Stansfield's visit in 1914 the electrodes used were 24 in. in diameter and 4 or 5 ft. in length. They had threaded ends for the addition of fresh lengths, were of amorphous carbon, and cost about 4 cents per lb. When making white pig iron from high-class ores the electrode consumption was about 10 to 15 lb. per ton of pig iron, thus costing about 50 cents per ton of product. In melting lower grade ores for foundry iron, Dr. Stansfield considers that the consumption might be from 15 to 20 lb., and that at the present prices in Columbia this would mean about $1.50 per ton of pig. A furnace of 3,000 KW. uses six of these 24-in. electrodes.

The cost of making pig iron in the Swedish furnace as given by Electro-Metals for a large plant of an annual capacity of 60,000 tons of white iron works out at $11.50 per ton, showing what can be done under exceptionally favourable circumstances. Dr. Stansfield's estimate for a British Columbian plant in 1918, with an output of 27,000 tons of grey iron per annum, is from $29.75 to a minimum of $23.90 per ton. In pit furnaces (10,000-KW. plant) one long ton of foundry iron would cost about $36.81.

The cost per long ton of blast-furnace pig iron works out at $25.95 per ton, showing that "there does not appear to be any reason why electric-furnace iron should cost more than blast-furnace iron under the conditions we find on the coast, and providing that power can be had at $15 or less."

The Panama Canal.—The Panama Canal report for the year ending June 30th, 1919, gives a *resumé* of canal operations for twelve months, during which the use of the canal was not interfered with by slides or other serious accidents. The period under review cannot be regarded as indicative of the canal's ultimate value as a trade route, on account of the period being an abnormal one. According to *Engineering*, the total amount of water passing off the useful catchment area per month averaged 15,410 million cu. ft., of which amount 35.24 per cent. was put to use, but only 9.232 per cent. was used for lockages. Of the water lost, 8,094 million cu. ft. went over the Gatun spillway, and 12 per cent., or 1,907 million cu. ft. were lost by evaporation. Leakage at the locks and spillway amounted to 44 million cu. ft. Of the water used 3,611 million cu. ft. was the average for the amount taken by the hydro-electric plant at Gatun. The lockages absorbed 1,423 million cu. ft. The electric plant used 66.5 per cent. of the water usefully employed, or about 20 per cent. of the yield of the watershed.

The electric towing system at the locks met with two accidents during the year; both due to a fault in design and since remedied. Both accidents happened to the same locomotive. In each case getting out of control it ran down one of the inclines. These locomotives are not under control when the clutch lever is in the neutral position. As an expedient a bell has now been fitted which continues ringing so long as both clutch levers are out of either the 2-M.P.H. or 5-M.P.H. notches, at both ends of the machine. A new brake is also being fitted which will operate regardless of the clutch levers. The actual lockage operations suffered a delay of about five hours on one occasion owing to the accidental flooding of the transformer rooms in the lock walls at Miraflores, from which it would appear that the interlocking of the controls is not so complete as it should be. As already described in our pages, the hydroelectric plant has been extended. The steam-generating plant at Miraflores is, therefore, an emergency standby. Steam is kept up in the boilers by small oil fires, and the plant is started automatically on failure of the Gatun supply. Failures in the 44,000-volt transmission line across the isthmus have been greatly reduced by the introduction of additional units to the insulators. These failures numbered 17 in 1917, 29 in 1918, while from July, 1918, to February, 1919, no less than 32 occurred. After the new insulation was effected in February, down till the end of June of last year, no failures had been reported.

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Summer Time.—An Order in Council was made on Tuesday, directing that Summer Time shall commence on March 28th, and last until September 27th. According to the French Ministry of Public Works, in a report quoted by the daily Press, Summer Time in France has during the last four years saved an hour's lighting by 39,000,000 people for seven months in the year. It saves on lighting £2,400,000 a year. The total saving on electric lighting is reckoned at 15 per cent., and on gas lighting at 5 per cent. As, this year, Summer Time is beginning a fortnight earlier, and will end 19 days later, it is estimated that a further saving of £374,000 will be effected.

Engineering Golfing Society.—The 11th annual general meeting of the Engineering Golfing Society was held at the Institution of Civil Engineers, Great George Street, Westminster, on Thursday, February 26th, when, in the absence of the President, Sir A. B. W. Kennedy, and the retiring Captain, Mr. Midgley Taylor, the chair was taken by Mr. F. J. Walker, one of the vice-presidents. The following were elected office-bearers for the ensuing year :—

President	Sir Alexander B. W. Kennedy.
Vice-Presidents ..	D. A. Stevenson, E. L. Mansergh, F. J. Walker, S. Price-Williams, G. Midgley Taylor.
Captain	W. H. Shortt.
Honorary Secretary ..	W. L. Mansergh, 5, Victoria Street, S.W.
Honorary Treasurer	S. R. Lowcock.

Although the membership of the society is steadily increasing, the opinion was expressed that there must be many members of the Engineering Institutions who are interested in golf, and who are eligible to join the society.

Stalybridge Dispute. — According to the *Manchester Guardian*, attempts were made on February 27th, at the meeting of the Stalybridge, Hyde, Mossley and Dukinfield Tramways and Electricity Board, to reopen the question of the dispute with the shift engineers, who ceased work in December. The Board declined to move in the matter, and rejected three proposals—to appoint a sub-committee to go into the matter and report, to refer it to the National Joint Industrial Council for the Electricity Supply Industries, and to allow two delegates to appear before the next meeting of the General Purposes Committee. It was revealed in further discussion that the Ministry of Labour had written to the Board in regard to the dispute, and had expressed the opinion that further steps should be taken to obtain an amicable adjustment of the difficulty, and it suggested a meeting between the Board and representatatives of the men's association. The Generating Committee replied that a new permanent staff had been appointed, that a full and increasing load was being carried at the generating station, and that the Committee felt compelled to decline the invitation of the Ministry to enter into further discussion of the matter.

Society of Technical Engineers.—A general meeting of the Bristol and West of England Branch was held at Bristol on February 27th, but there was only a sparse attendance. A paper, entitled "Organised Effort: Its Relation to Present Needs," was was read by Mr. A. Lennox Stanton, A.M.I.E.E., who outlined the origin of protective associations, and what had been accomplished by organised effort during the war, and pointed out that the most unorganised section of the community was the majority of professional workers, whose position in the economic life of the nation and the world's work was of the highest importance. The paper was illustrated by lantern slides, and a short discussion followed.

Appointments Vacant.—Mains engineer (£330) for the City of Carlisle electricity department; plumber-jointer (98s. 1d.) for the Hackney Borough Council electricity department; meter repairer, also meter fixer, for the Borough of Hornsey electricity works; fitter for the Nuneaton Corporation electricity works; shift engineer (£234), mains assistant (£208), control engineer (£234) for the Kilmarnock Corporation Electricity Works; electrical engineer and manager (£750) for the City of Peterborough Electricity Works. See our advertisement pages to-day.

Isaacs v. Hobhouse.—An echo of this libel case of 1918 has reached us in the shape of a circular signed by Mr. Godfrey C. Isaacs, and containing extracts from correspondence with Germany which was unobtainable during the trial of the action. The letters relate, mainly, to Sir Henry Norman's relations with Baron von Lepel before the war.

The Fullerphone.—At the sitting of the Royal Commission on Awards and Inventions, on March 1st, the claims heard were those of Major A. C. Fuller, in respect of his telephonic apparatus.

The device which, it is admitted, prevented eavesdropping by the enemy so far as telegraphic messages were concerned, and the manner in which silence is obtained, were explained by counsel. The President, Mr. Justice Sargant, remarked that the matter was very technical, and a good knowledge of electricity was necessary fully to understand it. Major A. C. Fuller said that his invention was made about November, 1915, and he took it to General Boyce. The only royalties he had obtained were about £1,800 from the French Government for the four other instruments they had made towards the close of the war. For two years he had endeavoured to obtain something from the American Government for its use of the system, but without success. General Sir John Fowler, Signals Officer-in-Chief to the British Army, said in reply to Mr. Trevor Watson, for the Treasury, that secrecy applied only to messages telegraphed over the line, and not to those telephoned. Judgment was reserved.

INSTITUTION NOTES.

Institution of Electrical Engineers.—The annual dinner of the NORTH MIDLAND CENTRE was held at the Queen's Hotel, Leeds, on Friday last. Mr. W. M. Selvey, chairman of the Centre, presided, and amongst those present were the president (Mr. Roger T. Smith) and secretary (Mr. P. F. Rowell), Mr. J. A. Robertson, Lieut.-Col. W. A. Vignoles, D.S.O., Mr. Hugh Lupton, Lieut.-Col. E. Kitson Clark, Messrs. Ll. B. Atkinson and W. B. Woodhouse, vice-presidents, and Mr. J. D. Bailie, hon. secretary of the Centre.

After the loyal toast had been duly honoured, Mr. J. A. Robertson proposed "His Majesty's Forces," drawing a contrast between the attitude of the nation towards the Army in 1914 and that of the present day, when the Army, in its various branches, includes the whole nation; he eulogised the work of the Navy and the mercantile marine, the most efficient Air Force in the world, and the women who played a great part in the war, and urged that in future the burden of military service must be equally shared by all—we must be prepared for war. Before the toast was drunk, the audience stood in silent tribute to the fallen. In responding, Lieut.-Col. Vignoles touched upon the historic exploits of the Navy and Army and the Auxiliary Forces, and said we must in the future take the Army seriously, and provide an adequate force to guard against a recurrence of the conflict.

Mr. Lupton proposed "The Institution of Electrical Engineers," which in 50 years had grown from 110 to 8,000 members, and suggested that as the Electricity Act did not provide the necessary funds for development, an Act should be passed empowering municipalities to take shares in companies, with corresponding representation on the directorate, as a solution of the difficulty.

The President, responding, received a "Yorkshire welcome": he said he served his apprenticeship in Leeds, and told amusing anecdotes of work and sport in those days, remarking that the knowledge he then gained of workers' ways had been of the utmost value to him. The Institution now had seven Centres and four Sub-Centres, and one part of its activities was thoroughly decentralised. The question had been raised why should there not be a "London Centre"? He pointed out that the membership in and around London equalled that of all the Centres and Sub-Centres combined. Every Centre cost money, and when the Institution was back in its old home, the great problem would be that of finance. He was heartily in agreement with this democratic development, in which the Institution was showing the way to kindred Societies, but it would be successful only if the members would provide the funds.

Mr. Selvey, in briefly proposing "Our Guests," remarked that electrical engineers had been so absorbed in giving the public cheap power, that they forgot to give themselves adequate salaries; but that mistake was in process of rectification, and the prospects before the electrical industry were rosy. Mr. Alderman R. A. Smithson responded.

Lieut.-Col. E. Kitson Clark proposed "The Electrical Industries," humorously deprecating the attempts of electrical engineers to supersede the steam locomotive.

Mr. Ll. B. Atkinson replied, with many interesting reminiscences of his apprenticeship at Airedale Foundry and old times in Leeds. He said that members of the electrical industry had been very ill-rewarded for their efforts; the true reason was the competition with extraordinarily cheap coal, the greatest enemy of electricity. Other countries had had to economise coal, and for that reason they developed electricity. But coal would never be cheap again, and now electricity was king. Manufacturers were snowed under with orders, and the great problem was to get the work done. Industrial peace was the prime necessity.

Mr. W. B. Woodhouse, proposing "Kindred Societies," said the keynotes of progress were specialisation, organisation, and co-operation. Electrical engineers were necessarily specialists, and must also depend in many ways on other specialists; it was the function of kindred Societies to look after the other kinds of specialists. Too much time might be spent on organisation, losing sight of the results that were to be produced; there were so many Societies that one had to know them by initials. The co-operation of other bodies had been extremely valuable to the I.E.E., which was hoping to collaborate with the Institution of Civil Engineers in connection with the registration of engineers.

Mr. W. T. Lancashire, M.Inst.C.E., City engineer, in responding, said that all would agree that those who had to take care of the public health should be properly qualified. Leeds was engaged in town-planning, to which the help of electrical engineers was indispensable, to provide rapid transport and power for smokeless factories near the houses.

The chairman's health, proposed by Mr. Woodhouse, was toasted with musical honours. During the evening a programme of music was performed, and Mr. Harrison Hill ably entertained the guests with song and story.

At the meeting of the WESTERN CENTRE at Bristol on Monday last, it was announced that a summer meeting of the Institution had been arranged in the Western Centre commencing on Tuesday, July 13th, and terminating on Friday, July 16th. A tentative programme had been drawn up, and would be submitted to headquarters for approval. The time-table for the summer meeting would be as follows :—

Tuesday, July 13th.—Cardiff—opening meeting and civic reception.
Wednesday, July 14th.—Newport in morning, returning *via* Bargoed to Cardiff.
Thursday, July 15th.—Visit to Bristol.
Friday, July 16th.—Swansea—concluding meeting.

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Prof. David Robertson delivered a lecture on "Electric Impulse Clocks," illustrated by a lantern demonstration and working models.

At the Informal Meeting, on Monday last, Mr. R. E. Dickinson read a paper on "The Future of Labour in the Engineering Industry." He described shortly the causes of the rise of Trade Unionism, and the present-day need for Unions in order to prevent victimisation, and finished by mentioning the Guild System and the Manchester Builders' Guilds' offer to supply houses cheaply. Mr. Rankin was welcomed back after his illness, and opened the discussion. Many others spoke. The general opinion was that labour should be given responsibility, and educated to understand the ramifications of trade and industry, and that labour unrest was a reaction from evil actions of bad employers in the past (cutting piece rates, &c.). Strikes were taboo; but E.P.E.A. men realised the difficulties of obtaining justice when many authorities agreed to go to arbitration *re* salary claims, and then only a proportion of them paid the award.

The chairman's final words suggested that men would respond to an appeal to serve the nation now in peace time as they had responded to the country's call for service in war time.

Association of Mining Electrical Engineers.—The Yorks. Branch held a meeting at Wakefield, on February 21st, when a paper by Mr. Robert Rae, on "Practical Machine Coal-Mining," was read. The uses and disadvantages of coal-cutting machines were discussed at length, and various opinions were expressed as to the efficiency of the machines.

Edinburgh Electrical Society.—Lieut.-Colonel Ogilvie, O.B.E., T.D., delivered a lecture to the Society on Wednesday, Feb. 26th, the title being "Electric Projectors and Some of their Uses." The lecturer indicated the principles which govern the disposition of searchlights for trench, estuary, ship, and aerial use. The development from the simple hand-fed inclined-arc type through varied forms and stages to the modern 60-in. projector, with its high-intensity carbons, was interestingly illustrated, and the various methods of deflecting and dispersing, distorting and dividing the beams were described and discussed. The war functions of projectors for locating, illuminating, and altitude-finding were indicated, and examples quoted of their use for whale fishing and navigation.

On Wednesday, March 3rd, Mr. J. Plucknett, A.M.I.E.E., read a paper on "Petrol Gas Plant for Electrical Engineers." The paper was accompanied by practical demonstrations of gas generators and other apparatus.

The next meeting, on March 10th, will be devoted to a general discussion on minor questions of electrical practice and to "Questions and Answers." The membership of the Society continues to make gratifying progress.

Institution of Civil Engineers of Ireland.—In a paper read on February 2nd, Mr. G. Marshall Harriss pointed out that the staple industry in Ireland was agriculture, and that the increased output per worker that was necessary could only be obtained with the aid of cheap power. Irish coal mines were not sufficiently developed; the abundant supply of peat possessed great possibilities, and the water power was only limited by the amount of capital required to develop it. Numerous small water powers were in full operation 80 years ago, but the vast majority were now disused; difficulties arose from the seasonal variations in the flow, and the necessity in those days of using the power on the spot. Cheap coal put the water powers out of action. Now the water turbine and electrical transmission had changed the situation, and as so little labour was required for operation, there was no fear of strikes interrupting the supply. The variation of flow mattered less if the hydro-electric station was linked up with steam stations. On the River Dee at Chester, Mr. S. E. Britton had secured an output of 7,300,000 units sold (during five years) from water power of 600 H.P., and 6,900,000 from steam plant, the capital cost of the former being £18,473, and of the latter £55,992. The total works costs per unit, including capital charges, were for steam 1·462d., and for water power 0·172d. Consequently, Mr. Britton proposed to develop the power of the Dee at 16 places linked together, and capable of producing 60 million units a year, of which 50 millions would be used for agriculture. The total cost of plant and mains was estimated at £600,200, and at 1·5d. per unit, the revenue would be £298,922, the expenses £93,542, and the surplus £205,468. State aid was essential, but State control undesirable, leading inevitably to inefficiency and waste. It was proposed to utilise the power of the Liffey at the Salmon Leap, where with a 35-ft. head, 1,500 KW. could be developed for 20 weeks in the year, and less at other times. The total cost was estimated at £38,500 (£26 per KW.), and a net output of 8,000,000 units per annum could be counted upon, at a total works cost of 0·138d. per unit generated. The Dublin and Lucan Electric Railway would take 250,000 units, and the remainder would be fed into the Dublin systems 7 miles away, at a total cost of 0·3225d. per unit. The cost of coal alone was at present over 1d. per unit in Dublin. Two other falls, of 26 and 104 ft. head respectively, could easily be developed, and would yield over 30 million units a year. The proposal was receiving practical attention.

Leeds Association of Engineers.—A lecture was delivered at Huddersfield on February 26th by Mr. W. H. Child, on "The Transmission of Power by means of Machine-cut Gearing."

Wireless Society of London.—At the last meeting on February 27th at the Royal Society of Arts, the President, Mr. A. A. Campbell Swinton, F.R.S., delivered his address, the subject being "Some Wireless Wonders."

Birmingham and District Electric Club.—At a meeting on February 21st, a paper was read by Major R. V. C. Brook (member) on "Electric Vehicles." The paper was comprehensive and dealt with the early history, progress, limitations and advantages of the "Electric." The writer urged the importance to the electrical industry of an increased interest in this branch of the business; but insisted that it was necessary to realise that the "Electric" had certain limitations, and must not be indiscriminately recommended. In the present state of development of batteries, the "Electric" could not show advantages for long-distance work; but for short hauls, such as town and suburban deliveries, refuse collection, coal cartage, interworks duties, street cleaning, and a host of similar duties, the "Electric" could show considerable economy and efficiency over any other methods of transport. The author gave tabulated examples of running costs and reliability in comparison with other types, and proved conclusively that electric vehicles, in their own particular field, had a future in which neither horse, petrol nor steam could compete. Major Brook appealed to all electrical engineers, in the interests of the industry, to do all in their power to spread the gospel of the economical electric vehicle.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

AFTER 21 years' service, MR. D. G. BROOKS severed his connection with Simplex Conduits, Ltd., in October last, when he was presented by the staff and workpeople at Garrison Lane, with a silver tea service, and by the branches with a silver coffee service. He has now joined forces with the Walsall Hardware Manufacturing Co., Ltd., and will take up the sales direction over a large part of England, Wales, and Scotland.

MR. W. W. LACKIE and MR. A. PAGE were entertained to dinner on February 23rd in the Conservative Club, Glasgow, by past and present members of the Committee of the Scottish Local Centre of the Institution of Electrical Engineers, to mark their recent appointments as Electricity Commissioners. Mr. W. B. Hird, chairman of the Centre, presided, and proposed the toast of the evening. Prof. Maclean proposed Mr. Goslin's health, and Mr. Sam Mavor toasted Mr. Joseph Taylor, secretary of the Scottish Centre.

MR. E. T. GOSLIN, M.I.E.E., electrical engineer to the Glasgow Corporation tramways, having been appointed general manager of the Clyde Valley Electric Power Co. in succession to Mr. A. Page, we have pleasure in reproducing his portrait. Mr. Goslin, after

E. T. GOSLIN.

acquiring experience with Messrs. Crompton & Co., Ltd., the Hove Electric Lighting Co., and the County of London Co., entered the Glasgow Tramways Department, of which he has been chief electrical engineer for 18 years. He has been a J.P. for three years, and during the war was Deputy Director of Labour under the Ministry of National Service.

MR. W. G. WATSON, managing director of W. G. Watson & Co., Ltd., of Sydney, is on his way to England and U.S.A. in connection with the company's business. He expects to be in London about May or June next, and communications may be addressed to him c/o The Editor of the ELECTRICAL REVIEW, or c/o English, Scottish, and Australian Bank, Ltd., Head Office, London.

The Bedford Town Council has appointed MR. BLAIKIE, M.I.M.E., as supervising engineer for the new electricity works, at a salary of £7 7s. per week.

MR. P. WARDLE, mains and sub-station superintendent in the Carlisle electricity department, has been appointed mains engineer at Walsall, in succession to Mr. J. D. Spark.

The employés of the Yorkshire (West Riding) Electric Tramways Co. have presented a gold watch to MR. A. KING, for 13 years traffic superintendent at Castleford, on his leaving to join the Electrical Contracting and Motor Co.

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Reigate Town Council has increased the salary of the electrical engineer, MR. W. S. ROSS, by £60 a year.

LIEUT.-COLONEL H. C. FRASER, D.S.O., has been appointed Superintendent of Organisation for the Yorkshire Electric Power Co. Colonel Fraser, during his military service, was in turn Commanding Officer of the 4th Battalion of the Yorkshire Light Infantry and of the Yorkshire Dragoons.

MESSRS. A. MURRAY COOMBS and A. F. W. RICHARDS, advisory and inspecting engineers, have removed from 25, Victoria Street, to Cross Keys House, 56, Moorgate Street, E.C. 2. Telephone: London Wall 9080.

MR. JUSTUS ECK having realised his interest in the Phonopore Construction Co., Ltd., has retired from the board, and resigned the secretaryship.

The salary of MR. R. B. LEACH, borough electrical engineer of Loughborough, has been increased to £550 per annum, as from January 1st. Mr. Leach also holds the appointment of Local Fuel Overseer under the Board of Trade Household Fuel and Lighting Order, for the Corporation of Loughborough.

Obituary.—MR. G. E. YOUNG.—The death has occurred at Southdene, Unstone, of Mr. G. E. Young, aged 57, who had for 16 years been chief electrical engineer to the Sheepbridge Coal and Iron Co., Ltd., of Chesterfield.

WILL.—The late LORD RAYLEIGH left £172,215 unsettled net personalty.

NEW COMPANIES REGISTERED.

Campion Ball & Co., Ltd. (164,342).—Private company. Registered February 21st. Capital, £2,000 in £1 shares. To take over the business carried on at Regent Terrace, West Street, Sheffield, as "Campion Ball & Co.," and to carry on the business of electrical engineers, &c. The subscribers (each with one share) are: W. J. Campion, 30, Lydgate Lane, Sheffield, manufacturers' agent; T. E. Osborne, 12, Banner Cross Road, Ecclesall, Sheffield, cutlery handle manufacturer. The first directors are not named. Solicitor: W. E. Esam, 29, Bank Street, Sheffield.

Premier Electric Welding Co. (Leith), Ltd. (10,979).—Private company. Registered in Edinburgh February 20th. Capital, £8,000 in £1 shares. To carry on the business carried on by the North British Electric Welding Co. (Eastern), Ltd. The subscribers (each with one share) are: J. G. de O. Coke, Bank Buildings, St. James' Street, London, S.W.1, Captain, Royal Navy (retired); A. L. Haggerty, Bank Buildings, St. James' Street, London, S.W.1, company secretary. The first directors are not named. Remuneration £100 each per annum. Secretary: A. L. Haggerty. Solicitors: Bircham & Co., 46, Parliament Street, S.W.

Rashleigh Phipps & Co., Ltd. (164,318).—Private company. Registered February 20th. Capital, £50,000 in £1 shares (5,000 employés). To take over the business of an electrical engineer and manufacturer carried on by A. Rashleigh Phipps at 147, Oxford Street, W. The subscribers (each with one share) are: A. Rashleigh Phipps, 58, Fitzjohn's Avenue, N.W.3, electrical engineer; W. A. Edelstein, 3, Chapel Road, W.13, electrical engineer. Permanent governing director: A. Rashleigh Phipps. Solicitors: Percy Robinson & Co., 15, Great Marlborough Street, W.

Sphinx Manufacturing Co., Ltd. (164,366).—Private company. Registered February 21st. Capital, £50,000 in £1 shares (15,000 preference). To carry on the business of manufacturers of and dealers in sparking plugs and terminals, magnetos, electric motors, accumulators, and storage batteries, carburetters, &c. The first directors are: H. G. Longford, Tresco, Barnt Green, Worcs.; W. A. Clark, Goldthornes, Trafalgar Road, Moseley, Birmingham. Registered office: 242, Bradford Street, Birmingham.

British Scientific Apparatus Manufacturers, Ltd. (164,339).—Private company. Registered February 21st. Capital, £3,000 in £1 shares. To carry on publicity and propaganda, with a view to introducing, making more widely known, and increasing the sale of articles manufactured by members; to acquire showrooms and display scientific apparatus of British manufacture, to promote export trade in British-made scientific apparatus, instruments and appliances used for chemical, medical, surgical, electrical, nautical, aeronautical, meteorological, mathematical, photographic, and other purposes. The first directors are: C. Beck, 34, Upper Addison Gardens, Kensington, optician; M. B. Field, Nanceakake, Bearsden, Dumbartonshire, nautical instrument manufacturer; F. C. Knowles, 16, Beaconsfield Road, Lammas Park, Ealing, W.5, electrical engineer; R. Miall, Chilton Croft, Wendover, scientific instrument manufacturer; H. T. Tallack, Rocklands, Fairfield Road, Croydon. Registered office: 6, Moorgate Street, E.C.

Alabaster Lighting Ware Co., Ltd. (164,377).—Private company. Registered February 23rd. Capital £12,000 in £1 shares. To carry on the business of dealers in electric and other fittings, especially fittings in which alabaster forms a part. The subscribers (each with one share) are: G. Vale, St. Andrew's Road, Caversham, Reading, secretary; S. S. Galsworthy, 15, Newman Street, Oxford Street, W.1, director. Each of the following companies, viz.: Best & Lloyd Co., Ltd.; Edison Swan Electric Co., Ltd.; Evered & Co., Ltd.; Galsworthy, Ltd.; General Electric Co., Ltd.; and F. & C. Osler, Ltd., may, so long as it holds 1,000 shares, appoint a director. Registered office: 84, Colmore Row, Birmingham.

Ballinrobe Electricity Supply Co., Ltd. (4,907).—Private company. Registered in Dublin February 13th. Capital £5,000 in £10 shares. To carry on the business indicated by the title. The directors are: Rev. E. A. Dalton, St. Mary's, Ballinrobe; P. D. Daly, M.D., Ballinrobe; T. Fitzpatrick, Ballinrobe, provision merchant; T. M. Scott, Ballinrobe, civil engineer; J. B. Staunton, Ballinrobe, provision merchant. Secretary: J. B. Staunton. Registered office: Abbey Street, Ballinrobe, Co. Mayo.

Radio Engineering Co., Ltd. (164,409).—Private company. Registered February 23rd. Capital, £5,000 in 5s. shares. To carry on the business of mechanical and electrical engineers, instrument makers, &c. The subscribers (each with one share) are: H. E. Straker, 47, Nelgarde Road, Catford, S.E.6, secretary to a limited company; F. H. B. Frere, 21, Wakefield Road, S. Tottenham, N.15, gentleman. The first directors are not named. Solicitor: J. Hoare, 3, Crooked Lane, E.C.

Dodds Finlay & Co., Ltd. (10,982).—Private company. Registered in Edinburgh February 21st. Capital, £5,000 in £1 shares. To carry on the business of electrical and mechanical engineers, machinists, wheelwrights, tube makers, bolt and nut manufacturers, manufacturers of cycles, &c. The subscribers (each with one share) are: T. S. Dodds, Leavenview, Fauldhouse, Linlithgowshire, engineer; R. M. Finlay, Myrtlebank, Fauldhouse, Linlithgowshire, engineer; J. Dodds, Leavenview, Fauldhouse, Linlithgowshire. The first directors are: T. S. Dodds, R. M. Finlay, J. Dodds, and G. S. Dodds, Cambuslang. Secretary: J. Dodds. Registered office: East End Engineering Works, Fauldhouse.

Hall Brothers (Manchester), Ltd. (164,574).—Private company. Registered February 27th. Capital, £10,000 in £1 shares. To take over the business of manufacturing, electrical, and mechanical engineers, millwrights, and machinists carried on by W. Hall and S. E. Hall at 11a and 11b, Eastnor Street, Old Trafford, Manchester, as "Hall Brothers." The first directors are: W. Hall, 11a and 11b, Eastnor Street, Old Trafford, Manchester, engineer; S. E. Hall, 11a and 11b, Eastnor Street, Old Trafford, Manchester, engineer; H. Ratcliff, Park Road, Timperley, Cheshire, engineer. Solicitor: S. Bishop, 23, Fountain Street, Manchester.

Dickinson & Thompson, Ltd. (164,527).—Private company. Registered February 26th. Capital, £2,000 in £1 shares (1,000 8 per cent. cum. pref.). To carry on the business of electrical engineers, founders, &c., and to enter into an agreement with R. G. Thompson and W. Dickinson. The first directors are: R. G. Thompson, The Briars, Benhill Road, Sutton, Surrey; W. Dickinson, 9, Grange Road, Clapham, S.W.; D. L. M. Thompson, 71, Endell Street, Holborn, W.C.; N. F. Thompson, 92, Dale Street, Birmingham. Registered office: 51-2, Chancery Lane, W.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

City of Freetown (Sierra Leone) Electricity Co., Ltd.—Return dated December 31st, 1919. Capital, £15,000 in £5 shares. 200 shares taken up. £1,000 paid. Mortgages and charges nil.

Consolidated Signal Co., Ltd.—Return dated January 1st, 1920. Capital, £425,000 in £1 shares (220,000 preferred and 205,000 ordinary). 214,195 preferred and 150,548 ordinary shares taken up. £52,839 paid on 24,999 preferred and 27,840 ordinary. £311,904 considered as paid on 189,196 preferred and 122,708 ordinary. Mortgages and charges nil.

Cape Electric Tramways, Ltd.—Capital £500,000 in £1 shares. Return dated December 31st, 1919. 491,222 shares taken up. £91,222 paid. £400,000 considered as paid. Mortgages and charges £276,300.

Electro-Coil Production Co., Ltd.—Debentures for £600, registered January 28th, 1920, charged on the company's undertaking and property, present and future, including uncalled capital.

Mersey Power Co., Ltd.—Particulars filed January 30th, 1920, of £100,000 debentures, charged on the company's undertaking and property, present and future, including uncalled capital, subject to charge for £300,000, amount of present issue being £20,000.

Tramways Supplies, Ltd.—Mortgage on pieces of land at Leeds and buildings thereon, registered February 3rd, 1920, to secure £6,000. Holders: Leeds Provincial Building Society, Leeds.

White & Poppe, Ltd.—Satisfaction registered February 4th, 1920, of charge for £10,000, registered November 20th, 1907.

Wycombe (Borough) Electric Light & Power Co., Ltd.—Debentures for £10,000, registered February 5th, 1920, charged on lands, buildings, machinery, works, plant, &c., and the company's undertaking and property, present and future, including uncalled capital.

CITY NOTES.

St. James' & Pall Mall Electric Light Co., Ltd.

Mr. W. Leaf presided at the annual meeting held on February 24th. He said that the past year had been a remarkable one. In the revival of trade the electrical trade had had its full share, and the company's main difficulty had been to cope with the fresh business that had been pouring in and was still doing so. The units sold increased by 15 per cent. and the revenue by about 30 per cent. They had not raised their prices since September, 1918, but during the whole of 1919 they had had the benefit of the increase that then came into force. The cost of generation and distribution had risen from £95,105 in 1918 to £116,763 in 1919. They now drew from the Central Co. all but about 2½ per cent. of their supply. The growth of the business had involved large obligations in the extension of the Grove Road station. They had endeavoured to keep that station up to date and well in advance of requirements, and but for the foresight of their engineers and managers, they would have been overwhelmed this winter by the calls that had come. They had further requirements pressing hard. They were already giving a supply in bulk to the Chelsea Co., and it was probable that before long they might be called upon to render assistance to other important undertakings unable to meet the heavy demands. They had been pushing on with the large extension of the Central Co., but there had been delays beyond their control in the delivery of the new 10,000 KW. set on which they were dependent for next year's supply. The fresh demands had, however, made it essential that they should order yet another 10,000 KW. set, and push on with building extensions in the form of a new boiler house. They had in hand an extension which would have been regarded only a few years ago as a complete new generating station of the first order. This had involved financial commitments of very large amount, and the way in which the cash was to be provided had been a matter of serious preoccupation to them all. The moment was singularly unfavourable for public borrowing in the form of either debentures or shares, not only because of the high rate of interest now required, but because the short and uncertain tenure of their occupation to them all. The moment was singularly unfavour- possibly suggest them. Under these circumstances, they had to provide the money from their own resources, and they had felt bound, therefore, to keep a large amount of the profits in hand. It was for this purpose that, in the first place, they

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wished to extend the borrowing powers up to £300,000, the total nominal capital of the company. They wished to have as little recourse to loans as possible, and to provide what they had to find out of their own money in hand. Their resources were to some extent locked up in the form of investments. It might be necessary to realise part of them and invest the proceeds in the business. They had hitherto taken them at cost price, on the ground that they did not expect to realise before the termination of their life in 1931, but the time had now come when they must revise that view, and adapt themselves to altered conditions. They had, therefore, decided to add to the depreciation account the whole sum required to write down these securities to their market value on December 31st last, and for this purpose had set aside £14,728, which made them safe if the necessity should arise, while, if there should be a recovery from the present low market values, as one hoped must be the case some day, this would all come back to them as a realisable reserve. In any case it was, of course, an addition to the resources which would be of material assistance in helping to make the necessary advances to the Central Co. before they had to borrow from the bank. They had raised the dividend from 10 per cent. to 12 per cent., the dividend of the year before the war. They would be returning to consumers on their current quarter's bills a small amount in consideration of the reduction of 10s. on the price of coal, and shortly they would be able to announce a concession which would have the effect of reducing the cost of supply to consumers. The outcome of these conferences in connection with the Electricity Supply Bill had been the formation by the companies in the West-End group, including the Charing Cross Co., of a small private limited company, with a capital of £50,000, for the purpose of drawing up a scheme for the electrical supply of London. That company was intended to form the nucleus of a general combination of all the London companies. There was a good prospect that it would succeed in this object, and would end by including all the companies, and the presentation of one common scheme. The municipal authorities had got out a scheme of their own, which would also be put before the Commissioners, so that they would have a straight issue between public and private supply. There would be plenty of work for all who were engaged in the electrical industry in the coming year. The report was adopted, and later a resolution was passed increasing the borrowing powers of the directors.

Westminster Electric Supply Corporation, Ltd.

Lord Downham, in the speech which was read in his absence, through illness, at the annual meeting on February 25th, said that the receipts had increased by £76,000 and the expenses by £39,000. The latter was largely due to increased cost of coal, materials, salaries and wages. Their stocks of coal were now very greatly depleted, and urgent representations had been made to the Coal Controller. The present average price of coal to the company was 39s. per ton. They burned 39,000 tons, and the increase over last year cost £12,000. In September last they notified an increase to lighting consumers of ½d. per unit as from January, 1920, but during the last quarter of the year an unexpected and very welcome increase in output occurred, owing no doubt largely to the removal of the restrictions on supply, so that the receipts during that quarter were the largest they had ever had in any similar period. They came to the conclusion that the increased charge from January 1st should not be made; in a few cases accounts had been issued at the increased rate, but the necessary adjustments would be made when the next accounts were sent out. The balance of the debentures were to be repaid on the following Monday, and the preference shares would then be practically in the position of a first charge on the undertaking. Orders were placed for new generating plant early last year, but owing largely to the moulders' strike it had not yet been delivered. They hoped to receive it before next winter's load came on. After referring briefly to the Electricity Supply Bill and the appointment of the Commissioners, the Chairman said that they had associated themselves with other London companies in putting forward a scheme for the supply of electricity to the London area, and the engineers were now preparing it, which, if approvad, would be put before the Electricity Commissioners. Clause 8 of the Act said that one of the duties of every joint electricity authority constituted under the Act was to provide or secure the provision of a cheap and abundant supply of electricity within its district. Finance, however, would be the great difficulty. When they considered that in London 42 per cent. of their total costs for generation and supply of electricity were due to capital charges, and that the construction of generating stations would be, at present prices, approximately from £25 to £30 per KW.—the cost of the erection of a large station, say, of 200,000 KW. would therefore be some five or six millions, to which had to be added the cost of mains and transforming plant—they would readily see how important it was that the companies should utilise their existing resources to the largest possible extent compatible with efficiency and economy. They had in the station of the Central Electric Co. at Grove Road a station that compared very favourably with the best in the country, and every care had been taken that it was kept quite up to date. Orders had been placed for more generating machinery of a much larger size than they had heretofore used, and this would still further add to its efficiency, and enable it to meet the great demands for supply in bulk which appeared to be coming upon it. Mention was made in the King's Speech of the proposal that a further Bill was to be brought forward by the Government. They did not know what the nature of this new Bill might be. The Government would be well advised, considering the present condition of the finances of the country and the prevailing high taxation, to leave expensive schemes such as these, which would amount to 200 or more millions, to private enterprise and existing undertakers, under the guidance of the Commissioners. In any case it was to be hoped that the Commission, now that it was constituted, would be allowed time to examine into present conditions and advise as to the best way of dealing with them before new proposals were formulated by the Government. The meeting approved of a resolution increasing the directors' fees.

Liverpool Overhead Railway Co.

At the annual meeting held on February 24th, Mr. H. C. Woodward, who presided, said that railway nationalisation seemed to be hung up for the present. The one cheerful feature in their experience was the vitality and growth in their traffic, which, though greatly stimulated by the requirements of the war period, showed no falling off, as might have been expected, since the war ended. The traffic figures proved the immense value to the port and trade of Liverpool conferred by the Overhead Railway, and the directors regretted that circumstances entirely beyond their control prevented the shareholders from reaping their due reward in the shape of increased return on their invested capital. Extensive repairs were needed both to railway and tramway, but with materials difficult to procure and shorter hours being worked, progress with such was slow. A shareholder called attention to the condition of the tramway track, and in reply the Chairman said it was most difficult to get repairs done nowadays, or to get new rails. The company's tramway lease was running, to a close, and they would have to make a fresh arrangement with the Crosby Council as to its renewal. Until an agreement was arrived at they could not do much more than patch.

South Metropolitan Electric Light & Power Co., Ltd.

Mr. H. St. J. Winkworth presided at the annual meeting on February 25th, and said that the reduction of 8 millions in the units sold was entirely accounted for by a reduction in bulk supply, which was less than half what it was in 1918. This demand was steadily recovering, the returns of the last few months having shown a regular and continuous improvement. Owing to the falling off in bulk supply and to the increase in the lighting demand the average price obtained had risen from 1.58d. to 2.47d. The net results were satisfactory. For 1919 the gross receipts at the Lewisham showroom were £25,000, and there were 7,385 transactions. Coal cost £59,951, against £72,897, a reduction of £12,946, due to the smaller output. The total expenditure of the year was 58 per cent. of the receipts, as against 62 per cent. in 1918, but the amount carried to net revenue was £70,109, against £63,387 for 1918. The work of installing the larger and more efficient turbo-alternators at the power house was now completed. Certain plant, which was no longer of service, had been disposed of, and the capital account written down. The power house at Greenwich had now been brought up to date, the older plant having been replaced by modern plant of high efficiency. The business of the West Kent Co. had been adversely affected by the reorganisation of works and factories, to which a supply was being given, from war to peace requirements. After referring briefly to the Electricity Supply Bill and to the resignation of Mr. H. W. Bowden, the speaker said that the prospect for the current year was favourable. There was marked activity in all sections of the business. On the other hand, the increased cost of machinery, mains and materials, the abnormal time for delivery, and labour unrest were very serious handicaps. Several new housing schemes were under consideration on estates in the company's area of supply, and the company was in negotiation with the L.C.C. and the local authorities concerned with a view to the installation of electricity in the proposed buildings.

Underground Electric Railways Co. of London, Ltd.

The receipts during 1919 were £692,364, a decrease of £67,901. Deducting directors' and other fees and expenses £10,116, income tax £13,036, loss on foreign exchange in respect of coupons £67,932, and commission and discount on issue of 5 per cent. three-year notes £10,674, there remains £101,758, an increase of £20,102, plus £36,693 brought forward. The interest on 4½ per cent. bonds, 5 per cent. three-year security notes, amount paid under guarantee on C.L.R. assented stocks, and interest on 6 per cent. first cumulative income debenture stock, absorb £242,643. There are paid 3 per cent., plus income tax, for the June half-year, and 1 per cent., plus income tax, for the December half-year, on the 6 per cent. income bonds, requiring £361,717, leaving £22,939. The report contains a summary of the results of the associated companies. It is stated that the Metropolitan District and the London Electric Railway Companies have, between them, ordered 140 additional carriages, and jointly ordered an additional 15,000 KW. turbo alternator for the Lots Road generating station at Chelsea. A new subway is being constructed at the Charing Cross station for the purpose of improving the exchange facilities. The L.G.O. has ordered 500 omnibuses

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of an improved type. The L.U. and the M. Elec. Tramway Co.'s have reconstructed considerable portions of their tramway tracks. The L.U.T. has completely overhauled the whole of its rolling stock. The Associated Equipment Co., Ltd., is extensively engaged in the manufacture of commercial lorries; the output for 1919 was £2,732,990, and orders for £1,600,188 are now on the books. The output was only 28 per cent. for the L.G.O. and 72 per cent. for outside customers.

Tramways, Light & Power Co., Ltd.—Viscount Chilston presided at the meeting of this company held on February 27th. After referring to the various undertakings of the company, he said that in July last shareholders were informed that in order to cope with the large demand for electricity a new generating station was to be erected on the Avon for the Leicestershire & Warwickshire Electric Power Co., and extensions to other power stations and cable systems of all the companies were necessary. The extension works then contemplated were in progress, and certain works, including the Avon power station, were nearing completion. The directors were about to make an issue of 247,900 additional ordinary shares for payment towards these extensions works. The high prices of fuel had been felt by all power users, as well as by power companies, and the effect had been to create an unprecedented demand for a supply of electrical energy to-day. Industrial power users were clamouring for a supply owing to the costs per H.P. of the small separately-owned plants having increased in greater ratio than the costs of the large central supply authorities. By the end of this year the company should have business which would produce a net revenue of about £80,000 per annum. They were very satisfied with the progress of the business at the present moment, and had every reason to anticipate a successful year.

Northampton Electric Light & Power Co., Ltd.—Satisfactory progress in spite of changing industrial conditions and the increasing costs. The Hardingstone Junction generating station began to come into operation in the spring of 1919, and nearly the whole of the company's output is now generated there. The anticipated economy in generating costs at the new station is being fully realised. 50,000 "B" shares were offered for subscription in October at 20s. 6d., and the issue was over-subscribed. The company has acquired control of the Wellingborough Electric Supply Co., Ltd., on very advantageous terms. The company began in November to give a permanent supply of all the current required for the Northampton Corporation tramways. Lighting and heating additions: equivalent 10,164—32 watt lamps (total 109,570). H.P. of motors increased from 6,298 to 6,950, of which 4,434 H.P. are let out on hire. Units sold increased from 6,233,019 to 6,589,108. £9,000 to depreciation fund. £4,000 spent entirely out of income during 1919 for removal of machinery from the old to the new generating station. After paying 5 per cent. preference dividend and 7 per cent. on the ordinary (as against 6½ per cent. for 1918), £1,110 is to be carried forward.

London Electric Supply Corporation, Ltd.—The report for 1919 presented at the meeting referred to here last week showed a profit of £95,240, against £78,376. Adding £10,397 brought forward, less interest on temporary loan, &c., £1,287, the total was £104,351. Debenture interest £23,494, debenture sinking fund, £16,580; 6 per cent. preference dividend, £26,952; 2½ per cent. dividend on the ordinary shares, £8,325; reserve, £12,500; contingencies, £5,000; carried forward, £11,500. Units sold 42,907,637, as against 46,357,227 in 1918; total costs per unit sold 1.17d., against 1d. in 1918. Average receipt per unit sold (lighting and power) 1.60d., against 1.35d.

General Electric Co., Ltd.—At an extraordinary general meeting held on Monday the resolutions passed on February 14th (Elec. Rev., February 20th, p. 247) were confirmed.

The prospectus is to appear to-day (Friday) inviting subscriptions for the issue of 1,600,000 7½ per cent. "B" cumulative preference shares of £1 each at par, and 400,000 ordinary shares of £1 each at 28s. per share.

Rushden & District Electric Supply Co., Ltd.—Number of consumers advanced from 179 to 223. Maximum load 365 KW., increase 46 KW. Units sold 607,028. Dividend for the year 6½ per cent., as against 5 per cent. for 1918. £356 carried forward. Auxiliary plant now being installed to keep pace with demand.

Direct Spanish Telegraph Co., Ltd.—Dividend at the rate of 10 per cent. per annum, less tax, on the preference shares; 5 per cent., free of tax, on the ordinary, and a bonus of 3 per cent., free of tax, making with 2 per cent. paid in October last, 10 per cent. for the year.

Prospectus.—*Yorkshire Electric Power Co.*—The list of applications was to close on or before March 3rd in an issue of £230,000—5½ per cent. redeemable debenture stock at 88 per cent., and of £400,000 in 40,000 £10 shares at par. The need for the new capital was explained in the report of the speech at the annual meeting.

Bournemouth & Poole Electricity Supply Co., Ltd.—Final dividend of 7 per cent. per annum, less tax, on the ordinary shares, making 6 per cent. for the year.

Brazilian Traction, Light & Power Co.—Quarterly dividend of 1½ per cent. on the cumulative preference shares.

Electro Bleach & By-products, Ltd.—The directors of this company received an offer from Messrs. Brunner, Mond and Co., Ltd., to purchase from the shareholders individually all the preference and ordinary shares in the company by allotment of shares and payment of cash as follows: For every two Electro Bleach preference shares one Brunner Mond ordinary share and 8s.; for every two Electro Bleach ordinary shares one Brunner Mond ordinary share and 3s.; for every odd preference share 25s.; for every odd ordinary share 22s. 6d. The sale of the Electro Bleach shares on the above basis will be ex the final dividend for the year 1919. The annual meeting has been postponed pending a decision on the proposed exchange, and should the exchange be accepted the directors will recommend final dividends making with the interim dividends already paid 7 per cent. on the preference shares and 14 per cent. on the ordinary shares for the year 1919. The Brunner Mond shares exchanged as above will be entitled to the same dividends as the existing Brunner Mond ordinary shares as from January 1st, 1920. The Electro Bleach directors recommend the acceptance of the offer.

Notting Hill Electric Lighting Co., Ltd.—The report for 1919 shows that out of 5,278 consumers 16 are supplied at 200 volts. The equivalent 30-watt lamps connected increased from 259,074 to 280,087. The available profit is £32,759. Of this £3,000 is put to depreciation, renewal, and reserve fund, £3,000 to special reserve, £1,792 is required for debenture interest, Kensington & Notting Hill joint debenture stock charges are £3,771; income tax £5,434; to be distributed to staff under co-partnership scheme £356. Preference dividend 6 per cent. Dividend on the ordinary shares 8s. per share, less tax, to compensate shareholders for loss in recent years. (The dividend on these shares after the capital arrangement in 1911 was at the rate of 5s. per share, but during the war it was reduced to 3s., and in 1918 it was passed altogether.) To be carried forward £1,784. Units generated 3,426,482; units sold 2,323,557; expended in distribution, transformers, and accumulators 1,085,925. Mr. A. E. Franklin has been elected chairman in place of the late Sir Wm. Crookes.

Torquay Tramways Co., Ltd.—Mr. L. B. Schlesinger presided at the annual meeting on February 27th, and said that the results of working were very satisfactory. The financial position of the company was quite strong. The traffic revenue was £8,200 better than for 1918, but operating expenses increased by £6,449. Passengers carried increased by 842,000, and made a record. They now had under consideration an application from the Transport Workers' Federation for an increase of wages. For the current year the receipts so far had been well maintained. They had ten omnibuses on order for connecting Torquay with Newton Abbot, Teignmouth, Dawlish, &c. In view of the high cost of labour and material close attention must be paid to the reserve and renewal account. The dividend was 8 per cent. against 7 per cent. for 1918.

Stock Exchange Notices.—The Committee has been asked to allow the undermentioned to be officially quoted:—

Babcock & Wilcox, Ltd.—500,000 ordinary shares of £1 each, fully paid (Nos. 1,660,001 to 2,160,000).

Lancashire Power Construction Co., Ltd.—400,000 six per cent. (income tax free up to 6s. in £) cumulative convertible first preference shares of £1 each.

Westminster Electric Supply Corporation, Ltd.—39,953 ordinary shares of £5 each fully paid (Nos. 310,101 to 350,054).

The committee has ordered the undermentioned to be officially quoted:—

Melbourne Electric Supply Co., Ltd.—£12,674 additional consolidated ordinary stock. 20,000 7 per cent. first cumulative preference shares of £5 each, fully paid (Nos. 60,001 to 80,000).

Metropolitan Electric Supply Co., Ltd.—Capital expenditure during 1919 £53,805, making it £2,396,921. Gross revenue £413,059, an increase of £64,333. Working expenses £242,623, an increase of £34,510. £69,486 to depreciation and reserve. Balance to credit of net revenue £100,951, plus amount brought forward and interest, &c., on investments, £119,510. After deducting debenture interest and preference dividend, and paying a total of 6 per cent. for the year on the ordinary shares, £4,441 is to be carried forward. New connections in 1919, 2,867 KW., making 45,426 KW. Meeting, March 9th.

Kensington & Knightsbridge Electric Lighting Co., Ltd.—During 1919 the number of houses and shops connected increased by 236 to 5,409, and the equivalent lamp connections by 30,604 to 603,219. Units sold 4,627,529. Net profit £13,529 plus £543 brought forward. After paying the preference dividend and 7 per cent. for the year on the ordinary shares, £1,223 is to be carried forward. The report contains references to the Electricity Supply Bill similar to those in the reports of the Westminster and other companies.

Canadian General Electric Co., Ltd.—Quarterly dividend 2 per cent., and bonus 2 per cent., on the common stock; and at the rate of 7 per cent. per annum on the preference for the half-year.

Vickers, Ltd.—Final dividend for 1919 of 2½ per cent. on preferred 5 per cent. stock, less tax, 2½ per cent. on 5 per cent. preference, less tax, and of 2½ per cent. on cumulative preference, free of tax.

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American Telephone & Telegraph Co.—According to the *Times* New York correspondent, stockholders are to meet on March 30th to approve the increase in the capital from £100,000,000 to £150,000,000. None of the new stock will be offered at present.

British Aluminium Co., Ltd.—It is stated that the directors have decided to make a distribution out of the reserves by the issue of two fully-paid ordinary shares for every three ordinary shares now held.

Brompton & Kensington Electricity Supply Co., Ltd.—Final dividend on the ordinary shares at the rate of 17 per cent. for the half-year, making 12 per cent., less tax, for the year. £1,230 carried forward.

Newcastle & District Electric Lighting Co., Ltd.—Dividend at the rate of 4 per cent. for the year, less tax.

Bruce Peebles & Co., Ltd.—Dividend 7½ per cent., less tax, on the ordinary shares for 1919.

STOCKS AND SHARES.

TUESDAY EVENING.

THE Stock Exchange has arrived at a halting place. Half-a-dozen reasons can be put forward to account for the slackening-off of business and the check thrown upon enterprise. The principal may be deemed the diversion of money into trade channels. Following this, the recent evidence in connection with the proposed tax upon war gains has seriously disturbed the mind of the public investor, who, seeing the prices of his war stocks steadily falling away in value, has begun to ask with unmistakable anxiety whether the Government have a scheme on hand which will amount to partial confiscation of national savings. The Budget looms in the near distance, and makes a third reason for caution on behalf of the capitalist, large and small. Other causes could be furnished to account for the depression that has developed in most markets, a depression deepened by lack of fresh buying orders. The buoyancy so discernible in the markets during the first few weeks of the year has given place to a more cautious feeling altogether, and people are inquiring whether shares are worth the money asked for them, instead of being content to buy on vague tips that the prices are sure to go up.

The electricity supply market would doubtless feel much more considerably the effect of the good dividend announcements, were it not for this prevalent dullish sentiment. Dividend results are certainly good, as those already chronicled in these pages have shown. The City of London dividend and bonus make 5 per cent. more than was paid a year ago, although the dividend itself of 10 per cent. is but 2 per cent. higher than that for 1918. In our tables of yield, we work out our calculation on a 10 per cent. basis, though it has to be remembered that there are still three years' extra dividends to be made up, and that on this account there may be a further 6 per cent. bonus to come by-and-bye. The Charing Cross dividend of 7 per cent. is 3 per cent. better than that for the corresponding period. The London pays 2½ per cent. on its ordinary shares, against nothing. Improvements of 2 per cent. are shown by the St. James's and the Westminster companies. Increases of 1 per cent. are declared by the Chelsea, County of London, Kensington, Metropolitan and South London companies. The Notting Hill ordinary dividend of 8s., being 800 per cent. as against nil twelve months back, furnishes the star turn of the programme, and the shares of the last-named have risen to 35s., on the announcement, a jump of about 10s. a share.

The rest of the list is not much better than firm, but shares are difficult to buy, and with dividends included in the current prices, it is natural that holders should be reluctant to part with shares which they have kept, many of them, through the bad times, in the expectation that something will happen of the sort upon which we are now commenting. Moreover, there is scope for further improvement, and without waxing unduly optimistic, it is reasonable to expect that the present rates of dividend, excellent as they are compared with recent achievements, do not represent the full advantage which shareholders in the companies should derive by reason of post-war conditions.

Manufacturing shares hold their ground. Underwriting agreements in respect of the forthcoming new issue by the General Electric Co. were in circulation early this week, and the terms are one new share at 28s. for every three old. Edisons hold their price at 26s., and Electric Constructions are another hard spot at 25s. It is announced that Brunner Monds, following their acquisition of the Castner Kellner Co., have made a bid for the Electro-Bleach & By-Products, Ltd. Brunner Monds offer one ordinary share in their company and 8s. in cash for every two Electro-Bleach preference, and for every two ordinary, one Brunner Mond ordinary and 3s. in cash. The directors of the Electro Bleach undertaking strongly recommend acceptance of the offer, and holders of at least 75 per cent. of each class of share must accept within four weeks of February 25th, otherwise Brunner Mond & Co. may withdraw their offer. Castner Kellner's hold their price of £2. Home Rails are weak. Central London Assented ordinary is down 2, allowing for deduction of the dividend. Underground Incomes, ex £1 dividend free of tax, are down to 74. There is no courage left in the market or in its occasional supporters.

Eastern Extensions, Globes, and Westerns have all receded 10s. owing to the dulness prevailing amongst investment stocks. Globe preference, on the other hand, are ⅛ higher, and Great Northern Telegraphs moved up 30s. to 24, a movement the likelihood of which was pointed out here last week, and counteracting to some extent the steady decline which has been taking place during the past few weeks. Marconis are also a better market at 3⅞. Callender's receded to 9⅞, and Telegraph Constructions are again £1 down at 38, the dividend disappointment still bringing in a few sellers. Automatic Telephones remain about 20s., shares changing hands a few pence either side of the round sovereign. British Aluminiums have risen to 2¼, and are the main feature of strength in their particular department. Amongst other industrials, the feature is the way in which prices in the iron, coal and steel market are advancing, in consequence of the bright outlook that opens out to the industry. Engineering shares, however, have hardly participated so far.

In the Colonial and foreign section, Canadian General Electric Common gained several points at 126. British Columbia stocks are weak, and Mexicans show further heaviness, the 6 per cent. bonds of the Mexico Tramways Co. shedding 4 points. There is little doing amongst Anglo-Argentine Trams. New issues continue to pour out in ceaseless streams. The offer of the Yorkshire Electric Co.—particulars were given in this column last Friday—made its appearance a day or two ago. There are several other electrical issues in course of preparation for the investor.

The price of rubber has gone back to 2s. 7d. per lb., and interest in the principal shares is meagre.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1918	Dividend 1919	Price March 2, 1920.	Rise or fall.	Yield p.c.
HOME ELECTRICITY COMPANIES.					
Brompton Ordinary	8	-	6½	—	£6 7 0
Charing Cross Ordinary	4	7	3⅞	—	9 6 8
do. do. do 4½ Pref.	4½	4½	2¾	—	8 8 8
Chelsea	3	4	3¼	—	6 3 1
City of London	8	10	14	—	7 2 10
do. do. 6 per cent. Pref.	6	6	8⅝	—	6 4 8
County of London	7	8	5⅝	+ ¼	8 2 2
do do. 6 per cent. Pref.	6	6	9	—	6 13 4
Kensington Ordinary	6	7	5½	—	6 13 4
London Electric	Nil	2½	1½xd	+1/6	5 10 6
do. do. 6 per cent. Pref.	6	6	84xd	+3/-	8 11 6
Metropolitan	5	6	3¾	— ⅛	7 14 10
do. 4½ per cent. Pref.	4½	4½	2¼	—	7 16 6
St. James' and Pall Mall	10	12	6½xd	+8/6	9 4 8
South London	5	6	2⅝	—	7 12 8
South Metropolitan Pref.	7	7	19/6xd	—	7 3 7
Westminster Ordinary	8	10	5½xd	—	8 13 10
TELEGRAPHS AND TELEPHONES.					
Anglo-Am. Tel. Pref.	6	6	90½	−1	6 12 7
do. Def.	88/6	1⅛	20½	—	7 6 4
Chile Telephone	8	6	8½	—	*1 13 2
Cuba Sub. Ord.	7	7	10½	—	*6 18 4
Eastern Extension	8	10	19½	— ⅛	*5 2 7
Eastern Tel. Ord.	8	10	195	—	*5 2 7
Globe Tel. and T. Ord.	8	10	19½	— ⅛	*5 2 7
do. do. Pref.	6	6	9¾	+ ⅛	6 3 1
Great Northern Tel.	22	—	24	+1½	9 3 4
Indo-European	18	—	48½	—	6 18 4
Marconi	25	—	3⅞	+ 1/6	6 8 10
Oriental Telephone Ord.	10	—	2⅞	—	4 16 0
United R. Plate Tel.	8	—	8	— 1/6	*5 0 3
West India and Panama	1/8	—	1½	—	5 11 1
Western Telegraph	8	10	21	— ½	*4 15 0
HOME RAILS.					
Central London Ord. Assented	4	4	47½xd	−2	8 8 6
Metropolitan	1	1½	21½xd	— ¾	5 16 3
do. District	Nil	Nil	18	— 1	Nil
Underground Electric Ordinary	Nil	Nil	2½	+ ⅜	Nil
do. do. "A"	Nil	Nil	6/6	—	Nil
do. do. Income	5	—	71xd	−1	—
FOREIGN TRAMS, &c.					
Anglo-Arg. Trams. First Pref.	Nil	Nil	3¼	—	—
do. do. 2nd Pref.	—	—	8½	—	—
do. do. 5 Deb.	5	5	63⅜	—	7 15 0
Brazil Tractions	—	—	5¾	—	—
Bombay Electric Pref.	6	6	18⅜	+ ¼	8 4 0
British Columbia Elec. Rly. Pfce.	5	5	62½	−1½	8 0 0
do. do. Preferrred	2½	5	53½	−2½	9 7 0
do. do. Deferred	Nil	3	45½	−2½	6 11 10
do. do. Deb.	4½	4½	61½	−1	6 18 3
Mexico Trams 5 per cent. Bonds	Nil	Nil	37⅛	−5	Nil
do. 6 per cent. Bonds	Nil	Nil	29⅛	—	Nil
Mexican Light Common	Nil	Nil	22⅛	—	Nil
do. Pref.	Nil	Nil	32½	−2½	Nil
do. 1st Bonds	Nil	Nil	52½	—	—
MANUFACTURING COMPANIES.					
Babcock & Wilcox	15	—	83⅜	—	*4 2 9
British Aluminium Ord.	10	—	2¼	+ 3/32	4 14 1
British Insulated Ord.	12½	—	2⅛	—	6 1 1
Callenders	25	—	9⅞	— ½	6 13 4
,, 6½ Pref.	6½	6½	4¾	—	6 16 10
Castner Kellner	20	—	4	—	—
Crompton Ord.	10	—	22/6	—	8 17 10
Edison-Swan, "A"	10	—	1½	—	8 0 0
do. do. 5 per cent. Deb.	5	5	79½	—	6 5 9
Electric Construction	10	—	1½	—	8 0 0
Gen. Elec. Pref.	6¼	6½	19/6	—	6 13 4
do. Ord.	10	—	2¼	—	*4 9 0
Henley	25	—	2⅜	—	5 0 0
do. 4½ Pref.	4½	4½	3¾xd	+2/3	6 4 2
India-Rubber	10	—	16	—	*6 5 0
Met.-Vickers Pref.	—	8	3⅜	—	5 0 4
Siemens Ord.	10	10	90/6	—	*6 11 2
Telegraph Con.	20	20	28	−1	*4 5 0

* Dividends paid free of Income Tax.

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THE BUYER AND BUYING.

(From a Salesman's Point of View.)

By "SALESMAN."

To one who has the good fortune (or otherwise) to be a salesman, Mr. McKinnon's article in a recent issue of the REVIEW*, coming as it obviously does from the pen of an "inside" man, is naturally of great interest.

Mr. McKinnon is not the first of his kind who, in the fullness of his heart, has set forth his idea of the qualities that go to make the "Admirable Crichton" of salesmen, but the writer does not recollect having encountered much in the way of criticism of the manners and customs of the buyer.

Perhaps this lack of criticism is due to the retiring, gentlemanly nature of salesmen, or it may be attributed to a spirit of caution, but in the humble opinion of the writer, the art of the buyer offers as wide a scope for the exercise of tact, politeness, &c., as does that of the salesman.

Now, in offering the following suggestions and criticisms for the consideration of buyers, due attention has been given to the fact that in some instances a would-be keen and courteous buyer is heavily shackled by the uncompromising and conservative attitude towards salesmen, taken up by his management; also there is that bugbear of the salesman known as the "contra" arrangement, which kills all efforts on the part of the buyer to introduce goods which are often better value than those of a similar nature supplied to the "contra" account.

Much might be written regarding methods of interviewing salesmen adopted by various firms, and in connection with this, let us consider the position of the salesman in relation to a firm with which he is trying to do business.

Now, unless a salesman be a born fool (and such do not exist long on the road) he will certainly not approach any firm without some ground for so doing, *i.e.*, he must be selling something which may prove of material use, or be cheaper than a similar article in daily use by that firm. Therefore it is obvious that it is to the advantage of the latter at least to give him a hearing, and that under circumstances which will enable him to explain himself properly, and not within hearing of competing salesmen.

One would think that all salesmen were thieves, or worse, to look at some of the interviewing traps which are a regular feature in the offices of many large firms even to-day. This abominable "trap" method is one of the most awkward and overtly insulting systems of interviewing known to the unfortunate salesman. Happily, however, these model booking offices are fast disappearing, and most firms of any standing have made far more congenial arrangements. Surely it should be possible to set apart a room to be used solely for the purpose of interviewing travellers. The room so reserved may be divided into two parts, one of which should be furnished with a few chairs and a supply of trade papers, &c., for the benefit of waiting travellers, the other section being devoted to the actual interviewing. Happily, many firms are adopting this arrangement, much to their advantage and credit as business houses.

Another stumbling-block to the salesman is the system of never granting interviews to travellers except by appointment. Now, assuming our traveller has to do with a firm of this stamp, he naturally writes for an appointment, and with what result? In nine cases out of ten his letter is ignored by the buyer, and should he get a reply, investigation will often show that it was prompted not by the buyer, but by some person, in the works perhaps, who was interested in his proposition.

Over and over again, a salesman will experience the joy of receiving a sharp letter from headquarters enclosing a communication from a firm, on his ground, requesting information as to a particular line, the advertisement of which has caught the eye of the buyer. The traveller immediately looks up his records and finds that he has tried that very firm perhaps three or four times, and been met each time with a blank refusal of an interview, as his proposition "does not interest us."

Would it not be possible for firms to have appointment cards printed stating clearly that if Messrs. Blank's representative cared to call at 11 a.m. on such and such a date he would be accorded an interview? The length of this interview would depend entirely on the ability of the salesman to interest the buyer in his goods, but it certainly should be part of the duties of a buyer to set apart so much time each day for such interviews.

Regarding the "contra" arrangement already mentioned in this article, the writer cannot forbear relating a recent personal experience.

A certain large firm, upon receipt of a circular letter calling attention to a particular article, wrote for prices *by return*. The quotation was duly forwarded, but nothing further was heard until the writer called upon the firm in person, and had an interview with the buyer. He was thereupon told that, while his prices were right, and the excellent quality of the goods offered was well known to the works engineer, it was quite impossible for this particular firm to pass him an order as they had "an arrangement with certain friends who took their goods." In other words, they had a "contra" account with their friends. Now, why on earth did this firm give all this trouble without the slightest intention of doing business?

Oh, ye travellers and salesmen! Look out for the "sample fiend" who asks for a sample of this and a piece of that, very often without any clear idea as to what tests are required. Say, for instance, one is selling electric lamps. Now, what is the use of supplying one lamp only, for test purposes? Ten to one the lamp is handled and fiddled with by half a dozen people before being put on test, and yet the writer has known a case where a certain type of lamp was absolutely turned down simply because one sample behaved badly on test, which it might easily do after having been shaken and turned this way and that by inquisitive clerks, &c. It should be stated that in this instance the buyer refused to order a dozen or so lamps for test, although such is the usual practice.

It is manifestly impossible for any buyer to be an expert judge of all the various goods which he is called upon to purchase for his firm, but he generally knows where to put his finger on a colleague who is in the position to give him expert advice and the samples a fair test. That this is not always done is due very often to petty jealousy or the fear of disclosing ignorance. It would be easy for any management to instruct the buyer to send all samples to various expert members of the staff, whose reports would be given due consideration when it came to a question of placing orders.

The "cheap" buyer is a nuisance to his firm, and is the prey of all manufacturers of shoddy stuff at cut prices. It has been proved over and over again that it is the falsest of policies to buy the cheapest goods simply because they are the cheapest, and yet there are hundreds of buyers who pride themselves on so doing.

The writer well remembers a case which came under his own observation where cheap buying eventually proved a most expensive business. In this instance certain gear was required for a switchboard, and inquiries were sent to half a dozen firms. The buyer, who was of an economical persuasion, to put it mildly, ordered up from the firm which sent in the lowest quotation, without referring the matter to those who could have

* ELECTRICAL REVIEW, December 26th, 1919, p. 804.

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advised him better. Result, the gear was delivered in several separate lots, all hopelessly mixed up, and was of the very flimsiest description. Two well-paid men had to devote a day or more to the sorting of this rubbish, and the correspondence on the subject was endless.

The buyer who cannot say "No" is easily the worst type of buyer with whom the salesman has to contend. He will listen pleasantly to all one has to say, he will express great interest in samples, &c., and will bid one quite a touching farewell, promising faithfully to forward an order "in the course of a post or so." Then he will hie him back to his office with the express intention of forgetting all about it. A downright "No" is far preferable to this sort of thing, yet the type of buyer referred to is by no means uncommon; he is, however, very much disliked by salesmen.

No reasonable salesman objects to fair criticism of his goods always provided it *is* fair, and does not seem to echo the voices of competitors. Many valuable hints are often given in this critical spirit, and if the salesman be wide awake he will pass the information thus acquired on to his headquarters for the consideration of the management.

It is the querulous critic who views *all* new goods with a jaundiced eye, who can see no good in anything which differs from that which he is already buying; it is such as this that even the most persistent salesman will in time learn to avoid, and incidentally, of course, the hypercritic may therefore one fine day miss a good thing, and wonder why.

Who does not know the cheery buyer who will tell one in mournful accents that: "No, there is nothing for you to-day," but (in a delighted tone), "I have just given Messrs. So and So's man an order for £200's worth of stuff"—Messrs. So and So being, of course, one's competitors.

There is yet another type of buyer whose ways are a source of much trouble to the salesman. This buyer will obtain quotations for certain goods on the distinct understanding that the prices are good for acceptance within a certain period only. For no apparent reason whatever, our friend the buyer will hold his order back for several weeks after the time limit for that price expires, and will be mightily upset on receiving an intimation to the effect that "prices have advanced 50 per cent. since our quotation of the ——."

Lastly, every salesman knows the buyer who, by fair promises and a sympathetic mien, will draw out of him full particulars as to prices, &c., and will, upon the first opportunity, transmit this intelligence to a competitor with whom he (the buyer) may be on good terms. This may be good business, but it breeds distrust, and should the offending buyer at any time be forced to turn to a victim of such practice for help in a time of bad deliveries, &c., he will not receive much consideration.

In conclusion, the writer would say that, while undue interference with the buyer, by his superiors, is to be deplored, in the majority of cases a great deal too much is left to be decided by that individual's personal likes and dislikes, with the result that very often an unscrupulous salesman (there are such, sad to relate) will so ingratiate himself as to exclude his more honourable competitors.

THE BRITISH INDUSTRIES FAIR.

(*Continued from page* 265.)

BIRMINGHAM.

The comprehensive section of the Fair that was held at Birmingham (Castle Bromwich) under conditions that peculiarly favoured such an effort was representative of most of the staple manufacturing trades of the Midlands. Not all the district's manifold trades were represented, but it was symptomatic of the newer spirit of manufacturers that, with order books full beyond the immediate capacity of execution, a majority of the leading firms should be found making determined efforts to extend their markets, both at home and abroad. The majority of the most important industries of Birmingham and South Staffordshire had their mart at their door, and if it served no other purpose, the Fair afforded an opportunity for manufacturers to feel the pulse of the markets of the world, and to ascertain the descriptions of goods that will sell best there. All three sections of the Fair close to-day.

The promoters of the Birmingham section of the Fair were the Municipality and the Chamber of Commerce, and the details were worked out by a council consisting of leading business men, and including Mr. R. A. Chattock, city electrical engineer.

The stands, of which there were some 630, including about 90 devoted either exclusively or partly to electrical apparatus, were allocated on a plan which brought exhibitors in the same industry together, and to a considerable extent it was arranged that allied trades were near neighbours.

The electric fire and stove exhibits were much less fully representative than those of gas heaters, but there were some neat examples of electric fires and cooking ranges, whose ease of manipulation, cleanliness, and general efficiency need no elaboration. Electric heaters, radiators, and stoves were exhibited on 13 separate stands, while domestic electrical accessories and fittings were to be seen on 10 stands. On the lighting side, electricity had the premier position, and many firms showed beautiful and efficient fittings for use in public buildings, private houses, steamships, and for industrial lighting purposes. No fewer than 36 stands included electric lighting fittings, but only one stand was seen on which arc lamps were on view.

On the principle that measuring and weighing machines are of great importance in the matter of profit protection, the section of the Fair dealing with such apparatus was of much interest, and the exhibit of Messrs. W. & T. Avery, Ltd., Birmingham, which consisted of road weighbridges, solid and liquid weighing machines, various types of platform machines (in foreign standards), counter scales, counting machines, testing machines, &c., received well merited attention.

Messrs. Stewarts & Lloyds, Ltd., Birmingham, had a comprehensive exhibit of solid drawn and lapwelded steel pipes for all purposes, including an 84 per cent. lap welded steel pipe with a "Vulcan" joint for water power purposes; a high-pressure steam pipe for 350 lb. per sq. in. working pressure, a patent long sleeve welded joint, tramway poles, boiler tubes, and various kinds of coils, &c.

Firms that exhibited sparking plugs, cases, and adapters were Messrs. J. B. Brooks & Co., Ltd., Forward Sparking Plug Co., Apollo Plug Manufacturing Co., Ltd., Howard S. Cooke & Co., Sphinx Manufacturing Co., all of Birmingham, and C. Binks, Ltd., Manchester, Igna Engineering Co., Ltd., Dudley, and Firth-Brearley Stainless Steel Syndicate, Ltd., Sheffield.

The Lucas Electrical Co., Ltd., Birmingham, exhibited Thomson-Bennett magnetos suitable for all types of motor cycles, and also the "Magdyno" combined electric lighting and ignition set for motor cycles as described in our columns recently.

The British Lighting & Ignition Co., Ltd., Birmingham, showed "Blic" magnetos for cycles and small cars, and for large stationary gas engines.

Messrs. Siemens Brothers & Co., Ltd., Woolwich. This exhibit included the more generally employed forms of dry batteries and primary galvanic cells as used for all purposes, and formed a comprehensive collection of such batteries as manufactured by this firm. The company also showed various types of incandescent electric lamps.

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Messrs. Ward & Goldstone, Ltd., Manchester, showed a wide range of their manufactures and supplies, among which were the following: high and low-tension automobile ignition cables, brass, nickel and aluminium armoured lighting cables, electric lighting flexible cords, tough-rubber sheathed cables, flexibles, bell wires, telephone wires, silk, cotton and enamelled instrument wires. Two sizes of country house lighting plant were also shown, one being the 350-watt set, comprising ¾-h.p. engine and belt driven dynamo, and the other a 3-h.p., 1,500-watt set, direct coupled. Switchboards for use with this plant were also shown. The T.R.S. wiring system consists of flexible conductors under a flat tough-rubber sheathed covering. This cable can be used for surface wiring, and is fitted in position by means of brass saddles, insulated with fibre. The T.R.S. patent connector box, which forms the really novel part of this system, enables the installation to be made without a soldered joint of any kind. The system does not require the skilled labour necessary to fit screwed tubing or casing, neither does it necessitate sinking in the wall or ceiling. The "Voltalite" self-generating electric cycle lamp was on view, and although this cannot claim to be a novelty, inasmuch as it has been manufactured now for some 15 years, it is still an article of considerable interest, and we understand the demand is greater than ever. "Volex" dry batteries were shown, and a large range of motor cycle lighting sets operated from Volex dry batteries. Among this range there is a simple headlamp lighting set, also the head and tail lamp lighting set, and the head, side, and tail lighting set. The dry batteries fit in a metal container, with the switchboard on top, and this metal container drops into the bottom of the side car, the wiring to the head, side, and tail lamps being provided with the outfit, and of a very simple nature. Many of these sets have been used one or even two years without the necessity of replacing the battery, which replacement can be made in a few minutes as the containers take the standard 4-volt "Volex Aero" dry battery. A variety of Izolex fuse boards, the firm's fuse units, main switches, and other ironclad switch and fuse gear, as well as such lines as pocket voltmeters, ammeters, switchboard type instruments, medical coils, and other novelties were also to be seen.

The Birmingham Private Telephone (New System) Co., Ltd., Birmingham, exhibited a large selection of automatic intercommunication telephones of various types, including the secret conversation, visual dial indication, &c., types. The "Laryngaphone," which is manufactured by the Telephone Manufacturing Co., Ltd., London, is a new form of telephone devised for rescue work in mines in conjunction with breathing apparatus. Its special feature is that it enables the worker to carry on a conversation although wearing a gas mask. Fig. 1 shows the complete mine rescue outfit. The

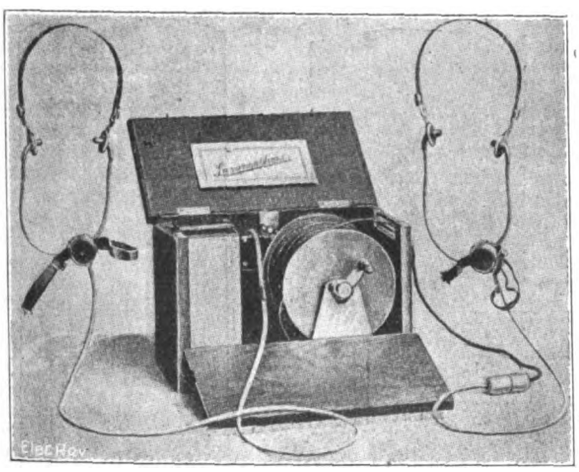

Fig. 1.—Laryngaphone Mine Rescue Outfit.

vibrations of the vocal cords during speech are collected by a transmitter strapped to the throat, which in turn reproduce corresponding vibrations in a receiver at each end of the line. The apparatus is also equipped with a signalling device, consisting of a Morse key and buzzer, which enables any prearranged code to be sent over the line should any failure take place in the transmitter. A lamp is also fitted which performs the double function of indicating the state of the line and repeating the Morse signals. Suitable drums are provided on which the flexible cable, specially insulated to withstand abnormal conditions, is wound; the apparatus can be used by two or more rescuers operating together. The transmitter and receiver are made as far as possible of aluminium, and are very light, the size being only 1⅞ in. in diameter by 1¼ in. in length. The flexible cable runs between two rollers, and on the drums a handle is fitted for rewinding. The outfit is contained in a teak case fitted with an open hinged front and lid; its dimensions are 1 ft. 3 in. by 7 in. by 8 in., and the total weight is 14 lb. When the case is lifted an auto cut-out disconnects the battery. The signalling switch is operated by pressure of the lower jaw of the wearer. The combined transmitter and receiver is contained in a weather-proof case, and is adjustable against the larynx; a flexible tube conveys sound from the receiver to the ear, and by means of moulded longitudinal grooves in the ear tube free ventilation and equal air-pressure on the ear drum is obtained. A general diving equipment consists of a semi-automatic indicator switchboard and central battery situated in a position convenient to the air pump plant. The switchboard indicator switches correspond with the maximum number of divers who may, at any one time, be "down" together. Each diver and the pump attendant are respectively provided with a diver's equipment. The pump attendant connects the set he is wearing to the switchboard, and the cables passing through the various divers' airlines are also connected up to the line terminals on the switchboard. The operation of the switchboard is novel and deserves special attention. The visual indicators also act as automatic switches. Thus, when a diver signals up and drops his indicator, the falling of the indicator immediately switches his speaking circuit on to the operator, and as the operator is permanently connected to the switchboard he is bound to hear what the diver has to say. The signal is made by the diver dropping his lower jaw to the full extent, which operates the signal switch. If, on the other hand, the operator wishes to speak to the diver, he mechanically drops the appropriate indicator by depressing the corresponding switch control, and thus is able to immediately speak to the diver in question. Should one diver require the assistance of another he signals the operator who, by depressing the other man's control switch, enables both divers to converse freely (he overhearing the conversation), and they can be left in communication, if necessary, to aid their co-operation. In the event of an emergency the attendant, by depressing a button, drops all the indicator switches simultaneously and can thus speak to all the divers at once. The above are only a few of the utility points of the "Laryngaphone" diving outfit. To those intimately associated with the ramifications of the diving industry many other applications will suggest themselves.

Messrs. J. H. Tucker & Co., Ltd., Birmingham, showed accessories for lighting and power, ironclad gear, switchboards and switchgear generally. In the centre of the back wall of the stand was a handsome white marble board on which were mounted numerous examples of the switches, fuses and other gear used in switchboard building. Fuses of many different patterns and ranging in size from 15-amp. to 1,000 amp. were shown, whilst switches of the firm's "N.K." and "O.K." patterns were also shown in a variety of sizes from 15 amp. to 1,000 amp., and in single, double and triple pole, single throw and change-over and other forms. Battery regulating, shunt regulating and voltmeter switches were also shown. The firm also showed a complete standard accumulator switchboard, consisting of ammeters, voltmeter, voltmeter switch, charge and discharge battery regulating switches, automatic battery cutout, main double pole switch and fuses for dynamo and also for lights mounted on enamelled slate for use in conjunction with batteries and lighting sets for country house lighting and similar purposes. A wide range of samples of ironclad switches and fuses for house, works and other industrial purposes were shown. The switches, shown in single, double and triple pole, varied in sizes from a 5-amp. ironclad and watertight to 100-amp., and were of the "turn," "push and pull," and other types. A special feature was the "Tucker" patent quick "make" and "break" ironclad switch, which was shown in two sizes—25 and 50 amps., and with and without D.P. fuses. The design of this switch case permits of it being used with either a large central tapped hole each end for the incoming and outgoing cables, or two smaller holes. This is effected by means of interchangeable and removable adapters, which can also be provided with recessed bodies and wood bushed holes for sealing hygroscopic cables and with watertight glands. A large number of different patterns of ironclad fuses were shown, switches for sunk and surface work, with plain, fluted and ornamental covers, with china and locked covers. One-way, two-way, two-way and "off" secret action combined switches and sockets were all shown in several designs and in a variety of finishes. Prominent was the firm's latest production in flat type switches, in which both a quick "make" and a quick "break" action is obtained. This switch is in size and actual appearance precisely the same as the ordinary (quick "break" only) flat type switch. In the lighting and power accessories section the firm showed samples of its lampholders, counterweights, ceiling roses, wall sockets and plugs, both ordinary ironclad and ironclad and watertight patterns, cutouts, round and oblong, bell pushes, porcelain connectors, 1, 2 and 3-pole B.C. and plug adapters, and many other similar articles.

The Austin Motor Co., Ltd., Birmingham. This exhibit included the glandless petrol pump, in section, showing the ingenious method by which all glands are done away with and leakage rendered impossible. Three sizes of generating plant for country-house lighting were shown in operation; the 0.75-kw. set was on view at the Ideal Home Exhibition, and was described in our pages at the time. The 3-kw. automatic set consists of a four-cylinder 6-h.p. engine direct coupled to a 27.5/22 ampere, 100/140 volt, 1,150 r.p.m., reverse compound-wound Siemens dynamo, both mounted on a cast iron bed-

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plate. The engine is cooled on the thermo-siphon system, and the engine starts up on petrol; the change-over to paraffin is effected by hand, but similar equipments are built in which the change-over is automatic. In the case of this equipment, the pressure is kept constant by cell-adjustment, and not by a third brush as in the 0.75-kw. plant previously described. The 5-7-kw. automatic battery booster, fig. 2, consists of a twin-cylinder engine, 10-11-h.p., four-stroke, water cooled, direct coupled to a 5-kw., 46-ampere, 110-volt generator running at 800 r.p.m., which in its turn is coupled to a battery booster, separately excited for an output of +40/0/−10 volts, 46/80 amperes, the three machines being mounted on one cast-iron bedplate; both the generator and booster are by Submersible Motors, Ltd. On the left of the three-panel switchboard is a starting panel for taking energy from the battery and starting the set up by "motoring" the dynamo. The right hand panel has mounted on it a double pole, double throw switch to enable energy to be taken direct from the

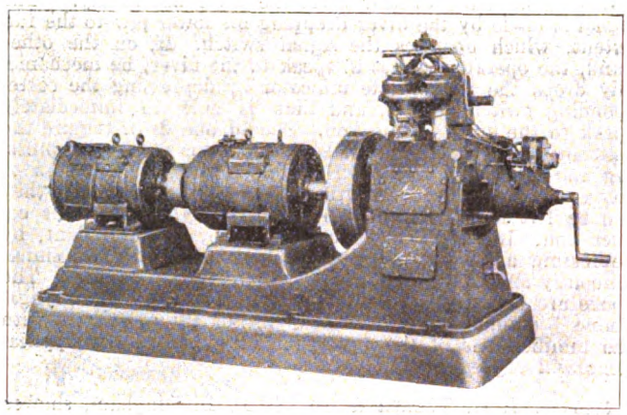

Fig. 2.—Austin Battery Booster Set.

battery, or from the battery and booster, or from the battery and booster in parallel with the dynamo. The centre panel is equipped for automatically shunt-regulating the booster so as to maintain constant loading on the dynamo at 46 amperes. This current will charge the battery in the event of there being no load on the system or will distribute its current between the battery and the load, or in the event of the load exceeding the output of the dynamo, then the dynamo current will assist the battery and provide current for the load up to a maximum of about 12 kw. at 110 volts. The plant has been designed with the object of using a small generating set to run at full load during the whole 24 hours, a large battery being installed to deal with the peak loads. The company is perfecting a system for running an electric lighting set in conjunction with a gas producer plant, utilising anthracite or peat as fuel. By this means it is hoped to be able to reduce the generating cost to less than 1d. per unit generated.

The Chloride Electrical Storage Co., Ltd., Clifton Junction, exhibited several small accumulators, as well as motor-car batteries, as described in our last issue, and a storage battery, composed of 55 glass cells of the S.L.G.7 type, each containing 15 plates, for use in connection with country-house lighting. The battery had a capacity of 427 amp.-hours at the 10-hour rate, and was shown in operation, being charged by the Austin booster in the next stand and described above, and supplying energy to light two rows of exhibitors' stands.

LONDON.

The Efandem Co., Ltd., of Wolverhampton, exhibited a collection of dry battery refills for pocket lamps and torches, cycle and scout lamps, military and police lamps, hand lanterns, and reading lamps. Accumulators for the same purpose were also shown, interchangeable with the dry batteries. Many pocket lamp cases of exceptionally handsome finish in printed metal and other materials were exhibited, as well as a variety of small motor-car lighting accessories, &c.

The Semaphore Engineering Co., Ltd., London, showed a variety of dry batteries for refills, as well as complete pocket lamps and torches, cycle lamps, and portable battery lighting sets. Other exhibits included round two-cell batteries of the sack type, of which many of the No. 10 size have been supplied to the Post Office, and samples of "Solidite" insulating composition made by the company.

The Orbit Electrical Co., Ltd., London, showed dry battery refills for pocket lamps and torches, &c.

Messrs. Henry Harvey & Co., London, who specialise in all kinds of fancy goods made from sea shells, showed a selection of reflectors and shades for electric lamps of this material, which gives beautiful colour effects, especially when the lamps are alight.

Messrs. A. Chase & Co., Ltd., Teddington, had an exhibit of tapping keys, sounders, buzzers, signalling lamps, and various types of small motors for battery working, suitable for the young amateur electrician, who by this means can add immensely to the interest and effectiveness of his Meccano set or model launch.

The Remoline Co., London, exhibited pocket lamps and dry battery refills, electric toys and novelties.

Messrs. Rose Bros., London, had a varied exhibit of dry battery refills for torches, pocket lamps, hand lamps, &c., bell batteries, portable battery lighting sets, and signalling lamps. They also showed medical coils, tapper keys, accumulators for hand lamps, and buzzer sets with signalling lamps. Ingenious electric toys, boxes of parts for the young amateur to make up shocking coils, lighting sets, and telegraphs, &c., were shown. The firm makes a speciality of silk shades on wire frames for electric lamps, of which many artistic examples were exhibited. Various small novelties were shown at this stand. A dry battery converted into a hand lamp was noteworthy, the lamp holder being simply fixed into the sealing composition, and the switch consisting of the usual brass spring, contacting with a brass catch; nothing simpler could well be imagined.

Messrs. Clifford Bros., Ltd., Birmingham, amongst a variety of non-electrical goods, showed samples of lamp-holders of various patterns, of substantial construction, and good finish; they are also makers of tumbler and turn switches, adapters, &c., a class of work which they have taken up since the war.

The Silent Electric Clock Co., Ltd., London, had a stand filled with some 40 dials of various sizes, all controlled by a half-second master clock of their patent type; a special feature of the dial movement is that there is no possibility of overshooting, the action being magnetically locked, while the absolute silence of the movement justifies the style of the firm. Other exhibits included a one-second master clock, and a master clock provided with means for synchronising by the Post Office daily time signal, or by the hourly time signal of the Standard Time Co., of which type many have been supplied to the Post Office department.

The British Ever-Ready Co., Ltd., London, showed dry cells and batteries in all their well-known styles, as well as small accumulators, and a wide variety of portable lamps and torches, hand lamps, reading lamps, inspection lamps, cycle lamps, &c. Some of the hand lamps were fitted with Morse keys for signalling purposes, and others had the lens and reflector fitted on the end of the case instead of on the side, so that they would stand upright even when the battery was removed; one of these is illustrated in fig. 3. Cycle lamps in nickel-plated fittings formed an exceedingly popular line, and a hand lamp containing a battery which on emergency could be used for ignition purposes was recommended as a useful stand-by on a motor car. Ignition batteries for various voltages were shown, with the terminals covered

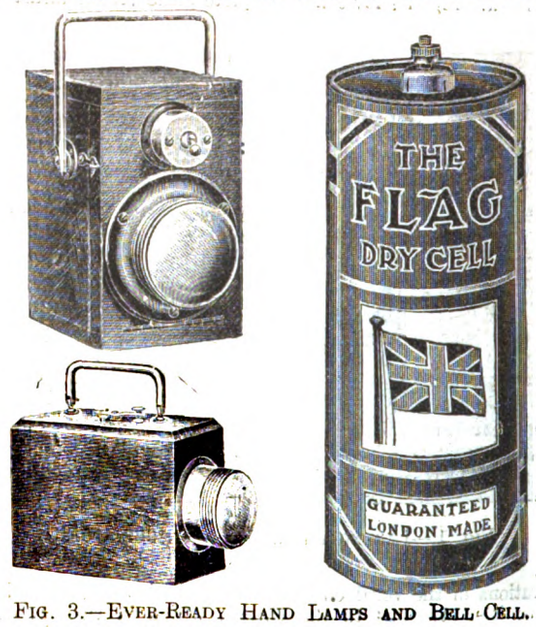

Fig. 3.—Ever-Ready Hand Lamps and Bell Cell.

with insulating composition, so that if left knocking about in the tool chest they could not be short-circuited. An ordinary bell cell fitted with a simple attachment became a portable hand lamp capable of giving from 50 to 70 hours' light according to size and type. The "Flag" cell for bells, &c., is shown in fig. 3, as well as an accumulator hand lamp weighing 5¼ lb.

Messrs. Marconi's Wireless Telegraph Co., Ltd., London, showed their latest ½-kw. station, in which the thermionic valve was used as the oscillation generator; the exhibit was marked by the total absence of any spark set, the valve being used up to at least 3 kw. The new direction-finder was exhibited, and the Marconi-Osram Co. showed valves up to 1 kw., while the Marconi Scientific Instrument Co. exhibited a variety of small apparatus suitable for the amateur wireless worker, but of excellent construction and finish, including the Marconi multi-valve amplifier, with six amplifying valves and a rectifier.

(To be continued.)

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TRANSFORMERS AND COILS FOR X-RAY WORK.

The following are abstracts of papers read and discussed at a joint meeting of the Institution of Electrical Engineers, the Royal Society of Medicine (Section of Electro-therapeutics), and the Röntgen Society, on February 26th, at the Royal Society of Medicine.

The Efficiency of Transformers for X-ray Purposes.*

By Reginald Morton, M.D. (Trin. Tor.), F.R.C.S. Edin.

The chief object of this combined meeting is to explain our difficulty to the members of the Institution of Electrical Engineers and the Röntgen Society in the hope that they may be able to suggest a more efficient means of exciting our X-ray tubes. The essential need of the radiographer is a supply of X-rays having a high degree of actinism and with sufficient penetration to pass through the thickest parts of the body without serious loss of this actinism. A "soft" or low resistance tube gives off very actinic rays which have only a low power of penetration; we can increase this penetration by raising the voltage of the current applied to the tube, but only to a limited extent under present conditions. We can have more highly penetrating rays by using a "hard" or higher resistance tube, but this is accompanied by an equal or even more rapid, falling off in the essential property of actinism.

With the aid of an oscilloscope and a rotating mirror some very interesting phenomena are presented for our study. The coil shows us a curve having the characteristics of fig. 1, while that of the transformer is shown in fig. 2, a rectified double-sine curve. In the one we have an alternating current quite unsymmetrical in both form and duration; in the other a series of perfectly regular sine curves. The first is the more efficient for our purpose, up to the limit of its capacity. We get more penetration and more actinism for a given current, greater steadiness, less heating, and a longer useful life for the X-ray tube. A further point in favour of the coil current is that it will keep a tube working smoothly on a lower reading of the milliammeter. Every tube has a certain amount of inertia and requires a higher voltage to start it than to maintain it in action; the sudden rise at the moment of "break" readily overcomes this inertia.

It is generally agreed that penetration is dependent on electron velocity within the tube, which in turn is dependent on the impressed voltage. Thus, it would appear that the impression of a sustained high voltage on a tube in the best condition to ensure the greatest actinism should meet our every requirement. By "sustained" I do not mean "continuous." The ideal current is one consisting of extremely high-voltage impulses, of very brief duration as judged by ordinary standards, yet sufficiently sustained to have an appreciable time factor. Such current as would pass through the tube by virtue of those lower voltages represented in the lower part of the above curves should be suppressed or diverted. If the voltage of the initial impulse be sufficiently high and sustained for even a small fraction of a second, one will be enough for any ordinary purpose in radiography.

This being the case, the question naturally arises why the coil is unable to meet our requirements, considering the enormous voltage available at the moment of "break." The initial rush of current has a very high magnitude, but its duration is extremely short. This is partly due to the self-induction of the secondary, cutting off this rush of current almost simultaneously with its birth. It is also due in no small degree to something inherent in the X-ray tube itself. Notwithstanding its brief duration it is this impulse that makes the coil current so efficient up to the limit of its capacity. It is the absence of any such high-voltage impulse that keeps the efficiency of the transformer current so low. For the same current through the same tube, the top of the transformer curve extends little more than half-way to the highest point of that of the coil.

Of the total radiation from a tube energised by a coil, probably no more than 20 per cent. consists of useful rays; energised by a transformer the proportion is probably less than 10 per cent. So long as the radiologist takes milliamperes as his sole criterion, quite regardless of how they are made up, just so long will the further improvement of existing apparatus be delayed. Yet improvement in efficiency is not only possible but easy, and manufacturers will readily do this for us if only we make reasonable demands backed up by knowledge of what we really do want. As an instance of the present state of things, take the case of a certain mercury break to which is attached a mechanical rectifying device that has achieved some success. I arranged the rotating wires to pass fairly close to the collectors, giving the latter the form of a sector. Following the lesson of the spark-gap, I shortened the sector to a point, and finally altered it to a ball. Then I began to increase the clearance between the ends of the wires and the balls, and every alteration was followed by a gain in efficiency, steadier action, less heating, and longer life of the X-ray tube.

Efficiency was improved (1) by the use of a spark-gap, (2) by increasing the resistance in the secondary circuit of my mechanical rectifier, and (3) by shortening the collecting blades in the Snook machine; all three being no more than the provision of one or more air-gaps in the secondary circuit.

It being my firm opinion that the initial impulse is the only part of the cycle that matters for our purposes, this is where we should concentrate our attention with a view to increasing its height—quite feasible, as the success already attained with the "single flash" coil proves—or by prolonging its duration, which may be more difficult. So far we have only partly succeeded in giving it an appreciable time factor. If we could do this, even to the extent of a very small fraction of a second, the problem would be solved so far as the requirements of medical diagnosis are concerned. I am disposed to regard what is known as the "single flash" monster coil with at least a friendly eye. Nothing else is possible if one is to be consistent. Long before I had an opportunity of seeing one that is in regular use and the most excellent results obtained, I had committed myself to the opinion that the system was not only sound but in all probability would

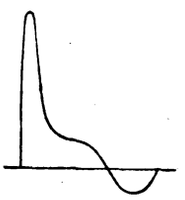

Fig. 1.

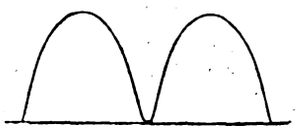

Fig. 2.

ultimately prevail. At King's College Hospital, under Dr. Robert Knox, extraordinarily fine results are regularly obtained. The apparatus is a revelation of simplicity, silence, and high efficiency. Exposures are the same for all parts, only the intensity of the discharge being altered by the primary resistance to meet the varying thickness of the different parts of the body. The best results are obtained with tubes of very low resistance, giving most beautiful contrast, a wealth of detail, and absolute sharpness of outline, even in the case of the heart. The effect of these intense discharges on the life of the X-ray tube is much less prejudicial than time exposures. It is my firm conviction that the future of radiography is bound up more or less inseparably with the "single flash" system, and manufacturers would do well to give this matter their very serious consideration.

Problems of Interrupted and Fluctuating Currents.

By Major C. E. S. Phillips, O.B.E.

The velocity and quantity of the electrons in an X-ray bulb are the principal factors controlling the design of electrical apparatus required for radiography. Since the potential difference between the electrodes of the tube determines the speed of the electron and therefore the quality of the X-radiation produced, the electrical problem resolves itself mainly into one of engineering. The potential difference necessary is, however, exceptionally high, and the machines and appliances require to be specially designed. In addition to the requirements of medical practice there are other calls for highly penetrating rays; metallurgists are asking for a machine that will give 300,000 volts. For instantaneous radiography in medical institutes large currents are also needed at these high voltages, so that the demand in this respect is, in fact, always ahead of the supply. In some cases the power put into the tube itself has exceeded 14 kw. On the other hand, there is the radiography of wood and a wide range of other uses necessitating only moderate electrical plant.

The induction coil has much to recommend it. The simplicity and absence of moving parts are great advantages. In the interrupter lies our principal limitation, and our troubles are divided between it and the condenser. The shape of the condenser is of importance; of two condensers with the same capacity the one having long narrow leaves is not so effective as one in which the leaves are nearly square.

One of the causes of coil breakdown during the war was fracture of the wax during transport. It is suggested that a fairly thin oil could be used as an insulator, thin enough to draw off before transport, and it should be possible to replace the oil without creating air cavities. The secondary could be wound with No. 36 aluminium wire and thus save one-third of the weight of copper. An improvement from an Army point of view could also be effected by using a removable core. A coil so designed would be extremely portable on account of the distribution of weight.

The weakest point of a coil outfit is undoubtedly the condenser. An alternative path should always be provided to carry off any excessive surges of current into the condenser. Recent experiments in this direction at the War Office X-ray laboratory have shown that a condenser, while in use, may be short-circuited through a water resistance (3 inches of tap water, using fine copper wires just dipped below the surface)

* Throughout the body of this paper, as distinct from the title, the word "transformer" refers to apparatus having a closed magnetic circuit as distinguished from the "coil" with its open straight core.

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with a reduction of only 20 per cent. of the coil output. Three 16-c.p. 250-volt carbon-filament lamps in series joined across the condenser terminals proved quite satisfactory. The filaments glowed a dull red, and irregular surges of current were indicated by momentary brightening of the lamps, but there was no appreciable reduction of coil output, and the plan will, I hope, reduce condenser breakdown in future to a minimum.

The value of the interrupted current that may be safely used with a coil is limited owing to the flare when the primary current is broken. Interrupters are frequently imperfectly designed and constructed. Experiments with tantalum blades are required, for in tests already made there is indication that flare can by this means be reduced. Although tantalum is not "wetted" by mercury, it nevertheless gives a perfect contact. The arc at break occurs in that case between the practically non-vaporisable tantalum and the mercury, and the speed of the motor assists in giving a sharper interruption of the circuit. In other cases the high surface tension of the mercury determines the suddenness of the rupture.

The design of transformers has reached a high degree of perfection. Their electrical efficiency is remarkable, but where very high-tension work is concerned (as in X-ray technique) and a rectifying disk is spun by a synchronous motor, the weak spot of the installation practically always seems to be the insufficient guarding of the armature windings from induced surges of current. Earthing through a condenser, or other means of assisting the insulation of the armature to withstand the strain put upon it, is essential. The reliability of this type of apparatus in skilled hands is, however, remarkable.

One serious objection to the transformer arises from the form of the secondary P.D. wave. A steeper P.D. wave is required. In 1895, and about six months before the discovery of X-rays, Messrs. Barr, Beeton and Taylor published a paper in the *Electrician* dealing with the question of changing the shape of alternator wave-forms. They keyed to their experimental alternator a special commutator called by them an "injector," by means of which inductance or capacity, or both, could be introduced into the circuit at regular intervals. In this way remarkable distortion of the original wave-forms was obtained without sparking. It is suggested that the wave-form of the current for the transformer be distorted synchronously by keying an "injector" to a small synchronous motor and connecting it in series with the main supply and the transformer. In this way a wave-form could be obtained which would render the rectifying disk unnecessary. The installation would not only be less costly, but would weigh less, occupy less space, and be highly efficient for the requirements of X-ray technique.

High-tension Transformers for X-ray Work.

By Russell S. Wright, M.I.E.E.

There are probably very few scientific instruments on which so little systematic research work has been accomplished as the subject of this paper. We have not yet even reached a satisfactory classification as regards either output or efficiency.

In the case of an induction coil, I am not convinced that we have, as yet, any means of ascertaining what the peak value of our discharge really is, as it is quite certain that the point of highest potential is only maintained for an exceedingly short interval of time, and it is doubtful whether any recording instrument at present available will really measure it. There seems every indication that the wave-form most suitable for radiography is not equally so for therapy. If this is the case, the question arises whether one instrument can be made from which outputs of sufficiently variable wave-form can be produced at will, or whether the same type of discharge is always suitable even for, say, radiography alone. Our ignorance of what is really required is at present a bigger obstacle to progress than the corresponding problem of how to obtain it. I would suggest that the time is now ripe for a definite move forward, and that radiologists, electrical engineers, and physicists should, so to speak, come into partnership in the attempt to solve a very baffling problem, and I would further suggest that the British Scientific Instrument Research Association is the proper body to co-ordinate and direct the work of the three so as to produce reliable results.

In the case of the transformer the problem is a simpler one, as we are at all events dealing with a curve of sinusoidal character.

In the original interrupterless machine as introduced by Snook, we had in fact a real sinusoidal curve with every alternate wave inverted. In the modern machine the curve has been somewhat modified and is no longer strictly sinusoidal or even symmetrical, but may be represented as in fig. 3. The direct measurement of such a current by means of an ordinary moving coil milliammeter is both more correct and more consistent than is the irregular discharge from an induction coil. The conditions of work with an interrupterless machine can be more exactly reproduced from day to day than is the case with an induction coil, and the readings of the milliammeter are more reliable.

A closed-circuit transformer also adapts itself far better to the indirect measurement of its output than does the induction coil, for the simple reason that its electrical efficiency is far higher and more easily computed. This question of efficiency is absolutely unimportant in one sense, but if it can be ascertained, it assists enormously in calculating the secondary output.

I should be inclined to suggest that an A.C. H.T. transformer be taken as the basis on which to work, and that an attempt be made to classify induction coils according to their effective outputs for the purpose of the radiologists and compared with a transformer of standard size and efficiency.

Assuming, therefore, that this suggestion is accepted, how should a transformer be rated? Before deciding this it must be borne in mind that what to an electrical engineer is a big overload is to the manufacturer of X-ray apparatus a normal condition, as in X-ray work machines are in practice only used to their full output for a fraction of a second at a time. An overhead rating is, therefore, perfectly justifiable, and our earlier machines were so rated by about 100 per cent., but when a machine was put on the market by an enterprising foreign firm rated at an overload of well over 1,000 per cent., I felt that the position was getting ridiculous, and I notice that now practically every responsible firm refrains from mentioning outputs in kilowatts at all.

The life of both transformers and coils is far less than it was ten or even five years ago, and few of the equipments being turned out to-day will permanently withstand the strain of modern conditions. The continual use of a coil for "deep therapy" is undoubtedly the most prolific cause of breakdowns at the present time.

If one considers that an output of, say, 3 milliamperes at a 12-in. spark-gap from an instrument capable of giving, say, 100 milliamperes, means that it is kept at a high potential on practically open circuit for long periods at a time, one

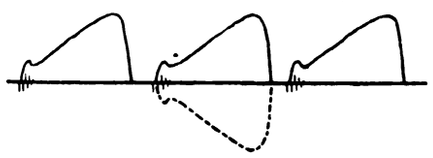

Fig. 3.

will realise at once the problem we are up against. Examining the exposed end of a secondary winding in this condition, we can see that it is in a constant state of effluve and that the discharge is literally spitting away in all directions.

It is impossible to look at this effluve without feeling that sooner or later the insulation is bound to go, and go it invariably does if the strain is continued long enough. Just now the position is made worse by faulty material, but in any case a coil or transformer, constructed to give a heavy output for radiographic work and with dry insulation, cannot be continually used for deep therapy without the risk of trouble.

Various devices can be used to safeguard more or less the end windings, but the only real remedies are two: either we must wind an instrument for deep therapy alone, or we must adopt oil insulation.

Discussion.

Prof. Salomonson, who had come specially from Amsterdam to take part in the discussion, said that in practice he could not see any appreciable difference between the transformer and the induction coil. Quite as good a picture was obtained with the coil as with the transformer. Therefore, they should not decide as to the value of either apparatus merely from the point of view of the results obtained. Other considerations must determine the choice, according to the particular work in hand, such as whether it was special radiographic work or therapeutic work. Where extremely high pressure was required the coil was best, because it was cheaper, and if breakdowns occurred—as they inevitably did with either apparatus—the coil was more cheaply repaired than the transformer. There was very little known regarding the efficiency of the coil or the transformer. He had developed a new method in which the secondary was connected up to a tube through which a stream of water flowed, the water being heated by the secondary current. He measured the amount of water flowing per second, and the temperature of the water at the inlet and at the outlet, and from these three data he was able to deduce with considerable accuracy the quantity of energy given out by the coil. He had also developed a method for measuring the efficiency of transformers by taking two transformers and connecting them together on the high-pressure side. The energy put into the first and the energy taken out of the second were measured by ordinary wattmeters, and from the result it was possible to deduce very accurately the efficiency of each of the transformers. Experiments on a transformer of the Snook type and one made by a German firm, both rated at 4 kw., gave an efficiency of 0.9 in the case of the Snook, and 0.89 in the case of the German machine as used in ordinary practice; when they were loaded to their fullest capacity, the efficiencies were a little higher. Measurements were also made on three induction coils in the same way, the average effi-

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ciency being about 0.8 in the case of certain German coils and a little lower in the case of a coil by a British firm, due to the larger quantity of insulating material used. With interrupted current the efficiency worked out to 0.68 and 0.75 in two cases. When using a rectifier the efficiency fell to 60 or 65 per cent. When measuring the efficiency with the interrupter the results were a little worse, and the figures showed that although the quantity of energy put into the coil was increased to nearly double, there was only a slight increase of the secondary output, and the efficiency fell off to quite small numbers, the greater part of the current being absorbed in the interrupter. Therefore he agreed with Major Phillips that the interrupter should be made a subject of serious research; he was convinced that with a better interrupter improved results would be obtained with the coil.

Prof. FORTESCUE said it had been shown that high voltage was necessary, and that it was useless to pass a large quantity of electricity through the tube at a low voltage, because this merely resulted in heating up the tube. Whether they used a coil or a transformer, some part of the current was at high voltage and some part at low voltage, but if the method was used which had been developed recently in connection with wireless telegraphy, viz., a hot-filament rectifier and a condenser, it was possible that the whole discharge through the tube—at any rate with the Coolidge tube—could be at high voltage. In wireless telegraphy this method gave an efficiency of 60 to 80 per cent. It was true that at present this method did not go beyond voltages which would be considered low for radiographic work, but the method promised a means of getting over the difficulty that had been mentioned.

Major G. W. C. KAYE thought it could almost be said that radiology was in a hopeless state with regard to units of measurement. There was no unit of radiation. At present the methods of measuring radiation were childish and ineffective; so, also, were their methods of measuring current through the X-ray tube. They did not, as a rule, know the wave-form either of voltage or current. Not one radiologist in a hundred took the trouble to measure the voltage across the tube properly. The average radiologist usually contented himself with measuring the sparks between the points, but as the American Institute had recently shown, the ordinary point gap might be 300 or 400 per cent. in error on large gaps, and the only way to measure voltage was by the use of sphere gaps, the spheres being as large as the maximum gap which was to be employed. Experiments on measuring voltages by sphere gaps had shown that the efficiencies obtained in X-ray work were such as to appal the electrical engineer. They started off by having a 90 per cent. efficiency for the transformer and 50 per cent. in the case of the X-ray tube, but the energy they put into the tube had an efficiency of the order of 20 per cent. with a coil-driven tube, whilst in the case of a transformer-driven tube an efficiency of perhaps 10 per cent. was a fair figure. In these circumstances, it did not matter much what the method of exciting the tube was. They should put their heads together to remedy that state of things.

Dr. A. E. BARCLAY showed a number of slides illustrating the difference between a coil and a transformer for X-ray work as regarded output. He said the milliampere was utterly useless as a unit of measurement to the radiologist; the character of the impulse counted materially in the production of X-rays, and it was the first part of the impulse which counted; what came afterwards did not matter at all.

Mr. R. C. CLINKER wished to know what was really shown by the oscilloscope—the voltage or the current of the supply to the tube. It was necessary to separate the ideas of voltage and current before it would be possible to get a clear idea of what would be supplied by the tube. Dr. Morton first referred to voltage in his paper and then to current. It was clear that what was wanted was high voltage, and the suggestion of Prof. Fortescue was a good one. With regard to the work of Barr, Beeton, and Taylor, he thought a great deal could be done by working the transformer at a high magnetic density in the core and using a resistance in series. In that way it was possible to get almost any wave required, and such a transformer would supply the same maximum voltage as the coil.

Dr. OWEN said a new theory with regard to the coil had been put forward by Prof. T. Jones, to which very little attention had yet been given. The concordance between the theoretical and practical results was remarkable. Coil makers ought to see what they could do to improve the induction coil on the lines of that theory before practitioners turned their backs upon the coil once for all.

Dr. HARRISON ORTON said the cry for more and more milliamperes was one of the chief obstacles in the path of progress, because the milliamperemeter was a misleading and unreliable instrument. Why should it be assumed that the milliamperemeter reading of a transformer current indicated the same thing as that of a coil current? From practical experience, it was evident to him that it was not so. The maximum impulse from a coil was of extremely brief duration, so brief, in fact, that the milliamperemeter, as at present constructed, was incapable of recording it, and he suggested that if the true milliamperage of a coil current could be measured it would probably be found that it was less efficient than the transformer. The superiority of the coil over the transformer did not exist. At present he did all his therapy with the coil and all his radiography with the transformer, and that gave the most satisfactory results. The difficulty with the oil transformer was that it would not stand the overloading necessary to obtain rays suitable for therapy, and it was more difficult to get replacements. For radiographic work radiologists required a machine which would give a current of high potential for a tube giving a 12- to 14-in. spark gap, and it must be able to stand such a potential for very long periods of working, and enable the full dose to be given for four or five minutes. They wanted a machine to obtain radiographs at a greater distance from the tube and in less time than at present, and without an intensifying screen, and in designing such a machine the type of tube to be adopted must be taken into consideration.

Mr. W. E. BURNAND said that the difference in results obtained with a transformer and a coil was largely due to the great rise in useful rays from the tube as the input energy was increased. If it was taken that the output of useful rays varied as the cube of the applied voltage and the curves of potential were plotted out, it would be found that the upper parts of the voltage curves were the only ones that mattered. The other chiefly heated up the tube. Major Phillips had referred to a million-volt transformer. He believed that one or two of them had been made in the States and worked, but not for long. They preferred to work at 500,000 volts, but even then it should be remembered that the insulator would have to be 10 ft. long, and the apparatus would weigh 20 tons and cost £10,000. The amount of energy required in the tube was a comparatively small item. Although it was quite impossible with present-day materials to keep up the high voltage required for any length of time, it might be possible to develop an apparatus that would give it long enough to give a regular discharge from the tube, say, 1/200th of a second. The apparatus he proposed for that would be substantially a transformer with an air gap in the magnetic circuit and excited by a small direct current. By that means it would be possible to pass a direct current of 500 watts for a matter of, say, five seconds, and the energy represented by that would be stored in the air gap, not the iron, and would be discharged when the circuit of the primary was broken in 1/200th second. That would give a matter of 200 KW. for that short period of discharge. He was constructing such an apparatus. The thing would weigh about two tons, and if any enthusiast would like to bring his tubes and test them on it, when the apparatus was ready, he would risk the transformer. He had a variable air gap, so that the intensity of the discharge could be varied, as well as the quantity, and they could start up at a low value and increase it until one or the other "busts up."

Dr. F. J. HARLOW said that the first thing to be taken into account in the question of the design of a generator for high-tension current was the tube. There was quite a difference in the characteristics of the gas tube and the Coolidge tube, and it was quite conceivable that the machine employed to develop the high-tension current would have to be different in both cases. He showed curves illustrating the difference in the characteristics of the tubes. He did not think the oscilloscope showed the voltage characteristics at all, but agreed with Dr. Morton that the effect of the spark gap in the secondary was to cut down the low-voltage current. He was inclined to think that the proper wave form was one in which the voltage rose immediately to the high value, remained there for the time it was required, and then went back to zero, so that there was no low-voltage current passing through at all. Experiments had been carried out in his laboratory on absorption curves obtained from different machines. It would appear that the same character of X-rays was obtained from the tube under the different conditions, whether coil or transformer was used, but the energy which was put in in the two cases appeared to be absorbed entirely in the tube. There was the same radiation sent out by the tube, but the energy which was got from the low-voltage current was simply absorbed in the tube and was not emitted.

It was decided to adjourn the meeting until a date in the autumn, to be announced later. The hope was expressed that during the interval experiments would be made in an endeavour to elucidate some of the points raised in the discussion.

Exhibition of Apparatus.

In connection with the meeting, some half-dozen firms exhibited X-ray apparatus, and we give brief particulars of the exhibits below.

MESSRS. WATSON & SONS, London, showed a 10-K.V.A. high-pressure transformer with a rotary high-pressure rectifier, and in this connection it is interesting to note that the first Government radiometallographic laboratory has recently been equipped by Messrs. Watson. The firm has decided upon the closed iron type of transformer, the insulation being of the "dry" type, as opposed to oil immersion, and the firm holds the view that the future will see a more general adoption of the closed iron dry insulated transformer. As will be seen from the discussion on the three papers, it is a very difficult matter to estimate accurately the output of transformers, either from an electrical or radiographic standpoint, but two types of this machine, as an approximate guide, have been designated ten and five K.V.A. respectively. The frequency-reducing device can be fitted to either machine, and is found to be of great advantage for screen work, owing

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to the lessened heating effect on the tube. Its adoption is recommended in all cases where the ordinary gas tube is used. The rectification of the high-pressure current is arranged by means of a disk of special insulating material mounted directly on the shaft of the rotary converter or synchronous motor, as the case may be. The collecting segments are arranged so as to utilise only the crests of the waves, thus reducing the heating of the tube to a minimum. Auto-transformer control can be incorporated. There was also exhibited a new instrument devised by Major G. W. C. Kaye in the form of a sphere-gap voltmeter.

The Solus Electrical Co., London, exhibited a large number of apparatus. A Solus centrifugal gas mercury interrupter designed by Mr. Eric J. Ward Watkinson, proprietor and manager of the business, is the only one of its kind. It consists of a revolving ring of mercury, with an insulated fibre ring with copper segments rotating in the mercury. The gas dielectric is claimed to be much cleaner than paraffin. A "Solus" Patterson fluoroscopic screen is a new screen from America, giving much greater brilliancy and fluorescing a mild blue. It is claimed for these screens that they are absolutely stable, the chemical coating not being affected by heat or damp, nor by the continuous bombardment of the X-rays. These Patterson screens are intended for 24-hour service every day, and they are used almost universally throughout the United States. The "Solus" tube stand has a patent double ball and socket joint, and any movement of the X-ray tube may be made without undoing any clamping device.

Messrs. Kodak, Ltd., London, showed their Wratten X-ray plates.

Messrs. Newton & Wright, Ltd., London, showed "Simplex" X-ray apparatus, the feature of which is that all moving parts can be eliminated if an A.C. supply is available. This feature is made possible by the radiator type of Coolidge tube, which has the property, within limits, of completely rectifying an alternating current, so that the apparatus can be energised by a high pressure transformer without the aid of any mechanical or other form of rectifier. When a direct-current supply only is available, a rotary converter can be included to produce the necessary A.C., but this machine need not necessarily be contained in the apparatus itself, but can be fitted in another room. In the Simplex No. 1 apparatus, the output obtainable has been limited and fixed in quantity, as by so doing it is possible to make the efficiency of the transformer so high that, while keeping the power employed within the limitations of ordinary electric light wiring, X-rays of very reasonable volume can be produced. The apparatus can therefore be worked from an ordinary electric lighting socket, without any special wiring being required, and under these conditions an output of up to 5 milliamperes at a 5-in. equivalent spark gap can be obtained, according to the voltage of the supply mains available. Owing to the output being a fixed factor it is only necessary to vary the time of exposure according to the part of the body which it is required to radiograph, and a simple chart is being prepared, showing at a glance the exposure required. An interesting dental unit was also shown.

Mr. Cuthbert Andrews, London, exhibited modern gas-filled X-ray tubes with tungsten or platinum targets, and cooled by various means. Mr. Andrews claims to be the largest producer of X-ray tubes in the British Empire. He also showed protective appliances, including gloves, masks, aprons, &c., and glass, high-frequency electrodes, microscopes, and microscope accessories. All the apparatus on view had been manufactured throughout in his own workshops.

NEW PATENTS APPLIED FOR, 1920.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. Sefton-Jones, O'Dell and Stephens (successors to W. P. Thompson & Co., of London), Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

4,640. "Electric switches." Midland Electric Manufacturing Co. and H. E. Sutherland. February 16th.
4,641. "Fastenings for hinged covers of boxes or cases." Midland Electric Manufacturing Co. February 16th.
4,661. "Attachment of dynamo for lighting side-car combination." S. G. Muir. February 16th.
4,662. "Electrically-driven mechanism." J. H. Hansen. February 16th.
4,667. "Storage batteries." G. J. van Swaay. February 16th. (Holland, February 15th, 1919.)
4,676. "Electric-lamp mountings." L. T. Dixon. February 16th.
4,679. "Electric hand lamps." E. V. Hayes-Gratze. February 16th.
4,681. "Control of excitation of dynamo-electric machines." British Thomson-Houston Co. and F. H. Clough. February 16th.
4,696. "Selenium cells or bridges." H. F. Knight. February 16th.
4,713/4/5. "Electric transformers." Hackbridge Cable Co. and W. C. Kennett. February 16th.
4,728. "Electric irons." R. Cox. February 16th
4,737. "Line selector switches for intercommunication telephone systems, &c." E. W. Holland, G. S. Holland and H. E. Holland. February 16th
4,739. "Valve transmitters for wireless telegraphy and telephony." A. K. Macrorie and G. Shearing. February 16th.
4,764. "Protecting electric cables and wires from being accidentally pierced." J. H. C. Brooking and St. Helens Cable & Rubber Co. February 17th.
4,766. "Sensitive-pressure relays for amplification of sound waves, &c." F. W. Baynes. February 17th.
4,786. "Adjustable carrier for electric lamps." H. R. Henderson and D. B. McIntosh. February 17th.
4,788. "Magnet for device for indicating during heating if a body has reached the critical point." G. S. Crawford. February 17th.
4,790. "Electric fires." C. B. Kersting and L. L. Lane. February 17th.
4,792. "Electric incandescent lamps." J. F. Poynter. February 17th.
4,795. "Electric induction-gas radiator." W. Boller. February 17th.
4,799. "Wireless communication." W. H. Eccles and J. H. Vincent. February 17th.
4,809. "Power-transmission systems." British Thomson-Houston Co. and F. H. Clough. February 17th.
4,810. "Electric power-transmission devices." British Thomson-Houston Co. (General Electric Co., U.S.A.) February 17th.
4,812. "Sparking plugs." G. E. T. Archer, F. O. Ellis and S. E. Taylor. February 17th.
4,829. "Automatic telephone systems." Automatic Telephone Manufacturing Co. February 17th. (United States, April 11th, 1919.)
4,832. "Sparking plugs." G. E. Lemoine. February 17th. (France, March 19th, 1919.)
4,863. "Insulating splice covers." J. B. Hamilton. February 17th.
4,887. "Connectors for cable suspension or straining means." G. V. Twiss. February 17th.
4,915. "Bonding-clips for electric wiring systems." J. C. White. February 18th.
4,916. "Junction box for electric wiring systems." J. C. White. February 18th.
4,919. "Inspection lamp for viewing interiors of casks, cylinders, &c." R. J. Lowthian. February 18th.
4,934. "Locomotive or electric engine stop signal." G. Taylor. February 18th.
4,947. "Governing mechanism for prime movers." British Thomson-Houston Co. February 18th.
4,950. "Control mechanism for electric cars with pneumatic brakes." Westinghouse Electric and Manufacturing Co. February 18th. (U.S.A., February 18th, 1919.)
4,958. "Primary cells and batteries." R. W. Clark. February 18th.
4,959. "Electric heating apparatus." E. J. Harman and E. Le Bas. February 18th.
4,965. "Apparatus for holding X-ray tubes." Siemens & Halske Akt. Ges. February 18th. (Germany, December 28th, 1917.)
4,970. "Means for indicating at a distance movements of a shaft, &c." Igranic Electric Co. (Cutler-Hammer Manufacturing Co.) February 18th.
4,979. "Distributing terminals for ignition magnetos." Fabriques des Montres Zenith, Successeur de Fabriques des Montres Zenith G. Favres-Jacot et Cie. February 18th. (Switzerland, February 11th, 1919.)
4,986. "Bayonet sockets for electric lamps." J. Wegmann. February 18th. (Switzerland, February 22nd, 1919.)
4,991. "Magneto-electric machines." G. M. Turner. February 19th.
5,000. "Process for production of flexible zinc." S. O. Cowper-Coles. February 19th.
5,007. "Electric incandescent lamps." F. Brighouse. February 19th.
5,008. "Sparking plug." W. Duerden and F. Rigby." February 19th.
5,024. "Electric fuses, switches, &c." Midland Electric Manufacturing Co. and H. E. Sutherland. February 19th.
5,025. "Electric distribution fuse-boards, fuse-boxes, &c." Midland Electric Manufacturing Co. and H. E. Sutherland. February 19th.
5,039. "Arrangement for protecting telephone installations from currents of dangerously high tension." A. Perego. February 19th. (Italy, November 23rd, 1918.)
5,040. "Removal of iron from solutions containing aluminium." Norske Aktieselskab for Elektrokemisk Industri Norsk Industri Hypotekbank. February 19th. (Norway, February 22nd, 1919.)
5,051. "Intercommunication telephone systems." L. C. Bygrave. February 19th.
5,066. "Electrode-holders for welding, soldering, or brazing metals." W. Blair and Sunderland Forge & Engineering Co. February 19th.
5,072. "Electrical apparatus for transmitting indications to a distance." M. P. Favre-Bulle and M. J. Lavet. February 19th.
5,097. "Dynamos for lighting and starting devices upon motor vehicles." J. R. P. E. F. M. Grimaud. February 19th. (France, June 13th, 1919.)
5,125. "Incandescent electric lamp projectors." E. Booth and N. R. Booth. February 20th.
5,127. "Plugs for motors, &c." M. MacGregor. February 20th.
5,136. "Electric switches." J. A. Crabtree. February 20th.
5,144. "Dynamo-electric generators and motors." S. Macdonald. February 20th.
5,152. "Galvano-therapeutic appliances." E. Brem. February 20th.
5,161. "Electric switches." H. D. Pyne. February 20th.
5,164. "Electric ignition, &c., systems for internal-combustion motors." H. A. Smith. February 20th.
5,165. "Sparking plugs." A. W. Armstrong. February 20th.
5,172. "Signalling systems." British Thomson-Houston Co. (General Electric Co., U.S.A.) February 20th.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1918.

18,895. Direct-driven electric lighting apparatus for cycles and other road vehicles. C. F. Dufaux. November 16th, 1917. (120,917.)

1919.

512. Electric lamps for motor vehicles and for other uses. G. A. Edman. January 8th, 1919. (138,147.)
1,416. Supporting insulators for electric high-tension conductors. E. Schwank. January 21st, 1918. (122,642.)
2,212. Trolley heads for electric trams and other purposes. A. Bannister and T. W. Tucker. January 29th, 1919. (138,160.)
2,486. Method of and apparatus for generating ignition current. Splitdorf Electrical Co. November 9th, 1917. (123,078.)
4,817. Means for securing electric lamps or lamp holders to hand lamps and other electric light fittings. February 26th, 1919. W. Harrison and E. H. R. W. Eyre. (138,186.)
4,983. Self-contained electric battery lamps. British Every Ready Co. and M. Goodfellow. February 27th, 1919. (138,188.)
5,925. Phonographs for recording telephone conversations. H. Ullmann. March 10th, 1919. (138,196.)
6,511. Controllers for use with electric motors and so forth. R. Amberton. March 15th, 1919. (138,204.)
6,655. Protective devices for electric circuits. British Thomson-Houston Co. (General Electric Co., U.S.A.) March 17th, 1919. (138,205.)
7,316. Swivelling brackets for mounting electric generators on aircraft. F. J. Hooper. March 24th, 1919. (138,212.)
8,969 Papers for use as a dielectric for electrical condensers and other similar purposes. F. Haigh. April 9th, 1919. (138,226.)
9,206. Brush holders for use with dynamo-electric machines and for like purposes. Electric Construction Co. and P. J. Stirrup. April 11th, 1919. (138,227.)
10,483 Distributor or commutator for Ford internal-combustion engines. P. W. Corless. April 28th, 1919. (138,234.)
12,447. Electrical switches. A. P. Lundberg, G. C. Lundberg, P. A. Lundberg, and G. Pegg. May 17th, 1919. (138,246.)
14,760. Electric insulators. H. Lutz. June 11th, 1919. (138,257.)
17,491. Electric weft feeler arrangement for weaving looms. H. Ter Kuile. August 23rd, 1918. (131,582.)
19,383. Material for the manufacture of electrodes of electric furnaces. O. R. Olsen. August 6th, 1919. (138,272.)

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DOMESTIC ELECTRICAL APPLIANCES: THEIR FORM AND FINISH.

THE Housing Exhibition in London has afforded the first opportunity for some time of reviewing progress in domestic electrification; the complete way in which every home use of electrical energy is covered, and the variety of means by which different makers secure the results, afford an eloquent testimony to the progress in technique which has taken place in recent years.

Electrically and mechanically most of the appliances put forward appear to have reached a high level of development, and although there is good ground for anticipating changes in detail, and even important variation in a few fundamentals of design, yet the immediate need seems rather for an attempt to link the apparatus more closely with the leading idea of its inception and the chief argument put forward for its use, namely, the saving of labour—direct within the home and indirect without it—by the reduction of waste and dirt, and the economy in labour which would follow from a cleaner air, and a longer useful life of buildings, decorations, and furnishings.

As everyone's expenditure ultimately becomes somebody's wages, so most economies in the end result in releasing labour for further production, and at present any method which decreases the cost of upkeep and maintenance and conserves capital values in business or in private life, is of the utmost use in re-establishing our much shaken economic position.

Devices and systems for saving labour or improving organisation must in themselves carry out the principle of unity and simplification towards which their use is aimed, but it is in the nature of things that their inventors are apt to be carried away by pride and pleasure in their own productions, and occasionally give to them elaborations not essential to their purpose, and capable even of discounting it; time and experience in use always prune away these exuberant growths, and leave only the essential and result-producing features.

In this connection the value of displaying electrical, or, in fact, any other appliances, in their working surroundings rather than in the showroom becomes evident; the maker can more easily realise that features upon which he had lavished attention may in practice detract from the utility of his products.

The great argument for domestic electrification to-day is that it reduces work by cutting out the chief source of dirt, and, in addition, assists in performing the reduced amount of work which remains.

One of the lesser, but important, divisions of household work lies in the cleaning and polishing of metals, a task of removing dirt which produces still more dirt in the process and also calls for a considerable amount of physical effort; we have already seen this problem attacked with great success by metallurgists, who have produced a rustless

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alloy, rapidly being extended to replace all ordinary bright steel and iron goods in household use. So far we have not produced a white or yellow metal which is proof against the effects of air and moisture, but the increased use of lacquers, fired enamels, and other preservative coverings, and even the replacement of metal by porcelain and compositions are indicated as the correct practice.

It is here that the electrical manufacturer must guard against introducing a new series of appliances which need polishing, or are unduly difficult to clean. Ranges with bright parts, toasters, kettles, and plates in copper and nickel finish are very attractive, and have been in earlier days admired as much for their luxury and appearance as for their utility. At the present time a more practical spirit and a keener criticism are applied to all suggestions for home improvement, and the device seeking adoption as a work-saver must bring no fresh responsibilities with it.

Similarly with power-driven appliances, too much refinement of detail should be avoided if it entails any risk of failure, or the occasional need of skilled attention, which will probably not be forthcoming; faults which can be remedied in a few minutes by the makers of apparatus are sufficient to render it useless to the uninstructed user, and destroy her confidence in the electrical method generally.

It is impossible to say how greatly the use of electricity for cooking and similar work has been retarded by trifling faults of detail in plugs and connections and flimsy accessories, the cost of which might have been doubled without appreciable effect on the consumer's outlay.

The power-driven appliances in particular will call for a good deal of attention to features generally known as "fool-proof." The treatment they will receive in use is not likely to be gentle or directed by an appreciation of their limits, and it is most essential to allow for overloading, and to provide that framework and mechanical features shall be on the heavy side, whilst attention to water and dust proofing, and the simplest arrangement for lubrication with clear reminders of its necessity, should be features of every motor-driven device entrusted to the hands of the housewife or her servants.

Even in lighting it may not be amiss to bear in mind the need for simplicity, and the provision of fittings which will retain a high average efficiency with little attention; one of the principal points of superiority of electricity over gas is the lack of any need for frequent cleaning of shades or reflectors, and the maintenance of light at a high percentage of its original value throughout the life of the lamp. Some of the more modern fittings and glassware sacrifice certain of these advantages; in attempting too much elaboration, it is easy to create dust traps, and lose one of the advantages of electricity, the production of an artificial light ever ready without attention from the user.

Elsewhere in this issue we have again brought together particulars of a variety of appliances for use in the home, illustrating some of the many ways in which electricity can lighten labour and add to domestic comfort.

Government Visits to Industrial Districts.

We welcome the announcement which appears in our "Business Notes" to-day regarding the periodical visits of officials of the Department of Overseas Trade to industrial centres in this country. To our way of thinking, if this Department is to be a complete success, it is absolutely essential that its staff should be closely in touch with the manufacturers at home. In no other way can these gentlemen have an intelligent opinion regarding the capacity and ability of British works, or a sympathetic understanding of the why and wherefore of the attitude of industrial authorities towards particular aspects of export trade questions; nor can they, without a fairly close personal relationship, keep themselves sufficiently informed of the new British developments that are continually taking place. That the Department is in a position to furnish valuable information to traders seems to us to be proved already, but it will learn from practical experience how to increase the value of its service. In addition to the daily means of securing that experience through correspondence, the officials will now have the benefit of rubbing shoulders with men of industry in their own centres of activity. We hope that they will find the manufacturers and traders accessible, receptive, and communicative. What is there to be gained by adopting a policy of secrecy or aloofness? Let them carry their own co-operative principles into practice in their attitude toward a Government Department which is established expressly to assist them in legitimate ways.

We observe that Lord Burnham, in an address at the Crystal Palace Fair, has been laying stress upon another important side of the activities of the D.O.T.—the influence of its representatives in creating an atmosphere in the Overseas Dominions and among foreign communities abroad, favourable to the sale and consumption of British goods. As we have said repeatedly, these representatives stationed abroad will be better qualified to put the case for British trade effectively if they understand our manufacturing qualifications at first hand—that is, from previous personal study of our industries in the great centres where these are carried on. There is quite as great a need for these officials to know their subject completely as there is for home representatives to get into local industrial touch.

Another Committee.

It is reported in *The Times* that the Ministry of Transport is about to set up a Committee to investigate the electrification of main-line railways, and to report to the Ministry as to the practicability or otherwise of the schemes that have been proposed. In the meantime these schemes are, of course, held up. The most important is that of the North-Eastern Railway, between York and Newcastle, others being rather of the suburban or interurban type.

We fear the result will be serious delay in making a commencement with the work, as we remarked in a recent issue, probably for months. We know these Committees. The best Committee is a Committee of one, but that is not the kind we get. The new Ministry has certainly lost no time in falling into line with the revered traditions of the Civil Service, of which the first and oldest is: "Go slow."

London Traffic.

That the London railways, tramways, and omnibuses are all running at a loss is a matter of common knowledge; that such a condition of things cannot possibly be maintained is obvious, and the only question on which opinion is not unanimous seems to be that of finding a remedy. All the transport authorities are agreed as to the necessity of increasing the fares for that purpose; but, strangely enough, the public, whilst paying 130 per cent. more than it did five years ago for other commodities, appears to regard the raising of fares as an iniquitous proposition. It may be a psychological phenomenon; the traveller receives no material consideration for his money, and is apt to ignore the fact that he has purchased service. Yet when he visits the theatre or the picture-house, he willingly pays on a luxury scale for benefits which are equally unsubstantial.

But how else can transport undertakings be restored to a sound financial condition? To talk of economising, with the cost of coal, petrol, labour, and materials constantly

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rising, and the rolling stock as steadily deteriorating, is idle. Even with the vehicles crowded to excess, the receipts do not balance the expenditure, and that with capital charges mainly on the pre-war basis of value; any new expenditure will necessarily be on a triple scale, and therefore will increase the difficulty of making ends meet. As a matter of fact, the fares, especially on the London tramways, before the war were absurdly too cheap—partly due to the competition of the omnibuses, which were indirectly subsidised by the maintenance of the roadways at the public cost, and by freedom from the burdens imposed upon the tramways, and partly due to political vote-catching.

The *Daily Telegraph*, whose attitude fairly represents the views of the Press, is astonished "that undertakings doing such enormous business are not more successful financially"; but it reports that the cost of carrying a passenger has increased 75 per cent., while the receipts per passenger have only increased 44 per cent.—where then is the occasion for surprise? Lord Ashfield refers to increases of 300 or 400 per cent. in the cost of materials and labour, "but against this we have to reckon that the number of passengers has increased by a third," says our contemporary, as if that could compensate for the other! It proceeds to declaim against the evils of competition, though admitting that in the "rush hours" "London needs every vehicle that can be run." If all are full, where is the competition? It is only during the slack times that competition can have an evil effect. The *Daily Telegraph* prescription to cure the malady is a Traffic Board for London, and that is certainly a crying need, as it has been these 10 years. We have consistently advocated the establishment of such a Board, but the politicians have blocked it up to now. It will have to come; but let there be no mistake about this fact—higher fares will have to come too.

If anything could be done to distribute the morning and evening traffic over wider periods, that would go a long way towards relieving the situation.

The Rating of Machinery.

The fact that machinery in England and Wales is rated for local assessment under a series of statutes passed during the years 1862 to 1880, whereas in Scotland or Ireland, or indeed, as far as is known in any other country, it is not, has been a bone of contention among machinery users for many years. Even so, there is no uniformity in the methods of assessment, and the fact that some towns in the country offer preferential rating systems to manufacturers to settle in their areas has been one among other reasons why many important engineering firms have left London and other places less favoured in this connection. The main point, of course, is that whatever system of industrial taxation is in force should be uniform throughout the kingdom, so that one manufacturer may not be handicapped against his competitors with a different rating system from that which prevails in other districts. The Machinery Users' Association has been hammering away at the question since 1890, with a persistence which deserves a better fate than that which has hitherto befallen it; but the fact remains that we are still rated in respect of machinery under antiquated legislation, notwithstanding that in 1896 a Royal Commission reported in favour of a change. That, however, is merely cause and effect, for we do not know of a case in which the findings of a Royal Commission on an industrial matter have been acted upon. Consistently, every year from 1890 until 1906, the Machinery Users' Association have introduced a Bill, the main object of which has been to have a uniform system throughout the country whereby loose machinery is exempted from taxation. The record of these efforts is that time after time the second reading has been carried by a large majority in the House of Commons, but further progress has been blocked. The Royal Commission reported in 1901 in favour of the proposal of the Association. The only argument against the Bill all through has been that under it much machinery now assessed would escape taxation, and that the revenue of the local authorities would thereby be diminished. That result is contested, but it is interesting to point out, as illustrating our national mentality, that much of the mischief which has caused the attempts of the advocates of this reform to fail has been due to opposition on the part of the agricultural interests, who, until they themselves got relief of agricultural land from rating, consistently laid themselves out to "block" the Bill of machinery users in the House of Commons. That was in the days when landowners were in a far greater majority than they are to-day. Since then, the business element in the House has increased enormously. In 1908, action by the Association was stayed on the promise of a new Valuation Bill by the Government, which never eventuated, and nothing further has been done. The new conditions created since the war, however, with the shorter hours and lessened productivity of machinery, have influenced the Machinery Users' Association again to bring forward its Bill, which is a measure consisting only of three clauses, providing that only "machinery, machines, or plant" for the purpose of "producing or transmitting first motive power for heating or lighting" shall be assessable, and that all loose machinery or tools, *i.e.*, those which are only so fixed that they can be removed from their place without necessitating the removal of any part of the premises, should be exempt. That is in the terms of the Royal Commission's report in 1901, but the present conditions are such that the Government can find only too ready to hand excuses for not giving facilities for such a private Bill, or for not taking up the question itself, yet it is a matter of considerable importance to the industrial community. With the much larger number of business men that there now are in the House of Commons, who themselves have a direct interest in the problem, there may be more hope than there has been hitherto, that some pressure will be brought to bear which will assist the passage of the Bill. Another factor also may possibly be that the disappearance of the old Local Government Board, which on this question always seemed to favour the line of least resistance, and its replacement by the Ministry of Health, may have the result of bringing more modern ideas into play. The drawback hitherto has been that the whole enunciation of the law of rating has drifted into the hands of lawyers and generations of Government officials who have faithfully carried on the old traditions. It is high time the business man's point of view came a little more into prominence as a corrective to the perpetuation of ideas which can no longer find a place in modern industry.

German Breaches of Contract.

The number of cases is gradually increasing in which foreign customers complain of the refusal of German firms to execute orders at the pre-arranged prices, this being especially so in Holland and the Scandinavian countries. After the unfortunate purchasers have been informed that the contract prices have been raised by 100 or 200 per cent. to meet the increased cost of wages and materials, they receive intimation later on, when inquiring about the expected delivery, that the Government will not give an export permit unless the quotations are further advanced by some hundreds per cent. in marks. Thus, after the German makers have forced up the prices as far as they deem it advisable to do directly on their own account, they make a further increase on the pretext that the responsibility for the fresh augmentation rests with the Government. A short time ago we drew attention to cases of this kind which arose in Denmark in the matter of electrical apparatus, but the most glaring instance has just been disclosed by Mr. L. J. Vogt at a meeting of the Christiania Chamber of Commerce, held a fortnight ago. The speaker stated that great losses had occurred in Norway through German breaches of contract. In one single case the question concerned the delivery of electrical machinery of the contract value of 3,000,000 kronor. The contract contained all possible reservations that the results of labour disputes, &c., should not prejudice the purchasers, but notwithstanding this fact the German firm subsequently demanded the payment of 18,000,000 kronor, an increase of 500 per cent. It is quite obvious that cases of this kind will not tend to improve the reputation in other countries of either German electrical firms or other manufacturers who are following the same practice.

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EXTENSIONS AT DARLINGTON.

A description of the plant recently installed at the Darlington Corporation electricity works is of more than ordinary interest on account of the exceptionally low working costs obtained at these works. Although there is no natural supply of condensing water at the Darlington works, and coal has to be brought a distance of from 15 to 20 miles, and the load factor is only 25·6 per cent., the cost of fuel per unit sold is the lowest recorded this year for any undertaking in this country. Darlington also has the lowest total working costs per unit sold for any undertaking with equal or lower output, and the third lowest for any output, the two undertakings with lower costs having very much larger outputs and higher load factors.

The latest installation of boiler plant will consist of four Babcock & Wilcox boilers placed in pairs on each side of a chimney stack, a Green economiser with 384 11 ft. 6 in. tubes being set across the back of each pair of boilers. The gases from the two boilers pass into a flue under the economiser, and dampers are arranged so that these gases can be passed through the economiser or directly to the chimney.

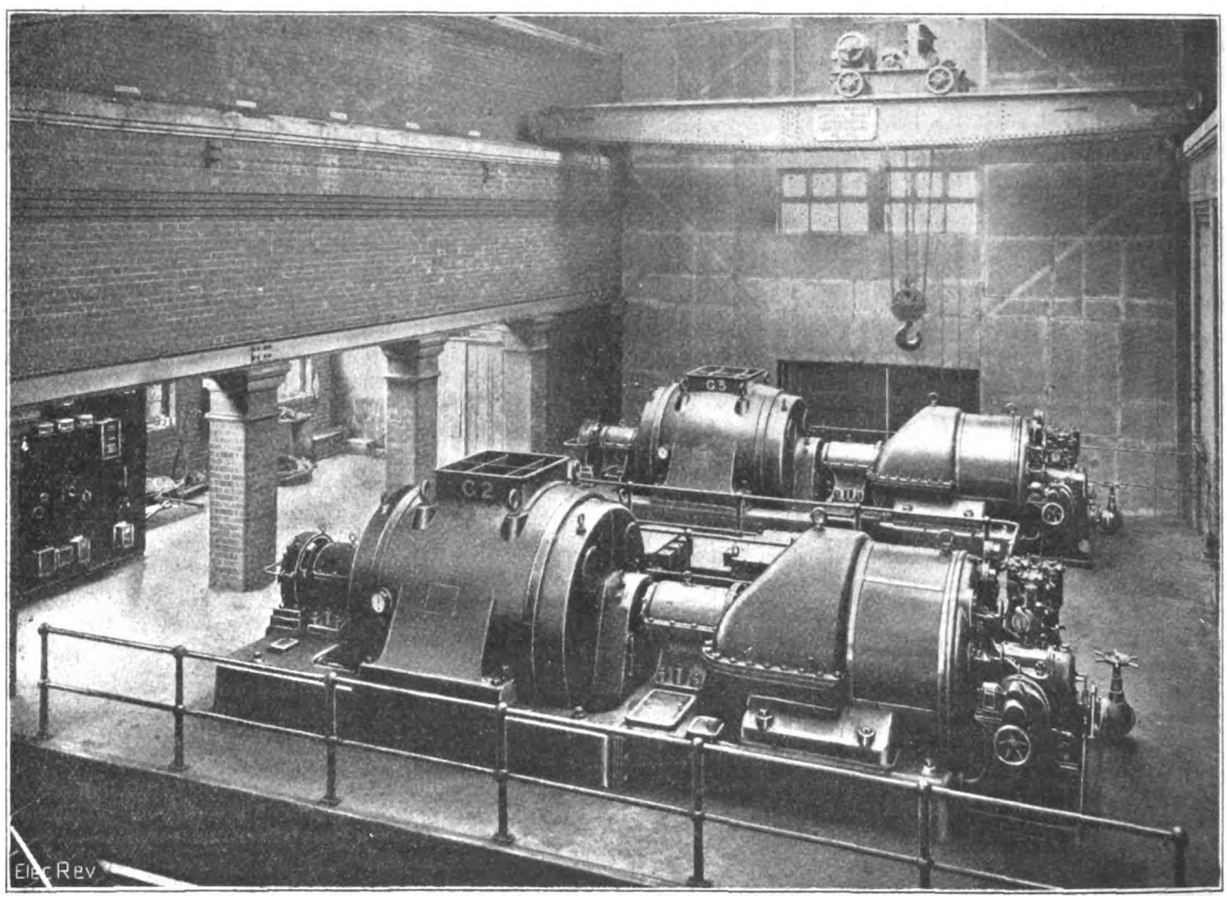

Fig. 1.—Fraser & Chalmers-Siemens 3,000-kw. Turbo-alternators at Darlington.

An induced-draught fan is fixed on a concrete platform above each economiser, and a horizontal damper is placed across the chimney shaft between the inlets and outlets of the fans. The inside diameter of the chimney shaft (10 ft.) was made unusually large for the output of the boilers, in order to prevent the emission of grits when small low-grade fuel is used, and the nuisance which existed from this cause before the chimney was erected has been effectually dispelled. The normal rating of each boiler is 25,000 lb. of steam per hour from, and at, 212° F. They are constructed for a working pressure of 200 lb. per sq. in. and a temperature of 650° F., but owing to other boiler and generating plant still in use, the working pressure at present is 160 lb. per sq. in., and the temperature is 550° F.

Two steam-turbo feed pumps by Messrs. G. & J. Weir, Ltd., each capable of an output of 7,000 gallons per hour, are placed on a raised platform between the two pairs of boilers and in front of the chimney. On the same platform are placed a Lea recorder capable of measuring the water for the four boilers, and duplicate motors for driving the stokers. This platform is raised 7 ft. 6 in. above the boiler-house floor level, in order to give free access to the boiler inspection and cleaning doors.

The four boilers, with economisers, chimney, induced-draught plant, feed pumps, Lea recorder, stoker motors, &c., form a complete unit, which can be repeated for future extensions, or, if desired, a different arrangement can be adopted for the next installation of boilers, without detriment to the existing plant.

Two of the boilers are fitted with chain-grate stokers working under induced draught only, but the stokers for the other two boilers, which are not yet erected, will be of a new type now being introduced by Messrs. Babcock and Wilcox, Ltd., and they will work with both forced and induced draught. The forced draught for these stokers will be furnished by fans located in the basement, one under each stoker, which will deliver into a common air duct of comparatively large area, also under the stokers; this arrangement will reduce the length of the duct between the fan and the stokers to an almost negligible quantity so far as loss of air pressure is concerned. It will also enable two boilers to be operated by one fan in case of breakdown, or under light load conditions. At present coke breeze and other low-grade fuel is being burnt, together with coal, on the sandwich system, but with the new stokers it is anticipated that low-grade fuel will be burnt without the addition of freshly-wrought coal.

The coal and other fuel is delivered in bottom-door trucks on a railway siding running through the boiler house at a height of 8 ft. 6 in. above the firing-floor level, and is dropped from the trucks into a receiving hopper, opposite the new chimney, from which it is fed into a Babcock and Wilcox gravity bucket conveyor by means of a rotary filler. Above the fronts of the boilers is a ferro-concrete coal bunker

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with a capacity of 50 tons of coal per boiler, and the fuel is delivered into this bunker by the conveyor. In addition to the chutes feeding the boilers immediately beneath the bunkers, each bunker has an auxiliary outlet valve which delivers fuel, when required, into a 10-cwt. travelling hopper, which runs on an overhead rail; this hopper is used for feeding the older Lancashire boilers, which are not provided with overhead bunkers, and which are mainly used for peak-load work. The boiler-house siding is shortly to be provided with a 15-ft. weigh-bridge, and a capstan to enable the trucks to be handled more expeditiously.

A new type of ash-conveyor, made by the Underfeed Stoker Co., is being installed under the boilers. The ashes drop continuously from the backs of the grates into this conveyor, which delivers them into a receiving-hopper, from which they can be dropped into wagons without any manual labour whatever. The conveyor is of the scraper type, running in a cast-iron trough filled with water, which performs the double purpose of quenching the ashes and sealing the ash chutes, from the grates to the conveyor, against leakage of air into the boiler. Corrosive action of the acid formed by the ashes and the water is prevented by continually renewing the water in the trough, a small stream of water entering at one end and overflowing at the other. Where the ash-conveyor emerges from the boiler house it carries the ashes up an inclined trough to a point above the ash-receiving hopper, and drops them into the latter. The speed of the conveyor is from 10 to 20 ft. per minute, and the power required amounts to less than 0·5 H.P. per boiler. Chutes are formed in the floor between the boilers and immediately above the ash-conveyor, so that all dust &c. removed from the boilers and flues can be raked into the conveyor. The induced-draught fans are of the low-speed type, by Messrs. Musgrave and Co., and are operated by pipe-ventilated, variable-speed motors, which enables the draught to be regulated without waste of power. The economisers are each fitted with a circulator, working on the injector principle, by the National Boiler and General Insurance Co. These circulators cause some of the hot water from the outlets of the economisers to mix with the water entering the economisers, and ensure that the temperature of the water is never low enough to cause corrosion of the end tubes by condensation of the water vapour in the flue gases. The exhaust steam from the feed pumps passes into a tubular feed heater through which the feed water is pumped to the economisers. A water softener by the Patterson Engineering Co. is used to soften the make-up feed water. The boilers are fitted with soot-cleaning apparatus, by the Boiler Tube & Flue Cleaner Co., Ltd., by means of which the soot and dust can easily be blown from the boiler tubes whilst the boilers are at work. One of the boilers has recently been fitted with an indicating CO_2 meter by W. R. Patents, Ltd., and similar instruments will probably be fitted to the new boilers, which will also be equipped with steam-flow meters and triple draught gauges.

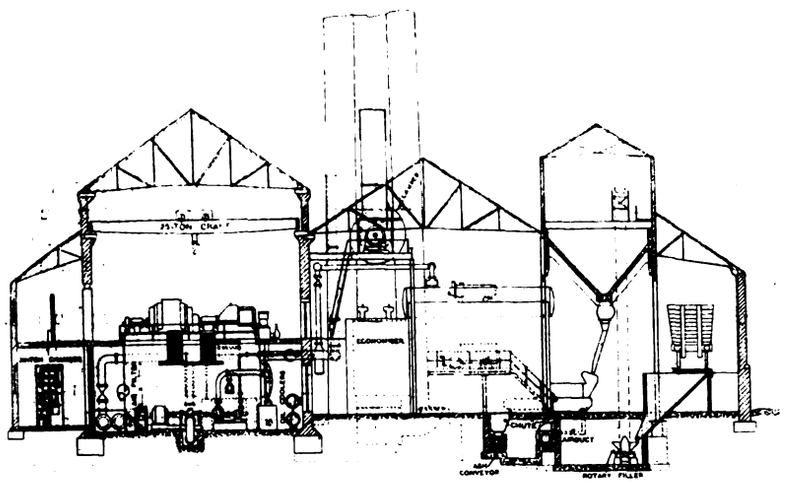

Fig. 2.—Elevation and Plan of Extensions at Darlington Electricity Works.

The usual temperature of the condensate from the condensers is 97° F., and this is raised to 127° F. in the feed-pump exhaust heater and to 238° F. in the economiser. The temperature of the gases leaving the boiler is 500° F., and leaving the economiser it is 295° F. Under ordinary full-load running conditions the amount of steam raised per lb. of coal burnt is equivalent to an over-all efficiency of boiler, economiser, feed heater, &c., from water at 60° F., of 85 per cent.

A small, but well-equipped, coal-testing laboratory has been fitted up at one end of the boiler house, and all coal received is tested for calorific value, &c., in the following manner:—A conical bucket, wider at the bottom than at the top, is placed in a suitable position under each truck of the fuel, so as to catch a sample of the fuel as it falls into the receiving hopper, and as the opening at the top of the bucket is smaller than the average diameter, it fills gradually as the truck empties, and receives a fairly average sample. The contents of the bucket, which weigh about 20 lb., are then fed into a Sturtevant crusher and sampler, which is driven from the stoker shafting, and this machine crushes the fuel to about $\frac{1}{8}$ in., and retains a 5 per cent. sample of the fuel fed into it. This sample is placed in an airtight tin, and when a sufficient number of tins of one class of fuel have been collected, their contents are fed into

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the sampling machine again, and a 5 per cent. sample of these contents is obtained, and is sent to the laboratory to be tested. In this way an average sample weighing from 0·5 lb. to 1 lb. is collected from each 10 to 20 trucks, according to the quantity of each class of fuel received, and an accurate record of the average calorific value is obtained with a minimum of labour. Samples of coal taken by the Sturtevant machines have been checked by an expert in the art of coal sampling, the machine sample being compared with a sample taken by quartering in the usual way, and almost identical results were obtained when the samples were tested.

The main steam range consists of a single 10-in. pipe running parallel to the wall between the engine room and boiler house, and fitted with sectionalising valves at suitable intervals, and all branch pipes to the boilers and turbines have their valves close to the main range, so as to reduce to a minimum the risk of a pipe failure affecting the main range. The boilers are not provided with any other valves than those close to the range, but the turbines have the usual starting valves on the machines. Steam traps of the bucket type, by Messrs. Alley & MacLellan, are used to keep the steam pipes clear of water, and where the failure of a trap might cause serious trouble by the accumulation of water, the traps are arranged in duplicate.

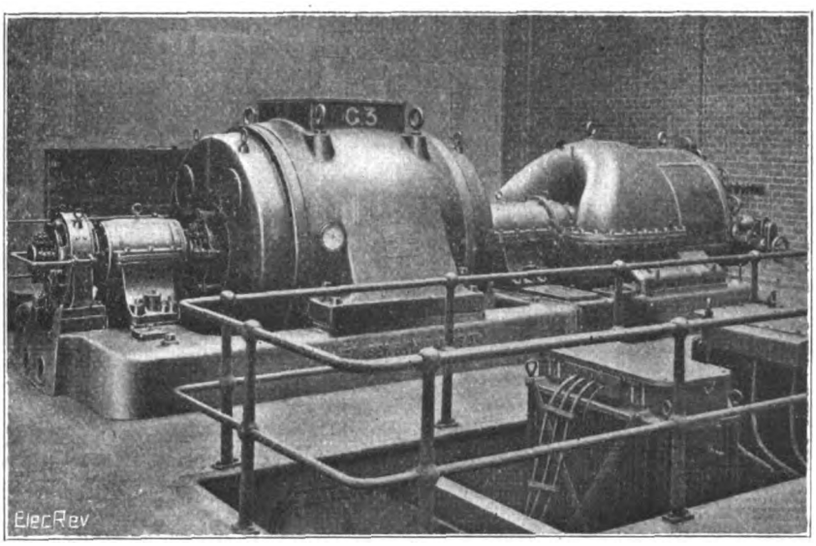

Fig. 3.—Generator End of 3,000-kw. Turbo-Alternator.

Two 3,000-kw. Fraser & Chalmers-Siemens turbo-alternators, figs. 1 and 3, have recently been installed in the engine room; they exhaust into Worthington Simpson rectangular surface condensers placed below and in line with the turbines. In order to provide room under the turbines for the condensing plant, the turbine floor was raised 9 ft. 6 in. above the old engine-room floor, while the condenser basement was dropped 5 ft. 6 in. below the engine room. There are no valves between the turbines and the condensers, but provision is made for flooding the condensers when the turbines are exhausting to atmosphere. In order that the condenser tubes may easily be cleaned or withdrawn, a large door has been formed in the engine-room wall opposite to the end of each condenser.

The condensing pumps, which include a circulating-water pump, an air-extraction operating pump, and a condensate pump, are all mounted on one shaft, and driven by a 110-b.h.p. squirrel-cage motor running at 1,460 r.p.m. Both sets of pumps are placed in the basement between the two turbo-generators, which makes a very compact and neat arrangement, and reduces the average distance between the turbo-alternator centres to 16 ft. 6 in.

Part of the water required to make up for the evaporation from the cooling towers is fed through the oil cooler and the air extraction pump, as this water, which is taken from the supply mains, is much colder than the condensing water from the cooling towers. The space underneath the alternator is formed into an air chamber, bounded on three sides by the longitudinal concrete foundation blocks and the condenser end, and on the fourth side by a Heenan & Froude rotary air filter placed across the space between the ends of the foundation blocks. The air inlet to the alternator which opens into this air chamber is provided with a damper, which can be closed by a lever on the turbine floor in the event of the alternator firing. Between the ends of the alternator foundations and the wall of the switch-chamber a passage, 5 ft. 3 in. by 14 ft. 6 in., is formed, along which fresh air is drawn to the air filters from outside; and the main condensing water-pipes are laid along the floor of this passage.

The turbines, which are of the Rateau impulse type, run at 3,000 r.p.m., the periodicity of the supply being 50 and the pressure 6,600 volts. Each turbine is provided with an automatic turbine-driven auxiliary oil pump for starting and emergency work. The turbines are fitted with B.T.H. indicating steam-flow meters, which can be checked at any time by the Lea recorder in the boiler house. To enable this to be done valves are provided, so that all but the condensate from one turbine can be turned direct into the feed pump suction pipe. The alternators are each provided with a dial thermometer, which registers the temperature of the windings.

On a concrete platform over the condensing pumps, but below the turbine floor level, fig. 3, are placed two 200-k.v.a. static transformers for providing a low-pressure three-phase supply for the station motors and neighbouring distributing mains. The transformers thus occupy space that would not otherwise be used, and they are within easy reach of the travelling crane.

The new section of the engine room is provided with a 25-ton travelling crane by Messrs. H. Morris & Co., with electrically-operated lifting and lowering gear, and hand travelling and traversing gear.

The e.h.t. switchgear is housed in a chamber running alongside the condenser basement, while the operating and instrument board is on the turbine floor level, immediately above the switchgear, and the switches are mechanically operated by rods. The switchgear, which is by the British Thomson-Houston Co., is enclosed in stoneware cubicles with steel doors, the different phases being separated throughout by stoneware partitions; duplicate sets of busbars are provided. The alternators are fitted with protective gear of the balanced-transformer type, the neutral-current transformers being located in the air chamber under the alternator. This gear, which controls the field as well as the main switch, has already prevented a bad internal short-circuit from doing any appreciable damage to the alternator. Voltage regulation of the alternators is attended to by a Taylor-Scotson regulator manufactured by Messrs. Cox-Walkers, Ltd.

It should be noted that the lay-out described above had to be adapted to make the best use of the existing plant, and to suit the width of boiler and engine houses, planned as long ago as 1899, as, owing to the position of the coal siding on the one side and other buildings on the other side, it was not advisable to alter these widths.

The cost of the above plant, which has all been installed since 1914, and a considerable proportion of which is being installed at the present time, excluding coolers, feeder switchgear, rotaries, &c., but including buildings and travelling crane, amounts to about £10 10s. per kw. of normal full-load continuous rating.

In conclusion, we must express our indebtedness to Mr. J. R. P. Lunn, borough electrical engineer, who is solely responsible for the lay-out and installation of the plant described, for the details and photographs set out above. Whilst congratulating him on the excellent results obtained from his plant, we may draw attention to the fact that in order to attain those results he has adopted the scientific principle of measurement throughout the installation, of which on previous occasions we have emphasised the importance. Only by such methods can the highest efficiency be secured and maintained.

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ELECTRICITY IN THE HOME.

In our issue dated June 20th last an article appeared under the title of "Domestic Electrical Appliances," in which details were given of a number of labour-saving electrical devices, which, in view of the difficulties of the domestic servant problem, would considerably lighten the housewife's burden. The need for aid in this direction has not decreased, and we therefore deem it desirable to describe several more of these appliances. As in the previous instance, the majority of these are of American manufacture, but it is hoped that in their schemes of reconstruction and progress British electrical manufacturers will not overlook the growing importance of the application of electricity to domestic needs.

The electric washing machine occupies the premier position as a labour saver, doubtless because of the drudgery entailed by the usual process. The "Geyser," fig. 1, sold by Messrs. L. G. Hawkins & Co., London, is a good example of its kind, and is being extensively advertised in this country. Made in three sizes, its main feature is a revolving, perforated zinc cylinder in a tank of galvanised steel. Entering this tank is a small motor-driven propeller, fig. 3, by means of which the cylinder is kept in rotation and the hot suds are forced through the cylinder and the clothes. The water is drawn back again through the clothes by suction, thus giving them a second treatment. When this process is completed the perforated cylinder can be raised and locked in its new position to enable the clothes to be put through a wringer. The latter, which is driven by the same motor, is provided with means for starting, stopping, or reversing, and also a quick release in case of accidents. The motor, fig. 3, employed for driving the gear is a ¼-H.P., 1,750-R.P.M. machine, and consumes a quarter of a unit per hour, and the machine makes no more noise in working than an electric fan.

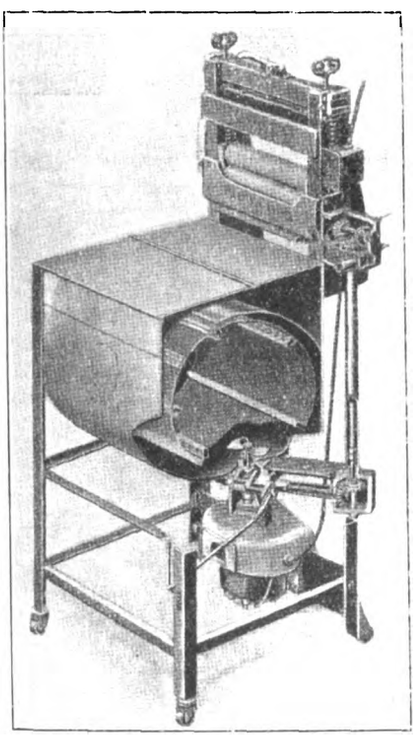

Fig. 1.

Many interesting features are possessed by the new Hughes automatic electrical range, made by the Hughes Division of the Edison Electric Appliance Co., of Chicago. In this range, fig. 4, both time and temperature for cooking are automatically controlled. The time-controller can be set to switch the current on and off over any period desired. The temperature regulator consists of a thermostatic device which permits the temperature to rise to the desired height and then switches the current off until the temperature falls, when it again closes the circuit. This is continued until the time-controller cuts the current off. In this way not only is waste of energy eliminated, but the adjustment of temperature prevents the food burning. The two devices are quite independent, and it is possible to use them either separately or in conjunction as described.

An outfit which will prove very serviceable in farmhouses or country homes is the electrical churning set, fig. 5, made by The Robbins & Myers Co., Springfield, Ohio. It consists of a small ½-H.P. motor fixed upon a steel tripod. The driving pulley is connected by a belt to the churn gear, which is supported by steel rods fixed in a solid base. The power is transmitted to the churning blades by means of direction-changing gears.

Another appliance which may prove of great use in the home is a pair of electrically operated shears, fig. 2, put on the market by the Sperry Gyroscope Co., of Brooklyn, N.Y. These are driven by a small motor making 9,000 R.P.M., to the cover of which the lower blade of the shears is rigidly fixed. The upper blade is connected by a link and eccentric to the motor shaft, which imparts an oscillating motion at the same frequency as its own. So rapid is this oscillation that it is said that each individual fibre of the material is severed. Although these shears will cut anything from silk to asbestos, perfect safety is ensured to the operator, as the actual movement of the blades is only about 1/16th of an inch.

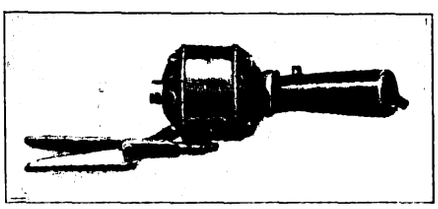

Fig. 2.

The electric suction cleaner considerably lessens the labour involved in keeping the home clean, and an appliance that possesses many valuable points as the "Hoover" sweeper, produced by the Hoover Suction Sweeper Co., London. While the usual type of cleaner depends solely upon the suction principle for its effectiveness, this machine, fig. 6, also beats and sweeps, and is therefore useful in many ways. The motor supplying the driving power is fixed on the top of the sweeping portion, and is enclosed in a metal case. In the sweeper is a small shaft upon which are mounted at intervals, and at different angles, small brushes. This shaft, which is belt-driven from the motor, rotates the brushes at a very high speed, and these, besides sweeping, cause a fluttering movement of the air which is drawn through the material being cleaned and set up a sharp beating motion, separating the dust from the fibres and sucking it into the cleaner. The dust receptacle is fixed under the handle of the machine. The cleaning attachment consists of a small enclosed exhauster coupled direct to the motor shaft, acting upon the sweeper-chamber and also through a flexible tube upon the mouth of the suction cleaner. It is claimed for the "Hoover" that it costs only 1d. per hour to run it from a lighting circuit.

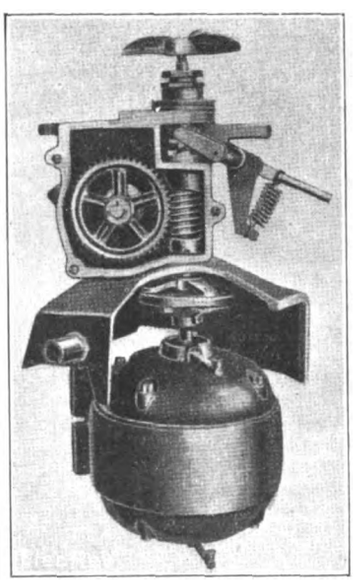

Fig. 3.

Fig. 4.

Fig. 5.

The "Overseas" vacuum cleaner embodies many new ideas, its outstanding feature being the "air-way" handle. This obviates the use of a tube attachment, as suction is employed through the handle itself. The whole appliance weighs only 7 lb., and therefore the end of the suction handle can be applied without much trouble. The sweeper, fig. 7, which

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runs on side rollers, possesses a swivel joint enabling it to be easily steered into corners and under furniture. The motor case has a transparent cover which affords an indication of the completion of cleaning. The dust drawn into the collector is retained by a paper container which, when filled, is taken out bodily and burnt. This container permits a faster escapement of used air, and keeps back the finer dust which a cloth container would allow to pass. The machine is made by the Overseas Engineering Co., Ltd., London.

Another method of cleaning carpets is provided by the Hamilton Beach Manufacturing Co., of Racine, Wisconsin, U.S.A., in a machine, fig. 8, recently introduced. This does not merely sweep carpets, but actually washes them while they remain in position. A specially prepared, soapy compound, supplied by the makers of the cleaner, is poured into an aluminium container, where it is electrically heated. It

politan Asylums Board proposes to install electric sewing machines in its institutions, calculating that the output by this means will be at least 50 per cent. greater with diminished fatigue to the workers.

A great deal of time can be saved, and no doubt a great deal of annoyance as well, by the adoption of electrical means for drying ladies' hair. The hair-dryer, fig. 14, consists of a very small and light motor having a fan fitted to its shaft. The air from the fan is forced through electric heating coils, and is thereby warmed and dried at the same time.

Many and varied are the uses to which the heating effect of the electric current is put, and it may be as well to mention one or two. Of course, the electric iron occupies the premier position in this connection, but it is unnecessary to describe what is, perhaps, the only domestic electrical appliance used in this country to any great extent. Simplex Con-

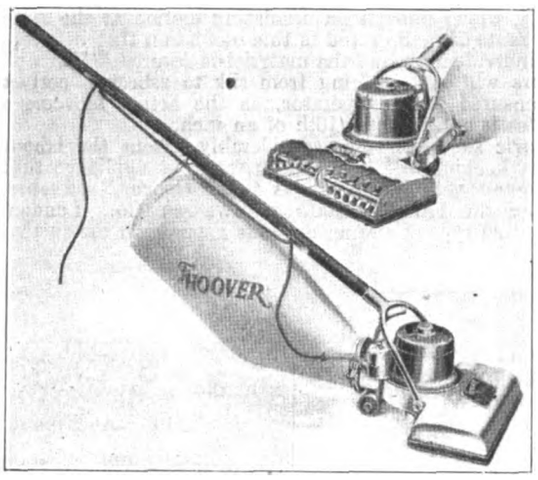

Fig. 6.

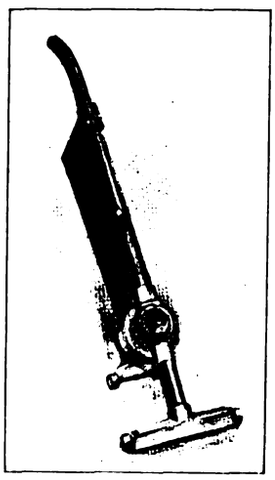

Fig. 7.

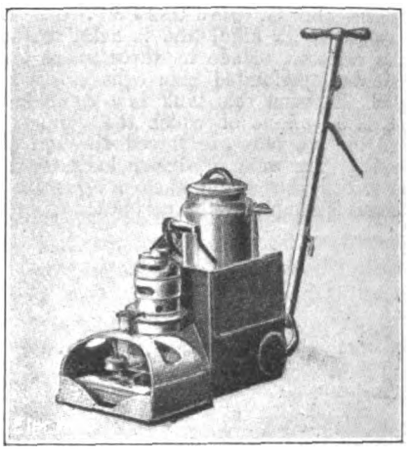

Fig. 8.

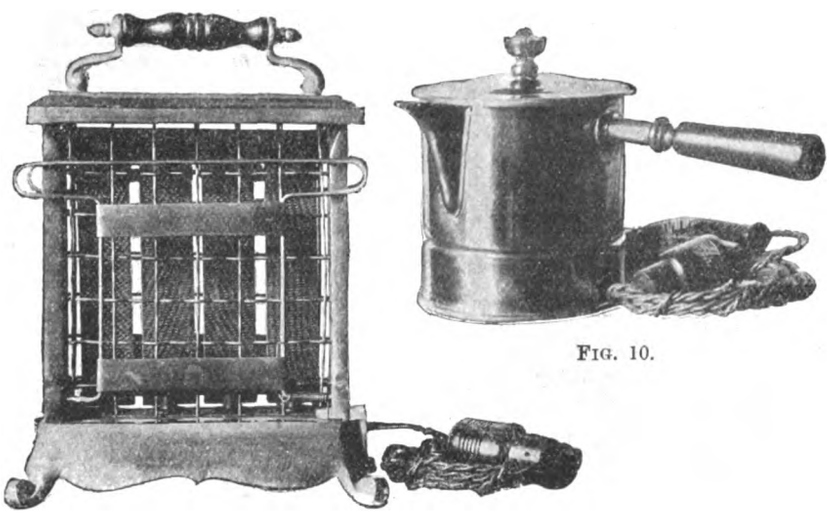

Fig 9.

Fig. 10.

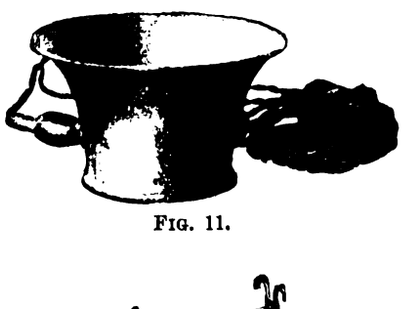

Fig. 11.

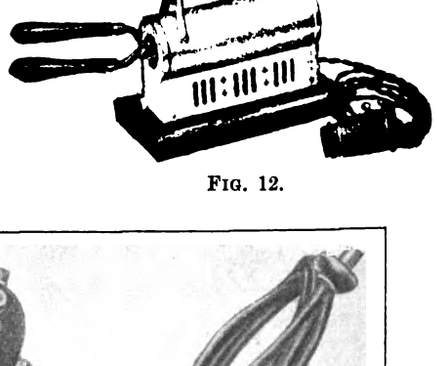

Fig. 12.

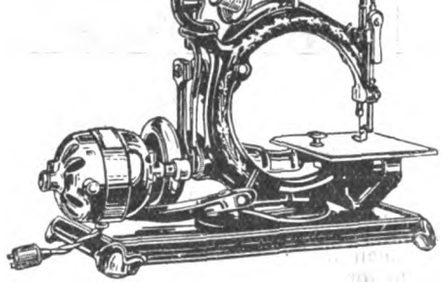

Fig 13.

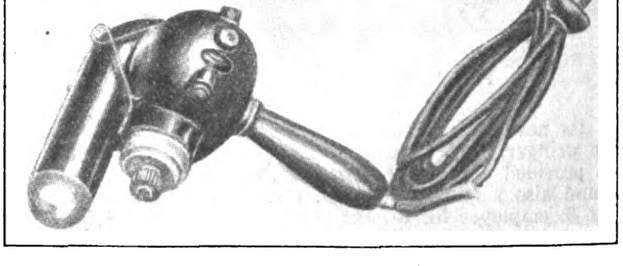

Fig. 14.

is then allowed to flow down to two soft rubber brushes which oscillate at the rate of 500 times a minute. The motion of the brushes is the same as that of the human hand when scrubbing. The compound is thoroughly scrubbed into the fabric and then drawn back into a receptacle, bringing with it all the dirt and grit from the material being operated upon.

The fatigue entailed in the use of the foot- or hand-operated sewing machine may be eliminated by the introduction of a machine driven by an electric motor. The latter is usually coupled directly to the sewing machine transmission shaft as in the Western Electric type, or drives by friction as in fig. 13. The motor leads are connected to a pedal switch, leaving both hands free for manipulating the work.

In this connection it is interesting to note that the Metro-

duits, Ltd., of Birmingham, manufacture a variety of small appliances of this nature, chiefly designed to localise the heat to a certain extent. An electric foot-warmer is one example. This is a box containing the heating element, covered with carpet and of a convenient shape and size for use as a foot-stool. Fig. 12 shows a curling tongs heater, and other articles are shaving cups, fig. 11, kettles and saucepans, fig. 10, all of which quickly boil water and are of great utility in bedrooms, &c., where small quantities of hot water are required.

"Breakfast table" appliances have become extremely popular, due mainly to their usefulness and convenience. Unfortunately it sometimes proves very inconvenient to have flexible leads to these from an overhead bracket, and it has, therefore, been suggested that an electrical sideboard would

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be a great improvement. On this sideboard would be a row of plug-sockets plugs to which the grills, toasters, fig. 9, &c., could be connected, and in this way the appliances would still be conveniently near, and the danger of catching up a wire with disastrous effect would be avoided.

Apart from devices specially designed for operation by electricity, a good many of the existing domestic apparatus can be adapted to enable them to be driven by a small electric motor, such as sewing machines and wringers, and also—turning to the musical side—gramophones or piano-players.

There is no doubt that the chief obstacle in the way of those who would otherwise be glad to avail themselves of the great help afforded by electricity is the initial expense, but when the resultant saving, both in labour and money, spread over the life of electrical appliances, is taken into account, as well as the absolute cleanliness of electrical methods, the use of electrical aids is unquestionably well worth while.

THE SALARY OF A TECHNICAL ENGINEER.

By "RUDDIGORE."

The other night I dreamt a wonderful dream. I was back in the High Street of my native village, basking again in its romantic quaintness, when someone tapped me on the shoulder. It was Peter, my old chum, returned from the wars.

"Wonders never cease!" he cried. "Millionaires in Villagehampton! Well!"

"Who's the millionaire?" I asked simply.

"Why, you, of course. An *engineer*—a man who's been on munitions for years."

"Alas, I am an engineer," I replied, "and, as you say, Fate kept me for years with what was called a controlled establishment. But you forget. I am only a *technical* engineer, who is ever poor. Had I been one of the 'amalgamated' type, skilled with hammer and chisel, instead of the calculus, I might now have been the rich man you take me for."

Peter took hold of my sleeve. "Look here, old chap," he cried, "perhaps your luck's been out, but I know just the thing to suit you. You know the old man—my uncle. He doesn't know a left hand thread from a right hand one, but he's done well out of engineering during the war, and has just bought up the Timbuctoo Electric Co. Well, I know he wants a technical man. What do you say to my proposing you?"

"Thank you. Thanks very much. I should be very pleased—of course, providing the salary would be right."

"Oh, yes. No need to worry about that. Just think it over, and let me know the salary you want (just what you think you're worth, you know), and I'll fix it up with the old man right away."

The next morning saw me at Peter's door.

"Have you reckoned it out?" he asked.

"Yes, I have it all down on this paper," I answered. "Let me explain. First of all, Jim Penman, the clerk, gets £5 a week, and I guess I'm worth that. Then my school and university training, together with my experience, swallowed close on £800. Interest on that at 7 per cent. means an extra £56 a year. To repay the capital in, say, 16 years means another £50. Then surely my value above that of Jim Penman can be put at a minimum of £1 per week. Putting all these together we arrive at a salary of £408 per annum, thus:—

Basic salary	£250
7 per cent. on £800	56
For repayment of capital	50
Minimum value above the basic salary, say ...	52
Total	£408

"What!" cried Peter, "only £408 a year! Why, the old man wouldn't impose. I'll tell him six . . ."

* * *

Loud coughing outside, a knocking on my bedroom door, a shrill voice through the chilly air, awoke me to reality and a roaring March morning.

It was Saturday. With a childlike hope born of my dream, I opened the Review at the list of vacant posts. To my dismay I found that one optimist wanted a technical man for £3 a week. A college anticipated another Kelvin for £200 a year. An insurance company desired a man's body and soul for a like amount. I closed the paper, and if a heart can be broken I knew mine was.

Next time I come on earth I shall closely examine the possibilities of life as a taxi-driver, hotel porter, bookie, shopkeeper, or trade union secretary, before rashly joining that ascetic band of unselfish saints—the technical engineers.

CORRESPONDENCE.

Letters received by us after 5 P.M. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Trading Agreements.

Can you, please, inform me what good purpose the trading agreements which we have on all hands to-day fulfil?

Take the E.L.M.A., for instance. Here we have a document which ties up the retailer or contractor to lamps of certain makes only. He may be (if he be a contractor) stuck fast on a job meaning hundreds or thousands of pounds to him, but if he cannot get "ring" lamps—we all know how scarce 100-watt half-watts are—he must perforce do without his money until the E.L.M.A. firms are pleased to deliver, although he could get non-ring lamps at once.

He may be asked to quote for a certain type of lamp, but because it is not a product of the Association, he cannot touch it.

Are not the above two instances restraint of trade?

Any retailer knows from the number of people who, when refused discount, walk away without buying, that dozens of firms do make concessions to casual buyers. An honest man cannot make any allowance, but his dishonest neighbour, who apparently will sign any agreement you like without the slightest intention of keeping it, reaps the profit and collars the customer. And there is no redress, no retribution overtakes the wicked one. The E.L.M.A. cannot find him out (does it ever try to find anyone out?), and the so-far honest competitor is driven almost to break his word. After all, it is easy to allow a man 10 per cent. or 20 per cent. off a lamp or two if you get all his work; you soon get the discount back. In short, these agreements simply breed rogues, and I would ask how many retailers keep strictly to their agreements? How many allow 2½ per cent. cash monthly? How many render two statements, one for work and general supplies, less 2½ per cent., and another for the all-sacred lamp net? And when the usual hard-headed business man you are doing the work for (they are all hard-headed when they've got to pay) says: "Why the difference? Cash in a month is worth 2½ per cent. whether it is for lamp-holders or lamps, and 2½ per cent. I will take," what steps have to be taken to get the deduction refunded? Why, it cannot be done!

How *can* you persuade a buyer for a graded firm that when he wants lamps for his own use he must pay 25 per cent. more for them? It is an insult to his intelligence.

Replies to the above queries will be thankfully received by

Pedalis.

Lubrication.

Referring to the article on "Lubrication" in your issue of February 27th, we beg to say that it was impossible in the time at our disposal when we gave our paper on "The Theory and Practice of Lubrication: The Germ Process," to go into many details of the subject. It was a preliminary paper to others to follow later on, as time and opportunity occur, as stated at the meeting.

The name "Germ" process, we explained, is used owing to the inherent fear of the word "acid" by chemists and engineers. Had we called it the "acid" process, the mere name would have ruled it out of court as an "impossible proposition" by every oil user. In fact it would hardly have got into any laboratory before being condemned out of hand, executed, and buried without ceremony and faint hope of trial on merit.

As a matter of fact, we used this name in the paper to avoid the semblance of punting our proprietary names by which the oils are sold, and to keep the subject on the level of a scientific contribution on the subject matter. They are sold as "Aptol" lubricating oils, or the lubricating "concentrate" as "Tonikol."

With reference to cheapening oils, towards the end of the paper we stated that "great economies may be anticipated from the use of oils made on this 'process.'" In comparison

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with oils compounded with fatty oils an economy of 10 per cent. to 15 per cent. in cost price for the same work is assured. The quantitative economy in mineral oil for many purposes cannot be definitely stated until exact records are collected from many trials in progress. We estimate 15 per cent. to 20 per cent. reduction in oil consumed.

One intention of the paper, as stated, was to clear away much prejudice, mistrust, and suspicion of the oil chemist and the oil manufacturer. When this is done, we trust a little more confidence in their good faith than hitherto experienced may result, followed by trials in actual practice. Without practical trials even the best theoretical work halts at the threshold of becoming available for practical utility in everyday use.

Henry M. Wells and James E. Southcombe.
Joint Authors.

London, S.W. 1.
March 2nd, 1920.

The Morse Code on the Gramophone.

I understand that gramophone disks have been prepared for the purpose of "home lessons" in telegraphy, being records of spoken words followed by the appropriate Morse code signals. Any information concerning the above, and especially as to the makers thereof, would be much appreciated.

E. C. Barton.

London, S.W.
March 3rd, 1920.

[Such records are sold by Messrs. Gamages, Ltd., Holborn, E.C. 1.—Eds. Elec. Rev.]

A New Thermionic Valve.

I have read with interest a description given in your last issue of a new thermionic valve, and would like to point out that some experimental valves which I made up during the war, to Dr. Erskine Murray's design, gave characteristics almost identical with those shown in the valve described by Mr. Scott Taggart.

It is perhaps to be regretted that the experimental work which has been done on wireless valves during the war has not been published.

This I know to be due to the fact that the technical people responsible for the production of valves for war purposes have been too much engaged in problems of reconstruction to be able to give this matter their attention.

S. R. Mullard.

London, S.W.
March 4th, 1920.

A Model Employer.

On February 13th there appeared in your "Situations Vacant" columns an advertisement for a staff for a modern E.H.T. power station in Liverpool district. It stipulated that the "working week comprises seven 8-hour shifts."

It will interest many of your readers, particularly central station men, to know that this advertisement emanated from Messrs. Lever Brothers, Ltd., who have a station, now nearing completion, at Brombro', near Port Sunlight. Having been under the impression that this firm was a "model employer," I was greatly surprised and also disappointed to see a company which had enjoyed a reputation for good conditions of employment stipulating seven days' work per week. In view of Lord Leverhulme's advocacy of better working conditions, which, however, he apparently does not give his own employés, can it be wondered that the worker is distrustful of combines and capitalists?

Sunlight.

March 4th, 1920.

Electrolytic Meters.

With reference to the correspondence regarding meters, we had not intended entering into this, but your correspondent, "A. W. C.," makes statements which may be misleading to those who have not had much experience of our electrolytic meters.

We refer more particularly to the remarks concerning crystallisation and vibration, as while it is true that these troubles existed many years ago, we can definitely guarantee that no meter sent out from our works since the year 1905 has shown the slightest sign of crystallisation, and that meters fitted with our spring suspension will work under any conditions of vibration that a motor meter will work under.

We should be pleased to demonstrate these points to your correspondent if he cares to visit our works.

With regard to the other points of "A. W. C.'s" letter, we would mention that a small amount of common-sense organisation is all that is required to overcome these suggested troubles, and in this connection would point to the fact that there are a very large number of engineers who prefer this meter to any other, no doubt on account of the many advantages it offers over motor meters.

We do not wish to burden your "Correspondence" column with details of these advantages, as they are so well known to the majority of engineers, but anyone interested can have any information required by applying to our works.

Reason Manufacturing Co., Ltd.,
Victor Breeze, *Technical Director.*

Brighton.

The Principle of Relativity Simply Explained.

I venture to call attention to a slight inaccuracy contained in the article contributed by R. W. Western, in your issue dated September 26th, 1919.

Referring to page 388, paragraph 1, of this article, the distance A A_2 should read $Ta\sqrt{c^2 + v^2}$, but the effect of making this alteration is to change the ratio for time to $\sqrt{1 + \beta^2}$.

The ratio given in the paragraph ($\sqrt{1 - \beta^2}$) is, I presume, correct, the error consisting of an incorrect statement of the case, thus:—

In the estimation of "A," the light passes from A to A_1, in time Ta, "B," however, thinks the light passes from A to A_2 in time Ta, and this distance, in his estimation, will be $c\,Ta$; distance A_1 to A_2 will be $v\,Ta$, and distance A to A_1 will be $Ta\sqrt{c^2 - v^2}$. Tb the time occupied by the light, in the estimation of "B," will be $Ta\sqrt{c^2 - v^2}/c$, whence $Tb/Ta = \sqrt{1 - \beta^2}$.

I trust your contributor will not find in the above reasoning sufficient evidence to warrant a practical experiment in the fourth dimension suggested by your correspondent, Mr. Carl Hering.

Edmund G. Staygle.

Electricity Works, Tonbridge,
March 6th, 1920.

Tale of a Cat.

In your issue of February 27th, an illustration was given of an electrical breakdown at the Daimler Co.'s works, due to a rat having attempted to walk across the high-pressure terminals of a switch. Enclosed is a photograph of a precisely similar occurrence, which was caused by a cat.

The incident occurred several years ago at the works of a client of my firm, Messrs. Criterion, Ltd., from whom we received an

urgent summons by telephone, as the high-pressure supply had failed. On investigation, the cat was found well roasted.

There was a space of a few inches at the bottom of the high-pressure switch cubicle, which was in an unfinished state, and it is presumed that the cat got inside the cubicle and up to the switch for warmth.

An unfortunate venture for poor puss!

Frank J. Moffatt.

Birmingham, *March 2nd*, 1920.

Radiators for Bath-Rooms.

In answer to "Radiator's" letter in your "Correspondence" columns for February, we make a complete line of glazed earthenware fires from 700 watts to 3,000 watts capacity, as per enclosed pamphlets. These fires were demonstrated at the "All-Electric House" at the Olympia Ideal Home Exhibition, and can be seen in our show-rooms throughout the country. Delivery from stock.

The General Electric Co., Ltd.,
C. G. Nobbs,
Manager of Heating and Cooking Department.

London, E.C.,
March 1st, 1920.

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The Einstein Theory.

I have reason to believe that a simple explanation will be published next month in the forthcoming issue of "Hibbert"—a quarterly journal which every engineer ought to read regularly.

Mr. Carl Hering's remarks appear anything but original to anyone who has heard of "Fluxions"; but pardon my saying that your own remarks, Sir, about Time show the necessity for a little clear thinking.

There is no such thing as Time—for the simple, but sufficient, reason that Time is not a thing! It is merely *an idea* which occurred to our remote ancestors as soon as they became "brainy" enough to notice that objects moved. If nothing moved, no one could have any idea of Time—that is of *Duration*, which can be expressed very unscientifically as *Space divided by Movement*—movement or motion being the state (condition) of a body whose position, relatively to its surroundings, is changing.

W. H. M.

March 6th, 1920.

[We are not sure whether our correspondent is here discussing metaphysics or metamathematics; but we ourselves said: "time is associated with motion," and we do not see that he carries the matter any further.

It is curious to note, on the other hand, that "according to the theory of relativity, if the observer is moving with the velocity of light, time remains unchanged." We do not profess to be able to reconcile these two propositions.—Eds. Elec. Rev.]

BUSINESS NOTES.

To Our Readers and News Contributors.—We shall be glad if reports and notes regarding social and other events can be sent to us as soon as possible after those events have taken place. Very frequently, especially of late, we have received notes of this kind five or six days after the functions, and as printing arrangements compel us to go to press early, such news cannot be published until it is a fortnight old. If somebody is deputed to send a paragraph to the Electrical Review immediately after the event, long delays in publication will in most cases be avoidable.

Football.—Messrs. Dick, Kerr's (Preston) team visited Coventry, Siemens (Stafford) in the first round of the Cup presented by Sir Charles Ellis for competition amongst electrical works staffs. The Preston party monopolised the game, and secured a 5—1 victory.

D.O.T. Officers to Visit Industrial Centres.—Arrangements have now been completed for the periodical dispatch of officers of the Department of Overseas Trade having specialised knowledge of particular trades to the more important industrial centres throught the country, for the purpose of bringing the Department more directly into touch with provincial firms than has been possible hitherto. With the co-operation of the Association of British Chambers of Commerce, the necessary facilities will be provided by the local Chambers of Commerce to enable the representatives of firms desiring to export British goods to interview the officers of the Department in their own locality. This, it is hoped, will obviate the inconvenience of travelling to London for the purpose of consulting the Department on matters connected with overseas trade. It is intended that the visits of officers shall be monthly, and will extend in each case over a period of about five days. The following programme has now been definitely arranged for the next two months :—

Birmingham Chamber of Commerce	8th/12th March.
Manchester " " "	15th/19th "
Glasgow " " "	22nd/26th "
Sheffield " " "	29th March to 1st April.
Bradford " " "	12th/16th April.
North Staffordshire Chamber of Commerce (Tunstall) ...	26th/30th "

The officers visiting the centres named will deal with inquiries connected with overseas trade possibilities and conditions, and, as far as may be possible, will discuss such matters as the following :—

1. Contracts open to tender.
2. Overseas demand for particular goods.
3. Importers of various goods in overseas markets.
4. Agencies for British manufacturers.
5. General conditions obtaining in overseas markets, including :
   - Best method of marketing and distribution.
   - Credit conditions.
   - Terms of payment.
   - Nature of competition and best methods of meeting same, &c.
6. Shipping and transport.

It is further hoped that these visits may be the means of enabling the Department to keep abreast of local industrial developments in their bearing on overseas trade. Applications to interview the Officers of the Department should be addressed direct to the Secretary of the Chamber of Commerce at the most suitable centre named above.

Liverpool Electrical Dispute.—There is every prospect of an early settlement of the dispute at Liverpool between the Electrical Trades Union and the National Federated Electrical Association over a new code of working rules. Our correspondent understands that a meeting has taken place between the Liverpool representatives of the Electrical Trades Union and the Association, and that certain decisions were arrived at which require the ratification of the operators on one hand and the Council of the National Federated Electrical Association on the other. The men, meanwhile, are withholding their labour, having refused to return to work pending negotiations. The dispute is now in its ninth week.

An Indian Inquiry.—Messrs. Daisy & Co., import merchants and agents, of 2/105, Armenian Street, P.O. Box No. 149, Madras, desire to receive samples and price information from British manufacturers of electrical fittings and accessories, as they are developing the business of their electrical department.

Plant for Sale.—Rochdale Corporation has for disposa two Bruce Peebles 120-kw. La Cour converters, direct coupled to generator; Tynemouth Corporation Electricity Department invites offers for two Holmes-Belliss and one Westinghouse-Belliss steam generators, each 190 kw. d.c. For full particulars see our advertisement pages to-day.

Coal in South Africa.—We have received a "Special Coal Number" of the *South African Mining and Engineering Journal*, Johannesburg, dated December, 1919, price 2s. 6d., in which is concentrated a veritable "mine" of information on the subject of the fuel resources of the Union of South Africa (p. 23). We note that Sir Dugald Clerk's statements regarding the virtues of gas have been taken literally, and that the "71 per cent. of the original total heat of the coal" which he claims for the carbonisation of coal is accepted at its face value, and used as an argument in favour of delay in the erection of large electric power stations, and the electrification of railways. We again point out that the "71 per cent." is a gross figure, and does not represent the net available heat—still less does it represent the available *energy* of the gas, coke, and tar, seeing that not more than one-third of it can be utilised for motive power. Moreover, as is pointed out on p. 23, electric power is generated at large stations from small waste coal, which is useless to the gas works. Apart from this aspect of the subject, the issue is an admirable one, containing an immense amount of detailed information.

Lead.—Messrs. G. Cawson & Co. report under date March 6th :—

> The supply of lead for consumers is still quite abundant. There, however, is less Broken Hill coming forward, and no arrivals are expected for some few weeks, although lead still continues to come in from other directions. Some reports predict a shortage of lead later in the year. This may or may not turn out to be correct, as the output may change very considerably during the next few months. We cannot pretend to tell at present what may be the ideas of speculators. There seems to be an opinion that they may take the market in hand and give prices a fresh push upwards. The position is now probably ripe for such an operation, as most of the weak holders have cleared out.

Messrs. James Forster & Co., on the same date, stated :—

> The immediate future of the market is in the hands of the Controller. . . We suggest that those who have bought the stock should pay for it where it lies, with an allowance for delivery. If it is shipped to London by the thousands of tons, it will probably go to America, with disastrous results here. . . . Our view is that a famine in lead in the summer is inevitable, and that if the Government stocks are allowed to go to America, we shall experience great scarcity before next month is out.

Italian Companies.—Six large Italian electrical companies are in process of increasing their capitals by large amounts :—The Società Industria Elettrica Schledense (Schio), from 300,000 to 1,000,000 lire; the Società Italiana di Elettrochimica (Rome) from 10,000,000 to 24,000,000 lire; the Società Italiana Telefoni Poivati (Milan), from 4,500,000 to 7,500,000 lire; the Società Generale Elettrica della Sicilia (Milan), from 32,000,000 to 50,000,000 lire; the Società Italiana dei Forni Elettrici e dell' Elettro-Carbonium (Rome), from 6,825,000 to 14,000,000 lire; and the Società Anglo-Romana (Rome), from 40,000,000 to 50,000,000 lire.

The Società Forze Idrauliche dell' Alto Po (Milan) has decided to transfer its quarters to Genoa, and elect a new council. This company is now controlled by the Negri.

There has been formed the Società Anonima A, B, G, D (with office at 22, Via Bigli, Milan), for the working of electro-mechanical patents, and the manufacture of and trade in mechanical apparatus. The capital is 600,000 lire, raisable to 1,000,000 lire.

The Società in Accomandita, "Sormani Aldo e Ca.," has been established at Netro, for the construction and repair of electrical material for lighting and power. Capital, 35,000 lire.

The Società Anonima Monti e Martini-Fabbricka Riunite Materiale Elettrico has been set up at Milan, with a capital of 2,000,000 lire.

The Società Itala per Forniture Elettriche has been established at Rome, with a capital of 100,000 lire.

French Companies.—Under the style of Henriquel et Noël, with offices at 15, Rue Delayrac, a company has been founded at Fontenay-sous-Bois, Seine, for the carrying out of mechanical and electrical undertakings; capital, 25,000 fr.

The Société Commerciale de l'Appareillage Gardy is the title of a company formed at 15, Rue de Milan, Paris, for the purchase, sale, export, and import of all kinds of electrical material, including ceramics. Capital, 100,000 fr.

The Société de la Forces de la Sélune is about to issue 2,000,000 fr. worth of 6 per cent. bonds.

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Reunions and Socials.—The staff and friends of Greenock Corporation electricity department met in a social capacity in the Tontine Hotel on February 25th, the occasion being the annual dance of the department. Mr. W. McGibbon, installation superintendent, was responsible for the decoration of the hall, a novelty in this connection being the use of four British Thomson-Houston floodlight projectors fitted with coloured screens. The kaleidoscopic effect of these colours on the ladies' dresses was too beautiful for words. The company included Mr. F. H. Whysall, burgh electrical engineer, and Mrs. Whysall; Bailie Russell, vice-convener of the Electricity Committee, and Mrs. Russell. Representatives of many leading engineering and manufacturing firms were also present. The programme, which included a number of the old popular dances, also contained many of the latest examples of the terphischorian art. The duties of the M.C. were capably executed by Messrs. W. Woodrow, N. Watson, and A. Lang. Mr. Roberts, meter superintendent, was responsible for the arrangements.

A grand concert, followed by a whist drive and dance, was held at the Borough Hall, Greenwich, on March 3rd, and was attended by employés of Messrs. Elliott Bros. (London), Ltd., Century Works, Lewisham, and their friends, to the number of about 500. The arrangements were in the hands of an Organising Committee consisting of members of the "Elliott" Social Association. The concert was arranged by Mr. Raymond O. Smith, secretary to the company, who also conducted the "Century Works" orchestra, which rendered selections from well-known composers. The vocalists were Miss D. Mackay Webster, Miss Helen Sola, Mr. Leslie Wissler and Mr. Ben Lawes, a member of "The Follies." Monologues were given by Mrs. R. O. Smith. Refreshments were served and there was dancing in the small hall, which had been engaged for this purpose. Mr. A. Treliving acted as M.C., and Mr. R. D. Johnson's Imperial Band provided the music. The whist drive was held in the large hall, about 45 tables being occupied. Mr. L. W. Smith, a director of the company, who also distributed the prizes, was M.C., assisted by Mr. W. F. Beaden.

The Social Club connected with Pope's Electric Lamp Co., Ltd., (Willesden), held a whist drive and dance at the Leopold Road Schools, Harlesden, on 3rd inst., about 450 of the staff and workpeople being present. The prizes were presented by Mrs. F. L. Pope. Mr. Pope, Mr. E. A. Marx (sales manager) and Mr. Stanley Carman (works manager) were present.

Trade Announcements.—Sir J. F. Payne Gallwey, Brown & Co., Ltd., with a capital of £50,000, have acquired the interests of Messrs. Payne Gallwey, Brown & Co., formerly trading at 49, Queen Victoria Street, E.C. 4. The offices of the new company are at 58, Victoria Street, S.W. 1. Sir J. F. Payne Gallwey and Mr. C. L. Brown, A.M.I.E.E., are joint managing directors. The company carries on the business of a central organisation for the distribution of machinery, equipment and stores for collieries and works, exporters and importers, and it also carries out complete equipment of collieries, &c.

Messrs. Brolt, Ltd., of Birmingham, have built and equipped a large works and head office at Rood End Road, Oldbury, to meet the increased call for their manufactures. The Princip Street works will be continued as a repair and service depôt.

Mr. J. Dyson, electrical engineer, of 7, Aldermanbury, Bradford, has acquired additional premises at No. 1, Hustlergate.

Messrs. Paxton & George have started in business as butchers' outfitters and electrical engineers at St. Peters, Gilmore Place, Edinburgh, and they desire to receive electrical manufacturers' catalogues, display cards, &c. Mr. W. J. Paxton was for some years on the engineering staff of the Clyde Valley Electrical Power Co.

Messrs. John Armstrong & Co. are commencing business as electric light and power engineers, at Lancaster Buildings, Barton Square, St. Ann Street, Manchester. Manufacturers' lists are asked for.

The Electrical Specialities Co., Ltd., whose registered offices are in Sheffield, have taken over the wholesale business carried on by Electro Agencies, of 21, Woodstock Street, Oxford Street, London, W. 1, where the business will be carried on as usual.

New Spanish Company.—The Sociedad Hidro-electrica del Cado is the name of a new company which has lately been formed in Barcelona, with a capital of 7,500,000 pesetas.

Catalogues and Lists.—The Falkirk Iron Co., Ltd., Falkirk.—List No. 219. Priced and illustrated leaflet dealing with the latest development of the "Falco" electric cooker. The makers state that deliveries can be made from stock.

Fuller's United Electric Works, Ltd., Woodland Works, Chadwell Heath, Essex.—Catalogue 69, describing portable accumulators (principally designed for automobile starting and lighting), hand-lamps, and small armoured cables. Priced and illustrated.

Automatic and Electric Furnaces, Ltd., 281-283, Gray's Inn Road, W.C. 1.—"Heat Treatment Bulletin No. 19." "The Transformation Ranges of Steel."

The British Thomson-Houston Co., Ltd., Mazda House, 77, Upper Thames Street, E.C. 4.—Sections 1 and 2 of new price-list giving illustrations and prices of a wide range of street lanterns for use with "Mazda" half-watt lamps. Data and characteristic curves are given for each type. Section 2 deals principally with watertight and gastight fittings.

Calendar.—The Hackbridge Cable Co., Ltd., of Hackbridge, Surrey, have sent us a handy and pleasing little calendar-card for desk use during the month of March. It is intended to issue such cards monthly.

Domestic Electrification.—Copies of the coloured supplement relating to this subject which appears in the *Beama Journal* for February can be obtained from the offices of the British Electrical Development Association (Inc), 84, Kingsway, W.C. 2.

Foreign Trade.—February Figures.—The following are the values given of electrical goods and machinery in the official returns of imports and exports for January:—

	February, 1920.	*Inc. or dec.*	*2 months*, 1920. *Inc. or dec.*
Imports.	£	£	£
Electrical goods, &c. ...	91,706	— 38,153	— 22,251
Machinery	1,383,429	+ 114,154	+863,211
Exports.			
Electrical goods, &c. ...	629,247	+ 388,974	+273,282
Machinery	2,743,237	+1,260,118	+271,243

National Joint Board of Employers and Staff Members (Electricity Supply Industry).—A special meeting of the above Board was held at the Ministry of Labour on the 6th inst., to consider matters referred to the Board by the E.P.E.A. Mr. R. P. Sloan was elected chairman of the meeting. The E.P.E.A. called the attention of the Board to the action of the Poplar Borough Council in declaring that the E.P.E.A. was not a recognised Trade Union, and instructing certain members of the technical staff of the undertaking to join the E.T.U. or the Municipal Officers' Association. After discussion, the employers' side of the National Joint Board agreed that they would notify the Poplar Borough Council that they recognised the E.P.E.A. as a Trade Union duly registered, and a competent body to deal with matters affecting the technical staffs in the Electricity Supply Industry. The members of the employers' side of the board were further of the opinion that members of the E.P.E.A. in the employ of the Poplar Borough Council should be accepted as belonging to a recognised Trade Union.

The E.P.E.A. cited the case of the Bournemouth and Poole Electric Supply Co., which had instructed one of its senior officers that he must resign his membership of the E.P.E.A., on the ground that "he could not sit on both sides of the table." The employers' side of the Joint Board agreed to notify the Bournemouth and Poole Electric Supply Co. that it had decided that the members of the technical staff "up to and including the deputy chief official" might quite properly be members of the E.P.E.A.

As it is stated that the duties of Mr. Goodyer are such as to bring him within the above grades, no exception can be taken to his membership of the E.P.E.A.

The E.P.E.A. referred to the position of affairs at Stalybridge, and the evidence indicated that the Stalybridge, Hyde, Mossley and Dukinfield Tramways and Electricity Board had

(*a*) Refused to institute a Committee of Inquiry into this dispute.

(*b*) Refused to refer the dispute to the employers' side of the National Joint Industrial Council (Electricity Supply Industry).

(*c*) Refused to hear the representatives of the E.P.E.A. in connection with the dispute.

The employers' side of the National Joint Board agreed to urge the Minister of Labour to order an inquiry into the dispute between the Stalybridge Board and the E.P.E.A. Further particulars as to the Stalybridge dispute appear in our "Notes" pages.

American Westinghouse Employés Insured.—One of the largest group insurance policies on record has been issued by the Hartford Travellers' Insurance Co. to the employés of the Westinghouse Electric Co., who have been insured for $20,000,000.—*The Times.*

A German Amalgamation Rumour.—Reports were in circulation on the Berlin Stock Exchange, last week, to the effect that negotiations were proceeding with a view to the amalgamation of the F. Krupp Co., the A.E.G., and Felten & Guilleaume. It is unofficially explained, however, that the rumours were due to a proposed agreement under which the Krupp Co. would supply the A.E.G. with a definite quantity of semi-finished materials.

Auction Sales.—By order of the Controller, Aircraft Department Disposal Board, Messrs. Goddard & Smith will sell by auction, on March 26th, at Earl's Court Exhibition, a quantity of balloons and balloon gear, also about 3,500 2-volt accumulators, insulating cable, &c. Assets Auctions Co. will sell by auction on March 18th, at Newington Causeway, the stock of an electrical factor. For particulars see our advertisement pages to-day.

Dock Electricians' Strike.—Owing to four G.P.O. employés engaged in installing telephones being non-Unionists, all the electricians at the Tilbury, Millwall, Blackwall, and Royal Albert Docks stopped work on Saturday last as a protest against the employment of non-Union labour, says the *Westminster Gazette*. A liner had to leave Tilbury in an unfinished condition with regard to electrical fittings, owing to the sudden termination of work by the electricians.

Liquidations and Dissolutions.—Collins Engineers, Ltd., 39A, Keens Road, Croydon.—In this matter a summary of the statement of affairs has now been issued, and according to this the unsecured creditors' claims amount to £15,363, while the assets are estimated to produce £6,549. There are other liabilities put down at £3,901, but these are not taken to rank in the statement of affairs. Then claims of the debenture holders amount to £10,000, and the assets are not sufficient to meet these claims by about £3,450, while there are preferential creditors in respect of taxes and wages amounting to £1,300, the deficiency as regards creditors, therefore, being £20,114. As regards contributories

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there is stated to be a total deficiency of £25,114. It appears that the winding-up order was made on December 11th, 1919, on a creditor's petition. On October 7th, 1919, one of the debenture holders appointed a receiver, Mr. Maurice L. Wells, of 118, Newgate, Street, E.C., who took possession on that date. The receiver had since been endeavouring to work up a large stock of parts to complete dynamo lighting sets, and although more may now be realised than appears in the statement, there seems no prospect of any dividend for the unsecured creditors. The failure of the company is attributed by Mr. Collins to losses on manufacture of munitions and losses incurred in manufacturing the A.P. Lighting Dynamo Set, which the company believed was a valid patent, but which turned out to be worthless. He further states that the machinery installed by Mr. Robinson, for the purposes of carrying out the munitions contracts was after six months of working found to be unsuitable: that it had to be scrapped and replaced by larger and more expensive machinery, and that the loss of output during that period was serious; that the quality of iron castings supplied by various manufacturers was unsatisfactory in 75 per cent. of the deliveries; that huge rejections of materials were made, and the loss of labour and output on this faulty material was persistent and heavy; that the Ministry of Munitions at last undertook to help to get suitable material, but it was some months before manufacturers could be found to supply a suitable quality; that the Armistice was declared just when proper qualities and quantities of raw materials were coming in and the machinery and labour were co-ordinating, and when the company was delivering 20,000 fuse plugs weekly: that at the end of 1918 the company's trading losses on war contracts had amounted to about £12,500; and that approximately £8,000 expended on the mass production of the dynamo lighting set has been lost.

Cosmos Consolidated, Ltd.—Winding up voluntarily. Liquidator, Sir A. F. Whinney, 4B, Frederick Place, Old Jewry, E.C.

Cosmos Engineering Co. Ltd.—Winding up voluntarily. Liquidator, Mr. T. D. Cocke, 44, Gresham Street, E.C. Meeting of creditors March 19th.

Motive Power Improvement Co., Ltd.—Meeting, April 12th, at 6, Eldon Street, E.C., to hear an account of the winding-up from the liquidator, Mr. D. G. Jarvis.

James Nelson, Johnson & Co., electricians, 25, Porter Street, and 68A, Wright Street, Kingston-upon-Hull.—Messrs. T. Hall and J. N. Johnson have dissolved partnership. Mr. Hall will attend to debts.

Furneaux & Thomas, electrical engineers and contractors, Swansea.—Mr. A. L. Furneaux and Mr. A. G. Thomas have dissolved partnership. Debts will be attended to by Mr. A. G. Thomas.

Johnson, O'Sullivan & Co., electrical engineers, 5, Manor Parade, Church End, Finchley, N.—Mr. H. W. Johnson and Mr. J. O'Sullivan have dissolved partnership. Mr. H. W. Johnson will attend to debts and continue the business under the same style.

Merchandise Marks Committee.—This Committee met at the Board of Trade, last week. Witnesses on behalf of the Association of British Chambers of Commerce and the Sheffield and London Chambers of Commerce dealt with the marking of imported, transhipped, and re-exported goods, and considered, among other things, the problems arising in connection with imported raw materials and with goods which undergo processes in more than one country. The probable effects of the adoption of empire, national, and community marks of origin were considered, and representations regarding the improper use of British hall-marks abroad were made by the Sheffield Chamber. The questions of the marking of imported goods, the prevention of false descriptions, the use of national trade-marks, and the protection of British marks in foreign countries were dealt with from the points of view of their respective industries.

British Trade with France.—The British Chamber of Commerce in Paris reports a membership of nearly 2,000, as against 800 before the war.

Book Notices.—"Mathematical Tables." Price 4s. 6d. net. Pp. 80. "Five-figure Logarithms and Trigonometrical Functions." Price 1s. 6d. net. Pp. 40. By W. E. Dommett and H. C. Hird. London: James Selwyn & Co., Ltd.—The former forms the second volume of a series of engineering tables and data, and contains five-figure logs, hyperbolic logs, and logs of functions, trigonometrical tables, general tables of squares, cubes, roots, &c., decimal equivalents and conversion tables, and mensuration tables for circles and spheres. The text is clearly printed and set out, on matt-surface paper, the lines being grouped where possible, to facilitate reference, and the decimal equivalents are generally carried only to five figures, which is ample for most purposes. The second book (a paper-backed brochure) contains the most useful of the tables given in the larger volume. All the tables are upright, which is by far the most convenient arrangement.

"Aluminium Sheet," "Aluminium Circles," and "Aluminium Tubes," are three pamphlets published by the British Aluminium Co., Ltd., with a view to supplying the information so often sought by those in the aluminium industry. The notes are practical, concise and in a handy form. The B.A. Co. will supply copies gratis to those interested in the subject.

"Electric Lighting in the Home." By Leon Gaster and J. S. Dow (32 pp.). London: Pitman & Sons, price 6d. net.—Notes on effective lighting for a complete house, detailing the requirements of each room.

We have received a copy of the first number of *The Rubber Age*, a monthly paper issued at 1s., from 43, Essex Street, Strand, W.C. 2. There are many notes of topical interest respecting rubber and the rubber trade, and subjects dealt with in article form include:—The future of the rubber industry; rubber for paving and flooring; rubber shock absorbers; rubber and aviation; the plantation industry, &c.

"The Henley Telegraph," the staff magazine of W. T. Henley's Telegraph Works Co., Ltd. Vol. I, No. 2 (32 pp.), price 6d.—This is a well-produced journal of no mean literary merit; it contains short articles and notes of general interest, and devotes a good deal of attention to the firm's social side.

"Vickers' News." Vol. I, No. 11.—This number includes notes on the Kwall Falls (Niagara) Power Scheme, and other Vickers undertakings.

"Text Book on Machine Drawing for Electrical Engineers." By E. Blythe. Pp. 81, 18 plates. London: Cambridge University Press. Price 20s. net.

"The Propagation of Electric Currents in Telephone and Telegraph Conductors." By Prof. J. A. Fleming. London: Constable and Co. Price 21s. net.

Technologic Paper, No. 143, of the U.S. Bureau of Standards. "A Study of the Deterioration of Nickel Spark-plug Electrodes in Service." 16 pp. Washington: Government Printing Office.—Notes on investigations into the effects of heat, &c., on nickel wire electrodes, illustrated by photomicrographs.

"Tilling-Stevens Gazette." Vol. I, No. 1 (16 pp.).—This first number of the magazine for the employés of Messrs. Tilling-Stevens, Maidstone, is well produced and illustrated.

A Dutch Export Veto Raised.—The Dutch Ministry of Commerce and Industry has just issued an order removing, as from March 1st, the export veto on dynamos, motors, apparatus, &c., with the exception of electricity meters.

German Export Veto Removed.—The export veto imposed by the German Government, last December, has been abolished in the case of spare parts for electrical machinery, arc lamps, and electrical heating and cooking apparatus.

New French Electrical Company.—A new company has lately been formed in Paris (39, Rue des Acacias) with a capital of 2,000,000 fr., and the title La Société Le Transformateur (Matériel Electrique et Mécanique).

LIGHTING AND POWER NOTES.

Athlone.—Electric Lighting Scheme.—Owing to the unsatisfactory state of the gas works, the Council has called in an expert to prepare a scheme of electric lighting for the town.

Barnstaple.—48-Hour Week.—The Town Council has adopted the 48-hour week system at the electricity works, and additional staff has been engaged accordingly. The wages of almost all the employés have been increased, and the assistant electrical engineer is to receive an additional £25 per annum.

Proposed Price Increase.—The Town Council has applied to the Electricity Commissioners for an order to increase the maximum charge for electricity.

Batley.—Loan.—The Electric Lighting Committee is seeking borrowing powers for plant and cable extensions.

Blackburn.—Electricity Supply.—It has been decided to inquire from the Darwen Corporation whether it is still desirous of Blackburn supplying electricity next winter; also to apply to the Commissioners for permission to supply electricity to the townships of Rishton, Wilpshire, and Great Harwood, situated on the borough boundary.

New Plant.—The Town Council has adopted the report of the electrical engineer advising the purchase of an additional 10,000-kw. set and accessories at the new Whitebirk station. Mechanical soot-blowers are recommended for all boilers in this station.

Blackpool.—Rebate.—The rebate to domestic consumers, consequent upon the reduction in coal prices, has been fixed by the Electricity Committee at ½d. per unit from January 1st last.

Birkenhead.—Loan Sanctioned.—The Town Council has received sanction to a loan of £21,331 for plant, mains, &c.

Bolton.—Proposed Price Increase.—The electrical engineer has submitted the following suggestions to the Electricity Committee to meet the increased cost of production. The price per unit for lighting to be raised by 0·1d., with a minimum charge of 30s. per annum. Power to ordinary consumers to be increased by 0·2d. per unit. To bulk consumers the charges should be raised from the present scale of 30s. to £2 10s. per kw. to a new scale ranging from £3 8s to £3 18s. per kw. The charges to bulk consumers not included in this scale to be increased by £1 per kw.

Bradford.—Sub-Station.—A scheme for the reconstruction of the Bolton Road sub-station has been selected from five alternative proposals by the city electrical engineer.

The Electricity Committee has approved the laying of mains to Richmond Road, Longside Lane, and elsewhere, at a cost of £425.

Braintree.—Bulk Supply.—At a recent meeting of the Council, a report of the Electricity and Lighting Committee regarding the advisability of obtaining a bulk supply for the district was adopted, and a licence is to be applied for,

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Colwyn Bay.—Bulk Supply.—The North Wales Power and Traction Co. has commenced the erection of overhead lines from the Dolgarrog station by means of which a bulk supply is to be transmitted to Colwyn Bay under the terms of a recent agreement.

Colchester.—Price Increase.—The Town Council has increased the price of electricity to 9d. per unit for lighting and by ½d. per unit for power.

Continental.—France.—According to the *Economiste Européen*, the French found no large water-power works in Alsace-Lorraine, but these provinces might well supply 1 million H.P. if the scheme for exploiting the Rhine from Bale to Lauterburg were realised. Portions of this scheme were prepared by the German authorities before the war. The French Public Works Department has made further plans of far-reaching importance; eight power works are to be erected, extending from the Swiss frontier to Markelsheim, near Strasbourg, which will develop on an average 800,000 H.P. Later on the water of the section of the Rhine below the influx of the Ill will be utilised.—*Economic Review.*

Discussing the question of the advisability of importing coal or electrical energy produced in England to work French railways, the *Revue Générale d'Electricité* says:—M. L. Neu has submitted to the Ministry of Industrial Reconstruction the idea of substituting the importation of electric energy from England to France, for the importation of coal. The question of the use of undersea cable for high-tension current may, he says, be considered as settled, since an installation of this kind has been working for several years between Sweden and Denmark, at 25,000 volts for a power of 50,000 KW. M. Neu's problem, therefore, involves no new principle.

Application has been made by the Electrique de Bretagne, located at Rennes, for a concession from the State, on public utility grounds, to set up a distribution network to serve the districts comprised within Guichen (départ. Ille-et-Vilaine), and Châteauneuf (départ. Cotes-du-Nord), with branches to Dinan, Bécherel, Dol, Combourg, Rennes, and Châteaubourg-Jauzé.

In the mining region of Marles, Pas de Calais, 125,000 miners are on strike. All the local railway workers and employés at the electrical works have also ceased work. It is feared that the trouble may spread to Bruay and other mining centres.—*Daily Mail.*

Switzerland.—The North-East Switzerland Power Works, which has largely increased the power generated in the last few years, intends to erect three new generating stations, viz., at Bottstein-Gippingen, on the Aar, at a cost of fr. 65 millions, to generate 260 mill. KW.-hours; and at Wäggital, near Zürich, at a cost of fr. 60 mill., to generate 60 mill. KW.-hours. The company intends to issue new capital for fr. 114 mill., viz., fr. 34 mill. in ordinary and fr. 80 mill. in preference shares. The shares will be divided among the cantons.

The company proposes to issue a debenture loan for fr. 15 mill. and its customers will be asked to pay more for their electrical energy.—*Economic Review.*

Denmark.—The Department of Overseas Trade has received advice from H.M. Chargé d'Affaires in Copenhagen to the effect that the Copenhagen Municipality is considering the vote of nearly 3,000,000 kroner for a 10,000-KW. turbo-generator for the electrical works, and 270,000 kroner for the conversion of 10 boilers to oil firing; 480,000 kroner for tank and piping installations, and 2,202,000 kroner for the extension of transmission and high-tension cables. It is further stated that one or two of the provincial municipalities of Denmark are increasing their electrical plant, and it is suggested that British firms which are represented in Denmark should request their local agents to watch proceedings carefully with a view to obtaining a share of this business. It will be necessary to consider the question of credit terms in view of the unfavourable Danish exchange. At present rate of exchange, 22-23 kroner = £1.

Rumania.—The Ministry of Finance has introduced a Bill to authorise an increase in the taxes on petroleum products and on electricity. It is calculated that the revenue from these two sources will exceed 2,000,000,000 lei per annum.

Germany.—It is reported that a large boiler burst, on the morning of March 9th, at the Rhenish-Westphalian electricity works, burying about 90 workmen. At least 50 persons are estimated to have been killed.

Dingwall.—Street Lighting.—The Electric Light Co. has offered to adapt the present gas lamps for electricity at a cost of £625. The Town Council has referred the matter to the Lighting Committee for investigation into comparative costs.

Doncaster.—Extensions.—The Corporation has approved estimates totalling £120,850 for the provision of new plant, &c. Application has already been made for permission to borrow £40,000.

Gillingham (Kent).—Supply from Dockyard.—The Town Council has decided to grant a licence to the Naval authorities at Chatham Dockyard to supply electricity to the Medway Shipbuilding Co., at works to be constructed at St. Mary's Island, for an agreed period and prices.

Harrogate.—Loan.—Borrowing powers are being sought for £15,750 for the establishment of a subsidiary power station near the Royal Bath, and for the installation of two 600-H.P. Diesel engines, to replace vertical steam engines which are now considered obsolete.

Holme.—Gift to Council.—The electricity undertaking, inaugurated about six years ago, has been handed over to the District Council. The formal proceedings took place last week, Mr. C. Tinker, the chairman of the Holme Electric Co., making a gift of the whole of the plant to the Council. Mr. Tinker had bought all the shares, representing a capital of £900.

London.—St. Pancras.—The borough electrical engineer has been instructed to submit a scheme of extensions to the Electricity Commissioners. This will include the addition of a 7,000-KW. turbo-generator, at an estimated cost of £60,000 and mains extensions in the King Street, Starch Green, Shepherd's Bush, and Wood Lane districts, costing approximately £21,700.

A five-fold increase in the number of consumers during the past year was announced at the annual meeting of the Metropolitan Electric Supply Co., on March 9th. Everything, it was said, pointed to a great broadening out in the use of electricity.

Loughborough.—Proposed Extensions.—The Town Council is seeking the permission of the Electricity Commissioners to extend the generating station at an estimated cost of from £150,000 to £180,000. It was stated at a Council meeting that manufacturers' demands could not be met unless these extensions were carried out.

Maidstone.—Loans.—The Town Council has applied to the Electricity Commissioners for loans of £15,000 for a 500-KW. rotary converter, switchgear, transformers, &c., needed for the supply of power to works at Tovil, and which will bring in a revenue of at least £14,500 a-year; and £6,500 for mains, &c., for the supply to the Cherry Orchard Estate. The Council is to take steps to supply for hiring purposes fittings and appliances for heating, lighting, and motive power.

Newcastle-on-Tyne.—Dividends.—Out of a net profit for the year of £21,593, Newcastle-on-Tyne and District Electric Lighting Co., Ltd., proposes paying a dividend at the rate of 4 per cent. free of income-tax, and carrying forward £13,263. Outlay on buildings, plant and mains totalled £19,000 for the year.

Salford.—Loan.—Sanction is being obtained for the borrowing of £144,344 for expenditure upon additional plant and cable extensions. Two items included in the proposals are generating plant (£47,340), and boiler-house plant (£42,000).

South Shields.—Prices.—The Electricity Committee has been approached by representatives of several of the largest power consumers, who request that if no reduction can be made in the present charges, which are considered too high, at least a guarantee should be given that rates will not be further raised. After consideration of the proposal, the Committee has decided that a guarantee of this nature can only be given if clauses, governing conditions created by rises or decreases in the cost of labour and coal, are inserted. It is accordingly willing to enter into an agreement over a period of years on these conditions.

St. Helens.—Loan Sanctioned.—The Town Council has received permission to borrow £21,414 for the purchase of additional switchgear, economisers, coal-handling plant, &c.

Swindon.—Loan.—The Town Council has applied for a loan of £20,000 for additional plant and cable extensions.

Watford.—Proposed Price Increase.—Sanction to the Urban District Council's proposal to raise the price of electricity from 8d. to 9d. per unit is being withheld pending the receipt of more complete particulars. The Urban District Council intends to give a supply to Radlett as soon as possible.

Water Power.—A special Committee, under the chairmanship of Sir John Snell, is investigating the possibility of utilising water power, both river and tidal, to generate electricity, and is drafting a report on how these means can be profitably employed in Great Britain.

West Riding (Yorks.).—Bulk Supplies.—A recent issue of the *Yorkshire Observer* gave some interesting information regarding the number of municipal authorities which have elected to take a bulk supply from a power company rather than incur the cost of extensions. Among these are Dewsbury, Batley, and Todmorden. The Brighouse Council has found it more advantageous to close down the town electricity works and take a bulk supply from the Yorkshire Power Co.

Wigan.—Extensions.—The Town Council is to apply for sanction to a loan of £50,000 to carry out extensions, including sums of £24,000 in connection with Ryland's Mills, and £12,000 for the Worsley Mesnes Mill.

Worthing.—Loan Sanction.—The Town Council has received sanction to a loan of £3,173 for the renewal of cables.

Wrexham.—Price Revision.—The Town Council has adopted the following revised scales of charges for electricity:—Power and heating, for the first 400 units per quarter, 3¼d. per unit plus 10 per cent.; and beyond, 2¾d. plus 10 per cent., less a discount of ¼d. per unit on all energy used, for prompt payment; or 32s. net per quarter for each KW. of maximum demand, plus 1d. per unit, and 30 per cent.; for heating premises lighted throughout by electricity, 1½d. plus 15 per cent., less ¼d. discount. A special rate of 6½d. per unit less ½d. discount, for factory, workshop, or warehouse lighting where 10,000 units per annum are taken for power, has been abolished

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TRAMWAY AND RAILWAY NOTES.

Accrington.—Tramway Shelter.—Mr. T. Gorden, of Blackpool, has promised to defray the cost of a tramway-waiting shelter at Accrington, costing £600.

Belfast.—Additional Rolling Stock.—In response to an appeal by a Labour Councillor for better travelling facilities for shipyard employés (numbering 10,000), it was stated that new cars would be delivered by the end of April if there were no industrial disputes in the meantime. The Corporation workshops are to be extended to enable the construction of cars to be accelerated.

Birmingham.—By-Laws.—A new by-law is proposed to compel motorists to come to a standstill before passing stationary tramway cars which passengers are leaving or entering.

Blackpool.—Advertisements.—The Tramways Committee recently decided to dispense with advertisements on tramcars. Advertisements are to be accepted on the newly acquired Blackpool and Fleetwood cars until present contracts expire, after which advertising is to be discontinued.

Burnley.—New Cars.—The Tramways Committee recommends the purchase of five additional single-deck tramcars, and the construction of two sidings and pits at a cost of £19,732. The Ministry of Transport is to be asked to sanction a loan for this purpose.

Fares.—Although it was stated at a Council meeting that wages increased by £24,000, and total working expenses by £33,000, against a revenue increase of £32,000, a proposal to increase 1d. fares by 50 per cent. was defeated.

Chesterfield.—Time Extension.—The Minister of Transport has extended the time under the Corporation Railless Traction Act, 1913, for the completion of the overhead equipment, &c., until August, 1921, and for the completion of certain tramways (Corporation Act, 1914) until July, 1921.

Continental.—France.—The Administration of the Railways has recently placed an order with Belgian manufacturers for 12,000 passenger coaches, which must be delivered within six months. At the same time, the Minister invited manufacturers to supply 42 new coaches, which are to be coupled to future electrically-driven trains. The Railway Department thus appears to be desirous of being equipped in advance, in view of trials which may be made during the year on the Brussels to Antwerp line, the first on which experiments will be made of electric traction. These coaches cost 250,000 fr. each (£12,000 nominal). They will be built of iron throughout, and will carry 100 passengers. Their length will be 21 metres. We may say in this connection that the 5,000 21-ton metal coaches ordered recently will involve an outlay of 80,000,000 fr. We are assured that the Belgian State is preparing a fresh order for wagons.—*L'Electricien.*

Norway.—The strike on the Christiania tramways has been brought to a satisfactory conclusion, the officials having accepted the Government terms. The tramway company will in future be subsidised by the municipality, being unable to meet its own liabilities in respect of wages, pensions, &c.—*Economic Review.*

Sweden.—The Swedish State Railways have asked the Government for a loan of 75,000,000 crowns for the electrification of the Stockholm-Gothenburg line, in order to save the high costs of fuel. It is calculated that with the present high price of coal the electrification costs will be redeemed in four years.—*Morning Post.*

Gateshead.—Fares.—The Town Council has disapproved of the request of the Gateshead and District Tramways Co. to terminate the existing agreement by which the company charges 1d. for all journeys on its routes, and to substitute a scale of fares up to a maximum of 3d. for a journey of 3¼ miles. Among other objections is one that the service is inadequate.

Halifax.—Year's Working.—The report covering the year ended March 31st, 1919, shows a total income of £149,715, and an expenditure of £111,757, leaving a gross balance of £37,958. The net profit, after deduction of loan interests, income-tax, &c., was £10,767. The total number of passengers carried during the period was 24,516,973, including blind persons and disabled soldiers, who were allowed free journeys.

London.—Deptford.—Evidence is to be submitted to the Advisory Committee on London Traffic, in order to prove the necessity of an underground railway for South-East London.

Fare Increase.—On Wednesday, after an all-night sitting, the London County Council decided to increase tramway fares by reducing the distance of the present stages. The new scale will come into operation as soon as the necessary arrangements can be made. A Committee of Inquiry is investigating the general conditions under which the tramways are operated, and, after it has reported, the Council will decide if it shall apply for powers to increase the statutory fare limit.

Newcastle-on-Tyne.—Proposed Fare Increase.—The City Council has received a report from the Tramways Committee urging increases in fares. The basis of the proposed new scale is 1d. per mile, 1½d. two miles, and 2d. for three miles. Halfpenny stages, with one exception, are to be abolished, workmen's and school-children's fares to be revised, and free travelling coupons for employés to be discontinued. It was stated that although the increase in revenue since 1915, has been £190,000, working expenses have risen by £234,000, of which £151,000 represents wage increases. With the exception of Glasgow, where the undertaking is being run at a loss, Newcastle is the only town where fares on municipally-owned tramways have remained at the pre-war level. The matter was eventually held over to another meeting. The Tramways Committee is arranging for the purchase of 20 new cars.

Railway Electrification.—It is reported that the Minister of Transport has appointed a committee to report upon the electrification of main-line railways.

St. Annes.—Opposition to Bill.—St. Annes Tramways Purchase Bill is being opposed by the L. & Y. and L. & N.W. Railway Companies, Lytham Council, and Blackpool Council. An interview has taken place between representatives of St. Annes and Lytham Councils, and a letter containing amended terms has been sent to Lytham Council.

TELEGRAPH AND TELEPHONE NOTES.

Cable Delays.—At a meeting of the Northamptonshire Chamber of Commerce last week, attention was drawn to the delay in cabling to the East. It was mentioned that a transaction involving a sum of £280,000 which would have been completed, had the cable gone out promptly, fell through owing to the difference in the value of the rupee making an adverse difference of about £14,000 in the quotation.

The daily Press announces that the Atlantic-Pacific cable between the U.S.A. and the Far East, which has been interrupted for some time, was restored on February 28th. The Pacific cable between Australia and Canada is still interrupted. The Eastern Telegraph Co. has just laid two new cables, one from Cornwall to Gibraltar, and the other from Malta to Alexandria. The cable ship which completed this work was expected in London last week, and she will load up a new cable to lay between Aden and Bombay. It is hoped to bring this cable into service in May next. Another cable from Gibraltar to Malta, and one from Madras to Singapore are to be laid shortly.

France.—A high-power wireless station is to be erected at Croix d'Hinge, near Bordeaux. According to *Weltwirtschaft* it will be five times as powerful as the Eiffel Tower station; it will be completed this year, and will be capable of transmitting 72,000 words per day with a range of 20,000 km.—*Economic Review.*

Japan.—A new wireless station has been opened near Tainan, Formosa, says *Weltwirtschaft*, for the use of the Japanese Navy, and another station is to be erected near Lin-shu-tun, in Manchuria.—*Economic Review.*

New Telephone Exchange.—Particulars of the Stepney Borough Council's opposition, in view of the shortage of housing accommodation, to the erection of the new telephone exchange at Spitalfields, have been brought to the notice of the London County Council and the Housing of the Working Classes Committee, and the latter authority has been in communication on the subject with H.M. Office of Works, acting for the P.M.G. The erection of the permanent exchange to occupy the whole site (comprising 30 houses and purchased by the P.M.G. in 1913), has, for the present, been deferred, it is now proposed to erect a temporary exchange on a part only of the site, and the disposed tenants will be accommodated in some of the unoccupied houses.

Portugal.—A strike of railway, postal and telegraph workers commenced on March 2nd. Disorders have taken place, and railway and telegraphic communication between Portugal and Spain was completely interrupted. The Vigo-Lisbon cable is no longer working.

The principal telegraphic centres have been occupied by military telegraphists, who, after repairing the damage, re-established some of the lines.

Nearly two months have elapsed since the telephone employés went on strike, and the instruments at the Lisbon central exchange were destroyed.

Ship's Wireless.—The standard ship's wireless sets in the past have been capable of transmitting messages an average distance of 200 miles, and of receiving messages sent out by stations like Poldhu, up to perhaps 1,500 miles. A ship in mid-ocean in the past requiring to send messages to coast stations on either side of the Atlantic, has had to relay these messages across a chain of other ships. A new maritime wireless set has, however, been evolved by the Marconi Co. employing continuous waves which, although occupying less space than the apparatus in use until now, has an efficient transmitting radius of 1,500 miles. One of these was fitted on the *Imperator*, a second on the *Carmania*, and a third on the *Mauretania*. Business men on the *Imperator* were able to send wireless messages from that ship direct to the British Admiralty wireless station at Aberdeen and the Canadian Government station at Barrington Passage. They were also able to maintain direct communication with the *Carmania*, 1,000 miles distant. The result

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was a heavy exchange of traffic in commercial messages, and with the co-operation of the Post Office authorities in this country, some excellent performances in the matter of speed were recorded. It is now possible for a person in London to communicate quickly with passengers on these vessels at any time during their voyage at a charge of only 10½d. per word. Of this 10½d., the Post Office receives 6½d. for shore wireless and landline services. These new wireless equipments on these vessels are additional to the sets hitherto installed, mainly for the purposes of safety at sea, and it is intended that they shall be used exclusively for traffic requirements.

Spain.—The Spanish Government, says *Weltwirtschaft*, intends to lay a Spanish-Morocco submarine cable between Cadiz and Larache.—*Economic Review.*

Wireless Direction-Finding Stations.—The *London Gazette*, March 5th, contains an Admiralty Notice to Mariners, No. 363 of 1920, which relates to wireless direction-finding stations, and gives regulations for D.F. stations in Canada, Newfoundland, U.S.A., United Kingdom, France, Italy, and Germany.

Wireless Telephony.—According to Berlin newspaper reports, the trials of wireless telephony from Berlin to Karlsborg, in Sweden (435 miles), and from Berlin to Moscow (1,060 miles), have proved successful.—*The Times.*

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the ELECTRICAL REVIEW *in which the "Official Notice" appeared.)*

OPEN.

Aberdare. — March 20th. Urban District Council. Reconstruction of existing tramways; also new tramways. Mr. E. M. Lacey, 12, Victoria Street, S.W. 1.

Australia.—MELBOURNE.—April 12th. City Council. Two 2,000-KW. rotary converters; H.T. switchgear, 6,600 V.; D.C. switchgear, 600 V. (January 30th.)

Aylesbury.—March 25th. Installation of electric light in St. John's Church. Specification, &c., from Mr. T. Moore, "Fern Lea," 36, Bierton Hill, Aylesbury.

Bedford. — March 31st. Electricity Department. Twelve months' supply of electricity meters and H.T. and L.T. cables. (March 5th.)

Belgium.—March 27th. Municipal authorities of Liége. 5,000-KW. turbo-alternator for the central electricity generating station. Tenders to the Bureau des Adjudications des Services Industriels, 3, Rue Saint Etienne, Liége, whence particulars may be obtained.

April 9th. Municipal authorities of Haccourt (Province of Liége). Concession for the electric lighting of the town.

Blackpool.—Tramways Committee. Lorry, with telescopic ladder, for repair work on Blackpool and Fleetwood route; also covered motor van.

Bristol.—March 22nd. Board of Guardians. Electric lighting installation at Eastville Institution. (March 5th.)

Carlisle.—March 19th. Electric light installation, Cecil Street Primitive Methodist Hall. S. W. B. Jack, Architect, 19 Lowther Street.

Durham.—March 18th. Board of Guardians. Electric lighting installation at Poor Law Institution, 37, Crossgate. Mr. H. E. Ferens, Clerk to Board of Guardians, Union Offices, 25, Market Place.

Eccles.—March 15th. Electricity Committee. 2/500 K.V.A. three-phase transformers. Mr. H. W. Angus, Electricity Works, Cawdor Street, Patricroft.

Edinburgh.—March 29th. Electricity Supply Department. Condensing plant for Portobello station. Specification No. 23. (February 27th.)

March 29th. Town Council. Structural steel for the new electric generating station, Portobello. Sir A. B. W. Kennedy, 17, Victoria Street, Westminster.

France. — PARIS. — March 30th. Two multiple commutator switchboards; one each for the Bureau central téléphonique, of Vienne (départ. Isère), and the Bureau central téléphonique, of Avignon (Depart. Vaucluse). Tenders to the Direction de l'Exploitation téléphonique, 4e Bureau, 103, Rue de Grenelle, Paris.

Gellygaer. — March 21st. Urban District Council. Transformer plant, H.T. and L.T. switchgear, 11,000 V. and 500 V. overhead line material. (February 27th.)

Kettering.—March 26th. Electricity Department. Concentric lead-covered feeder cable and feeder pillars. (See this issue.)

Lincoln. — April 8th. Electricity Department. Pipework, and motor-generator and switchgear for St. Swithin's power station. (March 5th.)

London.—Great Central Railway. March 17th. Stores for 12 months, including electrical line construction, electrical apparatus, wires, cables, lamps, &c. Specifications from Mr. W. Williams, Stores Superintendent, G.C.R., Gorton, Manchester.

Macclesfield.—March 15th. County Asylum. Electrical goods for six months. Mr. W. G. F. Tingay, Clerk.

Manchester. — March 19th. Electricity Committee. Supply and erection, at Dickinson Street generating station, of direct-current switchgear. Mr. F. E. Hughes, Secretary, Electricity Department.

Margate.—March 15th. Town Council. Electric light installation, Municipal Buildings. Borough Surveyor, 13, Grosvenor Place.

Mountain Ash.—March 20th. Urban District Council Electricity Department. Transformer plant. H. and L.T. switchgear, three-core and four-core armoured cables and overhead line equipment. (March 5th.)

New Zealand.—DUNEDIN.—April 26th. City Council. (*a*) electric car bodies; (*b*) car trucks; and (*c*) car equipment. Documents may be consulted by British firms interested, at the Department of Overseas Trade (Development and Intelligence), 35, Old Queen Street, S.W. 1 (Room 49).

April 31st. Auckland Harbour Board. Electric cranes. Mr. R. B. Burnett, Secretary, Quay Street, Auckland.

Plymouth. — March 18th. Electricity Committee. Turbo-alternator, converter and booster. (February 27th.)

South Africa.—April 24th. Oudtshoorn Municipality. Time for receipt of tenders extended from March 24th to April 24th.

Spain.—The municipal authorities of Caldas de Regas have lately invited tenders for the concession for the electric lighting of the town during a period of 15 years.

CLOSED.

Aldershot.—Urban District Council:—

Cables, turbines, &c., £7,658.—Callender's Cable & Construction Co., Ltd.

Belgium.—Tenders were recently invited by the municipal authorities of Villers-le-Peuplier (Province of Liége), for the concession for the electric lighting of the town. Not a single offer was, however, received.

Birmingham.—The Corporation has approved a recommendation of the Tramways Committee that 3,000 tons of tramway rails be purchased from the United States Steel Products Co.

Bradford.—Electricity Committee:—

Metropolitan Vickers Electrical Co., Ltd., one 70 B.H.P. induction motor for fan with starter.
Ruston & Hornsby, Ltd., steam grabbing crane on caterpillar gear, for new coal storage.
Metropolitan Vickers Electrical Co., Ltd., one 500-KW. rotary converter and accessories.
Babcock & Wilcox, Ltd., superheaters for boilers.

Broadstairs.—Urban District Council. Electric light installation, Pierremont Hall:—

Vernon Hill (accepted)	**£208**
E. A. Pinto	200
W. J. Cannon	232
G. M. Willis	215
Thanet Electric Co., Ltd.	250

Glasgow.—Tramways Committee recommended:—

V. I. R. cable.—Liverpool Electric Cable Co., Ltd.
25 tons fishplate bolts.—Ibbotson Bros., Ltd.
Six Ericsson telephones.—M. Breingan.
50 commutators for Witting motors.—P. R. Jackson & Co., Ltd.

The committee considered the following offers for special track work:—

United States Steel Products Co.	£11,291
Hadfields, Ltd.	11,505
E. Allan & Co.	11,590

It was decided that the contract be divided between the two British offerers—Messrs. Hadfields, Ltd., and Messrs. E. Allan & Co.

Clyde Navigation Trustees:—

Electrically-driven de-watering pumps, £27,945.—Worthington-Simpson, Ltd.

Leyton.—Urban District Council:—

Tramway trolley wire (3 miles 48 yards) 1s. 4⅛d.—Fernand Espir, France.

London.—STEPNEY.—Electricity Committee. Accepted. Converter plant at Osborn Street sub-station:—

Two 1,500 KW. converters, £15,186.—Bruce Peebles & Co. recommended. The General Electric Co., Ltd., and Messrs. Siemens Bros. Dynamo Works Co., Ltd., also tendered.

50 tons moulded pitch:—

J. Smart & Co. (accepted)	**£288**
T. Crow & Sons, Ltd.	£346
Burt, Boulton & Haywood, Ltd.	£360

220 yd. 0·5 sq. in. cable:—

Henley's Telegraph Works Co., Ltd. (accepted) ..	**£175**
British Insulated & Helsby Cables, Ltd.	£177
W. T. Glover & Co., Ltd.	£195

The Committee has accepted the offers of Messrs. Blackman & Co. for two barges of Pooley Hall nutty slack, and of Messrs. Foster & Co. for 100 tons Pooley Hall nutty slack at 35s. 9d. per ton.

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The Electricity Committee has received the undermentioned offers for the obsolete steam plant at Osborn Street sub-station :—

G. Cohen, Son & Co.	£1,150
H. H. Gardham & Co., Ltd.	£1,250
H. Base	£1,275
C. Griffiths	£1,315
J. Cashmore	£1,575
H. Hargrave (accepted)	**£1,850**

HACKNEY.—The Electricity Committee reports that the Tudor Accumulator Co., Ltd., has requested the Council to agree to a revision of the contract for maintaining the storage battery, owing to the increased cost of labour and materials :—

The Committee recommends that the contract be amended by the insertion of a clause, whereby the Borough Council agrees to pay at the end of each financial year, in addition to the premium provided for by the agreement, a sum equal to 5 per cent. of the premium for every £1 by which the average of the mean daily quotations of English lead exceed £18 per ton, the increased premium to take effect from April 1st next.

Two additional vertical-spindle circulating pumps, £1,708.—Rees Roturbo Manufacturing Co., Ltd , recommended.

Liverpool.—Corporation. Accepted :—

National Electric Construction Co., Ltd., for the renewal and repair, where necessary, of the permanent way of the Liverpool and Prescot light railway, including rails, points, crossings, according to the specification.

Middlesbrough.—Corporation. Accepted :—

Three miles H.T. cables, £6,870.—British Insulated & Helsby Cables, L'd.

Seven 150-K.V.A. single-phase transformers, £2,080.—Metropolitan-Vickers Electrical Co., Ltd.

12 3,000-volt switches, £1,470.—Metropolitan-Vickers Electrical Co., Ltd.

720 yards ·4 × ·4 × ·15 sq. in. cable, £1,240.—British Insulated & Helsby Cables, Ltd.

Stretford.—Urban District Council. Accepted :—

5,000-KW. Westinghouse turbine, complete with condensers and accessories, £35,210.—Metropolitan-Vickers Electrical Co., Ltd.

Wolverhampton.—Corporation. Accepted :—

Three 300-K.V.A. transformers, £1,617; three 100-K.V.A. transformers, £762. —Brush Electrical Engineering Co.

York.—The Corporation received six tenders for the equipment of the power house at the proposed hydro-electric works at Linton Docks, ranging from £52.331 to £107,388. The Electricity Committee has recommended the acceptance of the lowest, a composite one from Messrs. Vickers, Ltd.. and Timothy Patrick. The turbines specified in this tender are of the high velocity type and considerably smaller than those quoted for in the next lowest tender, that of the English Electric Co., £64,685. Of the eight tenders received for the necessary cable, ranging from £8,807 to £9,950, the committee recommended the acceptance of the lowest, sent in by Messrs. Vickers, Ltd.

FORTHCOMING EVENTS.

International Motor Boat and Marine and Stationary Engine Exhibition at Olympia.—March 12th to 20th. 11 a.m. to 9 p m.

Royal Institution of Great Britain.—Saturday, March 13th. At Albemarle Street, W. At 3 p.m. Lecture on "Positive Rays," by Sir J. J. Thomson, F.R.S.

Salford Technical and Engineering Association.—Saturday, March 13th. At the Royal Technical Institute. At 7 p.m. Informal talk on "Machine Tools, Ancient and Modern," by Mr. T. R. Shaw.

Birmingham and District Electric Club.—Saturday, March 13 h. At the Grand Hotel, Colmore Row. At 7 p m. Paper on "Advertising in the Engineering Industries," by Mr. W. E. Warrilow.

Chief Technical Assistants' Association.—Tuesday, March 16th. At Anderton's Hotel, Fleet Street, E.C. At 7 p.m. Annual general meeting. Adjourned discussion on Messrs. Bowden and Ingram's paper on "The Design and Equipment of Sub-Stations."

Institution of Civil Engineers.—Tuesday, March 16th. At Gt. George Street, S.W. At 5.30 p.m. Lantern exhibition of views taken throughout the war areas in France and Flanders, by Sir A. B. W. Kennedy, F.R.S.

Royal Society of Arts.—Wednesday, March 17th. At John Street, Adelphi, W.C. At 4.30 p.m. Paper on "Street Passenger Transport of London," by Mr. W. W. Beaumont.

Paisley Association of Electrical Engineers.—Wednesday, March 17th. At 7.30 p.m. At the Y.M.C.A., High Street. Open meeting for discussion.

Belfast Association of Engineers.—Thursday, March 18th. At the Municipal Technical Institute. At 7.45 p.m. Paper on "Deve opment of the Belfast Harbour," by Mr. T. S. Gilbert.

Institution of Electrical Engineers.—Thursday, March 18th. At the Institution of Civil Engineers, Great George Street, S.W. At 6 p.m. Adjourned discussion on papers read on March 11th.

Informal meeting. Monday, March 15th. At the Institute of Patent Agents, Staple Inn Buildings, W.C. At 7 p.m. Paper on "Industrial Electric Heating," by Messrs. J. W. Beauchamp and S. M. Hills.

(Liverpool Sub-Centre.)—Monday, March 15th. At the University, Liverpool. At 7 p.m. Paper on "The Application of the Electric Locomotive to Main-line Traction on Railways," by Lieut.-Col. H. E. O'Brien.

(South-Midland Centre.)—Wednesday, March 17th. At the University, Birmingham. Paper on "The Protection of Alternating Current Distribution Systems Without the Use of Special Conductors," by Major K. Edgcumbe, R.E.

(Wireless Sectional Meeting).—Wednesday, March 17th. At the Institution of Civil Engineers, Great George Street, S.W. At 6 p.m. Paper on "Duplex Wireless Telephony: Some Experiments on its Application to Aircraft," by Capt. P. P. Eckersley.

Chemical Society—Thursday, March 18th. At Burlington House, Piccadilly, W. At 8 p m. Ordinary scientific meeting.

Junior Institution of Engineers.—Friday, March 19th. At 39, Victoria Street, S.W. At 7.30 p.m. Paper on "Shipbuilding and Shipping Developments in Italy," by Mr. W. H. F. Robbs.

Electro-Harmonic Society.—Friday, March 19th. At the Holborn Restaurant (Venetian Chamber). At 8 p.m. Smoking concert.

Association of Engineering and Shipbuilding Draughtsmen.—Friday, March 19th. At the Y.M.C.A., Bothwell Street, Glasgow. At 8 p m. Lecture on "Oil Tankers," by Mr. C. R. H. Bonn. At Sheffield University. At 7.30 p.m. Lecture on "Some Steam Economies," by Mr. G. Rowe.

Institution of Mechanical Engineers.—Friday, March 19th. At the Institution, Storey's Gate, Westminster, S.W. At 6 p.m. Paper on "Exact Data on the Performance of Mechanical Stokers, as applied to "Lancashire" or other narrow-flued Boilers," by Mr. D. Brownlie.

NOTES.

The Isaacs-Norman Controversy.—Further correspondence in connection with this matter has been published. Mr. Godfrey Isaacs on January 5th informed the Premier that in view of the letters written by Sir Henry Norman, contrasted with his statements in the House of Commons, and in the case of Isaacs *v.* Hobhouse, he protested against the appointment of Sir Henry as chairman of the Sub-Committee on Imperial Wireless Communications which was set up by the Imperial Communications Committee in November last. Mr. Lloyd George replied on March 3rd that Sir Henry Norman would not resign his chairmanship. Mr. Isaacs informed the secretary of the Imperial Communications Committee on the same date that he could not depute a representative of the Marconi Co. to appear before the Committee so long as Sir Henry Norman was chairman, and the Committee passed a resolution of confidence in the impartiality of the chairman.

Mr. Isaacs, however, sent the Sub-Committee a copy of a memorandum of the scheme which his company recommended, and which it had offered to the Government to carry out.

A long letter from Sir Henry Norman to the Prime Minister was published in the *Times* of March 5th.

Electrical Trades Benevolent Institution.—The profit on the reception, supper and dance which was held in Newcastle on December 12th last, has resulted in a contribution being sent to the funds of this Institution of £50. This is in addition to what was collected as subscriptions and donations by the Organising Committee, which is to be much congratulated on its success.

Electricity Outpaced.—From the *Electrical Power Engineer* :—The following letter was received by a supply undertaking in the North-East Division. It requires no comments.

Mr.—— 41, Church Street,
Pork Butcher, December 7th, 1919.

Dear Sir,

Enclosed please find cheque for £5 as my contribution towards laying caule to 41, Church Street, and I hope your men will appear as quick as the invoice as (*sic.*) I understand electricity is very quick, but this invoice leaves it stood still, but apart from joking, I hope you will try and get me fixed up this next week.

Yours truly,

Imperial Wireless Communication.—Whilst going to press, we have received from Messrs. Marconi's Wireless Telegraph Co. a copy of the memorandum submitted by the company to the Sub-Committee dealing with Imperial Wireless Communications, and of the terms upon which the proposal is submitted. The scheme provides for communication throughout the Empire, independent of submarine cables and land lines (except at terminals), with alternative routes, and automatic transmission at not less than 100 words per minute. with duplex working, and contemplates the admission of foreign traffic, in order that the system may be commercially self-supporting.

The scheme is based upon the establishment of "main trunk" long-distance stations, and "main feeder" transmitting stations, operated from a central control office in each area, and "local feeder" stations, and the use of continuous, or "undamped," waves throughout; the abolition of the timed spark and the arc generator in favour of the high-frequency alternator and the valve; and the use of the Franklin aerial, which, it is claimed, represents "such enormous improvement over previous methods as regards selectivity and avoidance of atmospheric disturbance" that no other system need be considered—with it, signals can be received only from one direction. The concentration of staff at a central control office saves an enormous amount of time and labour; retransmission is entirely eliminated.

Seven trunk routes are suggested, requiring 26 main trunk stations, but roughly it is estimated that 30 main trunk stations. 50 main feeder stations, 100 local feeder stations, and 200 small local stations will be needed.

On this basis the organisation is founded, and maps and tables of personnel (amounting in all to 17,170) are given.

The company offers to construct, maintain, and operate at its own cost the complete network, paying annually to each Government 25 per cent. of the net profits locally earned; the trunk stations to be completed in three years, and the whole system to become the property of the Governments concerned in 30 years, free of cost. The right of purchase at any earlier date is provided for. The company asks for no monopoly.

It is a truly remarkable proposal, and we shall deal with it more fully next week.

X-Ray Research.—The Senate of the University of London on February 25th instituted a Chair of Radiology at the Middlesex Hospital, to commemorate the work and sacrifice of the late Mr. C. R. C. Lyster. It is hoped that the new Professor of Radiology will share in developing new methods of diagnosis and treatment of disease, especially with regard to cancer.—*The Times.*

As a permanent memorial to the late Sir James Mackenzie Davidson, who did valuable work in connection with radiology, it is proposed to create an institution for teaching and research. The appeal for funds points out that a diploma in radiology and electrology at Cambridge University has been established, and its success will be greatly assured if similar facilities are provided in London. Contributions should be sent to Dr. Robert Knox, 38, Harley Street, London W. 1.

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The Stalybridge Dispute.—A circular recently published by the E.P.E.A. gives a *résumé* of the proceedings which have taken place between the Association and the Stalybridge, Hyde, Mossley, and Dukinfield Tramways and Electricity Board. This circular, together with correspondence, has been placed before the recently-formed National Joint Board of Employers and Members of Staffs (Electricity Supply Industry), by the following letter :—

"The E.P.E.A. submit this matter to the consideration of the National Joint Board, for the reason that the Stalybridge Joint Board have refused to hear any evidence on behalf of the men concerned.

"A brief statement of the facts of the case is given in the printed circular attached herewith, and recent events are enumerated in the following correspondence :—

"From the above correspondence it will be seen that the Stalybridge Joint Board are adamant in their determination not to hear any evidence on behalf of the men concerned, neither have the Board, the courage, to submit their case to the judgment of an independent tribunal.

"We submit that this attitude is not only contrary to the spirit of the times, but it is distinctly inimical to this undertaking in particular, and the electricity supply industry.

"We would urge that the National Joint Board should support us in our request to the Ministry of Labour for an inquiry under the Industrial Courts Act, 1919."

The correspondence referred to consists of letters from the Stalybridge engineer-in-chief to the Ministry of Labour, stating that the E.P.E.A. had refused arbitration for its members, and also that since the latter had left a complete new staff had been engaged, and was giving satisfaction ; from the secretary of the E.P.E.A. to the Ministry of Labour stating that the Association had not refused arbitration, and pressing for an inquiry under the Industrial Courts Act. This letter further states that in spite of the Stalybridge engineer's assertions, interruptions of the supply occur almost daily ; from the E.P.E.A. to the Ministry of Labour reporting the refusal of the Stalybridge Board to hear evidence on behalf of the men, and reaffirming the request for an inquiry ; from the Stalybridge Board to the E.P.E.A. stating that arbitration having been refused by the Association, the Board considered the matter closed, and were not prepared to enter into further discussion. Arising out of this dispute is the case of a member of the E.P.E.A., who, in spite of his knowledge of the break between the Association and the Stalybridge Board, has accepted an appointment under the latter as a charge engineer. He has, therefore, been expelled from the Association for what is considered very disloyal action upon the part of a member of a protective association.

Electricity and Oranges.—The American *Electrical Review*, in a recent issue, gave some interesting details of the part played by electricity in the orange-growing industry of Southern California. By means of electrically-driven centrifugal pumps wide areas, formerly arid pasture land, have been rendered suitable for the successful growing of oranges and similar fruits. Electricity for this purpose is generated by the harnessing of mountain torrents. When the fruit is picked, electric washers are employed to clean it. Then it is sorted, packed, and labelled, also electrically, even the boxes being made by this means.

Educational.—University College, London.—Prince Arthur of Connaught will preside, on March 19th, at a luncheon to be held at the Savoy Hotel, when the proposals for the reconstruction and re-equipment of the engineering laboratories at University College will be explained by the treasurer, Sir Ernest Moir, and others. An appeal for £100,000 towards this object was recently issued, and already over £33,000 has been collected. Further donations should be sent to Prince Arthur of Connaught, at 42, Upper Grosvenor Street. *The Times* states that a number of engineering firms have recently sent donations, including Messrs. Babcock & Wilcox, Ltd., £500 ; the City of London Electric Light Co. and the St. James's and Pall Mall Electric Light Co., £250 each ; and Rolls-Royce, Ltd., and the Sunbeam Motor-Car Co., Ltd., £100 each.

Freemasonry.—Nearly 50 members of the Kelvin Lodge of Instruction gathered together at the annual supper at the Restaurant de Boulogne, Gerrard Street, on Friday, the 5th inst., when Mr. J. O. Pearston, the genial Preceptor, occupied the chair, supported by Mr. T. W. Greaves, the W.M. of the Mother Lodge. After the supper, there was an excellent musical entertainment provided by Messrs. Victor Holliday, Sandiford, Buck, Jones, Porter-Cox and other gentlemen, and altogether all present spent a very happy evening.

The English Glass Industry.—With regard to the remarkable revival of the English glass trade, a correspondent points out that it was in the manufacture of electric lamp bulbs that the greatest progress was made, and that it was this section of the industry that first reached the position of being able not only to satisfy home requirements, but also to provide a surplus for export. This satisfactory state of affairs was due to the introduction of machinery from America, without which the output would have been quite impossible. Before the war production by machinery in this country was restricted under an arrangement with the manufacturers of several Continental countries, who combined to purchase the European rights of the Owen machine. That arrangement has come to an end, and our own manufacturers, in addition to the Owen machine, have now acquired two other American machines—the Empire and the Westlake. During the last few weeks the latter machine, which requires only a mechanic and two boys to attend to it, produced in an eight-hour shift at Leamington-on-Tyne 24,000 articles for illuminating purposes, while under the old glass-blowing system the weekly output of 180 men was only 500,000. These figures give some idea of the great production of electric lamp bulbs in this country at the present time. The initial difficulties of the machines have now been overcome, and the goods produced are of excellent quality. The peculiarity which will be noticed in the machine-made bulb is the absence of the little glass tip. This tip was made by the workman in closing the exhausted bulb, but the machine rounds off the articles beautifully.

Two a.m.—A Switchman's Soliloquy.—

Is't a voltmeter, which I see before me,
The pointer off the scale ? Let me adjust thee :—
I harmed thee not, and yet thou treat'st me ill.
Art thou not, cursed gadget, sensible
To pity, as to load ? or art thou but
A phantom of the night ; a quaint mirage
Proceeding from my sleep-befuddled brain ?
I see thee yet, and now thy finger's poised
Below the zero mark.
Thou mak'st me sweat with fear of my undoing,
And visions of "the sack" curdle my veins.
Mine eyes but make a mock o' the sober reason,
Or else I'm half asleep ; I see thee still ;
And now methinks thou standest on thy head,
Which was not so before.—I do but dream ;
It is th' infernal nightshift, which distorts
Thus commonsense.—Now in the engine room
Some are abed, and snoring loud betrays
The secret sleep ; now others celebrate
With tea and sandwich ; and th' Engineer,
Alarumed by his sentinel, instinct,
Halts in his stride ; then, cursing loud and deep,
With vengeance in his eye, scenting a "cop,"
Moves like a ghost.—Thou slow and laggard clock,
Get thee a move on, and thou canst, for fear
The very log prate of thy sluggishness.
What evil have I done thee then, that thus
Thou driv'st me crazy ? Whiles I fume and sigh,
I think of those who comfortably lie
Safe tucked in bed.—Would that such lot were mine.
(*A bell rings.*)
"Yes, switchman speaking !" "Volts are down ?"
"Asleep ?"
Some one seems dubious of the watch I keep.
'Tis only two a.m.—ye gods, this life of joy—
I think I'll go and be a farmer's boy.

W. H. S., in the *Electrical Power Engineer*.

Representation of Staff Members on Joint Boards.—The *Electrical Power Engineer* in a recent issue states :—"The preliminary Conference called for the purpose of forming a National Industrial Council for the Electricity Supply Industry was held in June, 1918.

"The E.P.E.A., representing the technical engineers on the staffs, were represented at this Conference, but opposition to such representation came from the manual workers' Unions.

"At this period the E.P.E.A. were holding conferences with the representatives of the employers in different parts of the country on the matter of basic rates of remuneration for staff engineers, and had also made a definite claim for a war advance.

"After considerable negotiation at a Conference held on December 12th, 1919, between a Committee of Employers and representatives of the E.P.E.A., it was agreed to form a National Joint Board of Employers and Members of Staffs (Electricity Supply Industry).

"This National Board will deal with all matters connected with the staff members of the Electricity Supply Industry, and will consist of 12 representatives on each side, of the Associations representing the employers and the staffs in the Electricity Supply Industry.

"Sectional Committees are being formed to deal with the affairs of particular sections of the staff, and one such committee consisting of four employers' representatives and four representatives from the E.P.E.A., has been formed to consider a schedule of salaries put forward by the E.P.E.A.

"It is gratifying to record that since the above was written, the Ministry of Labour has officially recognised the joint board, and that already two meetings of the committee have been held, to discuss the salaries schedule."

Appointments Vacant.—Telegraph sub-engineer (£200 + £60). for the Posts and Telegraphs Department, Tanganyika Territory ; assistant electrical engineer (£300 + war bonus), for the Dar-es-Salaam electric power plant ; shift engineer (94s. 6d.), for the Glasgow Corporation Electricity Department ; fitter (84s.), for the Borough of Tunbridge Wells Electricity Works ; draughtsman for the Greenock Corporation Electricity Department ; mains engineer (£350), for the City of Coventry Electricity Department ; assistant charge engineer (£354), for the Carville Power Station ; lectureships in mechanical and electrical engineering (£380 + war allowance), for the Birmingham Municipal Technical School ; mains engineer (£250), for the Borough of Torquay Electricity Department ; works superintendent (£300), for the Nelson Corporation Electricity Department ; assistant mains engineer (87s. plus E.P.E.A. awards to date ; plumber-jointer (98s. 3d.), meter fixer (80s. 7d.), for the Stepney Borough Council Electricity Works. See our advertisement pages to-day.

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Lighting Conditions in Mines.—In a paper on lighting conditions in mines, with special reference to the eyesight of miners, read by Dr. T. Lister Llewellyn before the Illuminating Engineering Society, on February 24th, the subject of the occurrence of miner's nystagmus was considered. Dr. Llewellyn condemned the miner's oil lamp as extremely inefficient; the lighting at the working face is not only bad, but it also falls off seriously towards the end of the shift, and figures show that such poor illumination very seriously affects miners' eyesight. Oil lamps, when tested, showed a power of 0·50 Hefner unit at the beginning of the shift, deteriorating to 0·28 at the end, compared with electric lamps showing 1·75 units to 2 units at the start, and 1·5 units to 1·75 units at the end. Acetylene lamps showed no deterioration. The effect of this on eyesight is reflected in the following statistics. With oil lamps the number of grave cases of nystagmus per 10,000 was 35, and of serious cases 57. The number of cases as a percentage of the workers on day shift was 31. This percentage was reduced in the case of electric lamps to 15·4, of which the grave cases were only 8 per 10,000. Evidence showed that the introduction of the electric lamp had enabled scores of miners to continue at work underground. In two similar pits, after electric lamps had been introduced into one of them the cases of nystagmus had been greatly reduced in the pit which had adopted electric lamps of 0·62 C.P., compared with oil lamps of 0·25 C.P. These lamps gave respectively 0·023 ft.-candle and 0·015 ft.-candle at the face. The men with electric lamps turned out 5 per cent. more than those with oil lamps, while the shifts lost from accident were 1 in 54 with the electric lamps against 1 in 23 for the oil lamps. The cost of an oil lamp was put at 3½d. per week, while the electric lamp was said to cost ½d. to 1d. more, though figures were given claiming it to be actually cheaper at some collieries. The electric lamp was more expensive as regarded first cost. In a contribution to the discussion, Mr. Elworthy pointed out that it was the light reflected from the coal face which affected the miner. To give relief it had been suggested to colour-wash the roof, &c., and where this had been experimentally attempted considerable relief had been experienced.

The Cost of Petrol.—The Automobile Association and Motor Union is organising a petition to the Prime Minister, urging that legislation shall be at once introduced to ensure the immediate production of benzole and power alcohol in large quantities. Everyone is directly affected by the price of motor fuel, and we earnestly commend the petition to the attention of our readers. Particulars can be obtained from the Secretary of the Association, Fanum House, Whitcomb Street, London, W.C. 2.

Electro-Harmonic Society.—The last smoking concert of the season will be held at the Holborn Restaurant, in the Venetian Chamber, on Friday, March 19th, commencing at 8 p.m. Chairman, Mr. Hugo Hirst. Artistes:—Mr. John Collett, tenor; Mr. Robert Howe, baritone; Mr. Spencer Dyke, violin; Mr. Louis Nikola, magician-entertainer; Mr. J. M. Campbell, Scotch humorist; Mr. Will Bentley, humorist; Mr. Norman Long, entertainer at the piano; Mr. Bernard Flanders, A.R.A.M., pianoforte solo and accompanist.

INSTITUTION NOTES.

Institution of Electrical Engineers.—On Thursday, last week, the annual dinner of the Institution was held at the Connaught Rooms, Kingsway, London; Mr. Roger T. Smith, president, was in the chair, and there was a record attendance of 410 members and guests. The guests of the Institution included the Dean of Westminster, General Sir C. F. N. Macready, Rear-Admiral Sir W. C. M. Nicholson, Sir Sidney Chapman, Sir Gregory Foster, Sir G. E. P. Murray, Lieut.-Col. Sir F. Younghusband, Major-Gen. G. D. Jeffreys, Col. O. C. Armstrong, Dr. S. Russ, Sir Frank Heath, Prof. W. H. Bragg, Sir Chas. Parsons, Rear-Admiral F. L. Field, Capt. A. K. Waistell, Prof. J. E. Petavel, Messrs. S. C. Aldington, W. W. Lackie, Stanley Machin, W. Noble, A. P. Trotter, H. A. Payne H. Booth, E. Guy Dauber, A. Page, T. Roles, H. F. Carlill, G. C. Lloyd, C. D. le Maistre, John Gray, E. Raven, G. W. Humphreys, and A. Hurst; and among the members present were Messrs. W. M. Mordey, Ll. B. Atkinson, G. W. Partridge, J. S. Highfield, J. Devonshire, Dr. W. H. Eccles, Capt. H. Riall Sankey, Messrs. S. E. Fedden, P. D. Duckett, H. J. Cash, J. Sayers, A. Carpmael, W. M. Selvey, D. N. Dunlop, C. T. Allan, C. H. Wordingham, Col. H. C. Sparks, Dr. C. C. Garrard, Messrs. A. P. M. Fleming, C. C. Paterson, B. Welbourn, H. W. Clothier, P. R. Allen, and Mr. P. F. Rowell, secretary.

During the evening messages of greeting were read by the president from the sister societies in Italy and the United States.

After the loyal toasts had been honoured, Sir Gregory Foster proposed "The Institution of Electrical Engineers," pointing out that it dated its origin from the year 1871, a year big with the world's destiny, of which we had learnt the fruits during the past five years. After making the welcome announcement that Prof. Fleming was recovering from his recent illness, he referred to the wonderful record of electricity, which he attributed in great part to co-operative industry and team work, and emphasised the need for the better organisation of research in this country, which the Government had recognised by the establishment of the Department of Scientific and Industrial Research during the war.

The President, responding, said that scientific training was of the first importance to the electrical industry, and drew attention to the scheme for the rebuilding and re-equipment of the engineering department at University College, London. The Institution this month, he said, would attain a membership of 8,800, which was greater than that of any other engineering society in this country; and next year it would celebrate its fiftieth birthday. Welcoming the newly-appointed Electricity Commissioners (of whom the chairman, Sir John Snell, was, unfortunately, prevented from attending the dinner), Mr. Smith expressed the hope that the Institution would be able to assist in carrying out the provisions of the Electricity Supply Act, and that its administration would bring about the benefits intended—an abundant and *cheap* supply of electrical energy. In the recent history of the Institution, the most interesting feature was the decentralisation of some of its activities by the formation of Territorial Centres and Sub-Centres, of which there were now 12 in all, in addition to the Centres abroad—a natural development which was wholly beneficial. The parent body in London was delighted with the vigour and enthusiasm of these local bodies; happy in the stored traditions of half a century, it was amused at the suggestion that London should become a Centre—there were 3,000 members within its radius, equal to the whole of the Centres and Sub-Centres put together. Centres cost money, and when the Institution returned to its home, the great difficulty that would at once arise would be a financial one. Outside the Institution, the essential need was industrial peace, and the key to that, he believed, was "service"; until the idea of service replaced that of self-interest, there would never be peace in this country.

Mr. Ll. B. Atkinson, proposing "The Guests," and referring to their respective claims to distinction, laid stress on the supreme importance of industrial research, and stated that the industrial association formed by the Institution and the B.E.A.M.A. was approaching the stage of recognition by the Research Department. The whole industry was unanimous in approving of the establishment of a Board of Electricity Commissioners to guide the Government and assist the industry; welcoming the Commissioners who were present, he said that the Board would command the confidence of electrical men, and that if mistakes were made, they would be due not to the advice that was given, but to the perversity of politicians. The Overseas Department was doing very useful work, though it had started at an unfortunate time, when the home markets fully occupied the attention of manufacturers; it also had to live down a past of Foreign Office contempt of traders. The Board of Trade also had to live down a past, so far as trade was concerned; it had looked after trade, indeed, but any kind of trade—what they were interested in was British trade, not that of their competitors, and the Board of Trade, in the past, had sought to encourage imports, leaving the rate of exchange to look after the exports. Lenin had advocated wholesale electrification in Russia on the Soviet principle; if capitalists had not been extirpated in this country, many of them had extirpated their capital.

Responding, General Sir C. F. N. Macready said that it was necessary for all citizens to come forward in times of stress and do their bit; men who were not technically trained should join the special constabulary. He referred to the fact that 2,000 members of the Institution had been engaged in war service, and that their late president had been called in to assist in reorganising the Royal Engineers.

Lieut.-Col. Sir F. Younghusband also replied on behalf of the guests.

The members then adjourned to the reception room, according to custom, for a reunion. During the evening a programme of music was performed by the British Imperial Orchestra, and the arrangements were in every way conducive to the success of this, the most important annual function of the Institution.

Institute of Metals.—The report of the Council for the year ended December 31st, 1919, presented at the twelfth annual general meeting on March 11th, announces that the membership has reached a total of 1,213. The death of Sir William Crookes, O.M., F.R.S., an honorary member of the Institute, is mentioned. The body of the report is devoted to the proceedings, &c., of Special Committees. A deficit of £470 on the year is estimated, and an increased subscription is considered necessary.

Physical Society of London.—At the meeting held on February 27th, a paper, entitled "Notes on the Testing of Bars of Magnet Steel," by Dr. N. W. MacLachlan, was read. The paper described the results of experiments with the Ewing double permeameter. It was shown that the assumption underlying the theory of the method—viz., that the end effects were the same with the long and short bars—was not justified, and that the value of H, as found by calculation on this assumption, was in error. The error did not, however, exceed 1 per cent. for any of the bars tested; but the author concluded that the method was inferior as regarded accuracy and convenience to the differential coil method.

Institution of Civil Engineers.—The following series of meetings has been arranged, with a view to placing before the Institution some account of the engineering work done in the war, and the part taken by civil engineers therein:—Tuesday, March 9th, "Royal Engineer Work in the Great War," by Major-General Sir G. W. Heath, K.C.M.G., &c. (late Engineer-in-Chief of the British Armies in France). Tuesday, March 16th, lantern exhibition of views taken throughout the war areas in France and Flanders by Sir Alex. B. W. Kennedy, LL.D., F.R.S. Tuesday, March 23rd, "The Work Done by Railway Troops in France during 1914-19," by Colonel David Lyell, C.M.G., &c. Tuesday, April 13th, "Richborough Military Transportation Depôt," by Lieut.-Colonel J. Ker-Robertson, and "The War Department Cross-Channel Train-

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Ferry," by Major F. O. Stanford, O.B.E. Royal Engineer officers and ex-officers will be welcomed at these meetings, and cards of invitation will be issued to them on application to the secretary.

The twenty-sixth "James Forrest" lecture will be delivered at the Institution on April 20th, at 5.30 p.m., by Sir Dugald Clerk, K.B.E., F.R.S., M.Inst.C.E., the subject being "Fuel Conservation in the United Kingdom."

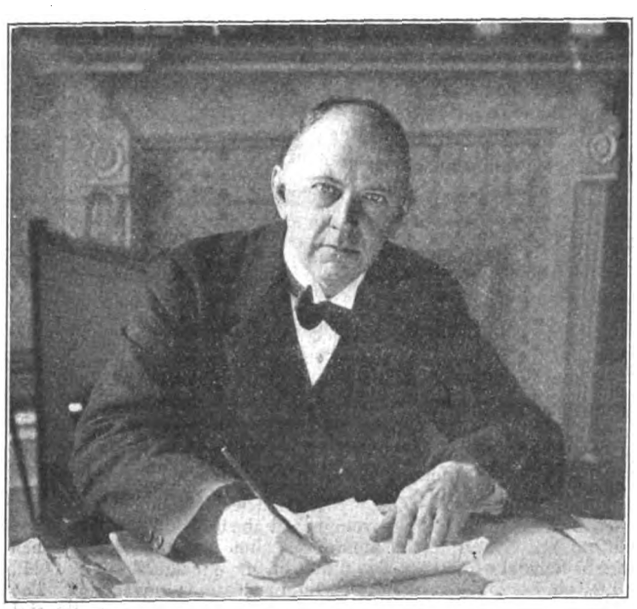
Birmingham University.—The value of X-rays in the examination of metals to detect flaws was dealt with by Major J. Hall-Edwards, in a lecture at Birmingham University on March 2nd. Blow-holes and cracks, he said, had been detected in aluminium, steel, and iron up to 6 in. in thickness, and in strips and castings of brass and copper up to 1 in. thick. Captain Knox and Major Kaye had done excellent work in the examination of timber, and X-rays had been used with great success in the examination of car and cycle tires. Another important application of the rays to practical engineering was the examination of ferro-concrete.

Junior Institution of Engineers.—At a meeting of the Institution held in London on February 20th, a lecture on "Some Obscure Points in the Theory of the Internal Combustion Engine" was delivered by Prof. F. W. Burstall, M.Sc., M.A.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

THE ELECTRICITY COMMISSIONERS.—With the appointment of Sir HARRY HAWARD, whose portrait is given herewith, the Board of Electricity Commissioners is completed; now the word is "Full steam ahead!" Sir Harry Haward, as Comptroller since 1893 of the London County Council, in whose service he has been for over 38 years, has acquired that knowledge of affairs which qualifies him to assist the engineer Commissioners in connection with



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SIR HARRY HAWARD.

legal, commercial, and financial questions. In a report of the General Purposes Committee, just issued, his merits are eulogised, and the greatest regret is expressed at his leaving the Council's service, to enter a wider sphere of usefulness. The committee recommends that he be granted a retiring allowance of £1,206 a year, to commence on his leaving the Government service after attaining the age of 60 years. He will take up his duties on April 1st.

The Birkenhead T.C. is recommended to increase the salary of the electrical engineer, Mr. G. P. SHALLCROSS, from £500 to £600 a year, as from February 1st.

Subject to his agreeing to stay with the Corporation for three years, the salary of Mr. OWEN, electrical engineer to the Wigan Corporation, has been increased from £650 to £850 per year, with house, fuel and light, from April 1st next, this to be increased to £1,000 per annum a year later.

Sir AUCKLAND GEDDES, having been appointed British Ambassador to Washington, will not return to McGill University. A *Times* dispatch says the governors intend, if possible, to secure a Canadian as Principal.

Mr. C. G. D. JACKSON, general manager's assistant of the Liverpool Corporation tramways, has been appointed assistant general manager, and Mr. H. I. PALMER, chief traffic superintendent, to take full charge of the traffic department.

Mr. J. H. STORRIE, district manager for the York district of the Post Office telephones, has been transferred to Aberdeen.

Mr. D. J. BARNES has been appointed district manager of the York Post Office telephones. He has held a similar position at Blackburn. Mr. Barnes entered the service of the National Telephone Co., Ltd., in 1887.

Mr. E. F. W. ALEXANDERSON, consulting engineer of the American General Electric Co., has recently been the recipient of two marks of appreciation for the services rendered by him in radio research. He has been elected chief engineer of the recently formed Radio Corporation of America, and in addition has been awarded a gold medal by the Institute of Radio Engineers, of which he is a vice-president. Mr. Alexanderson is the inventor of a great deal of wireless apparatus, including a high frequency alternator, a magnetic amplifier, multiple-tuned antennæ, and a barrage receiver all of which are to be used in the 16 stations to be installed by the Radio Corporation in its comprehensive scheme.

Mr. E. P. BENNETT now holds the position of secretary and sales manager to Messrs. Simplex Conduits, Ltd., Garrison Lane, Birmingham. Mr. Bennett has held a number of positions in the company, including that of manager for Liverpool and also for London and the South of England. He has had a long experience in the electrical business, both in England and America, and was connected with well-known contractors in London and the provinces prior to joining the Simplex Co. During the war Mr. Bennett held a technical commission in the R.A.F. Immediately after the conclusion of hostilities he undertook an extended tour, covering most of the European countries, studying the possibilities of the markets for electrical commodities. His observations relating to Switzerland and Italy were published in the ELECTRICAL REVIEW last year.

The Accrington Corporation has decided to apply the civil service arbitration award to the tramways manager and the electrical engineer.

The Southwark Borough Council is increasing the salary of the electrical engineer from £400 to £745 per annum.

Mr. W. W. FIRTH, mains superintendent, Dewsbury Corporation electricity department, has been presented by the staff with a mahogany plant-stand and a pair of vases on the occasion of his marriage.

The Glasgow Tramways Committee recommends that Mr. G. C. BRAID be appointed deputy chief engineer, at £800 per annum, inclusive of all bonuses (present salary £503 inclusive), and that Mr. J. MACDONALD be appointed chief electrical assistant, at £500 per annum, inclusive of all bonuses (present salary £347 inclusive).

Mr. A. P. TROTTER, of Messrs. Handcock, Dykes & Trotter, is retiring from the firm as from March 25th, but will continue to give attention to his special subjects in engineering and science from his new address, Greystones, Teffont, Salisbury, Wilts.

Mr. H. W. WOODCOCK, late of the Rotherham Corporation Electricity Supply Department, has been appointed assistant engineer to the River Plate Electric Co. at their works at La Plata, Argentine. There were 70 applicants.

Owing to the continued ill-health of Mr. DOUGLAS A. BROWN, consequent on his service in the East during the war, he has been ordered by the doctor to live abroad for some years, and the partnership between Mr. Harold Couzens and himself (Couzens & Brown) has accordingly been dissolved. Mr. Harold Couzens will continue to carry on the practice at 9, Old Queen Street as heretofore.

Obituary.—PROF. H. S. CARHART.—We regret to record the death, at Pasadena, California, on February 12th, of Prof. Henry Smith Carhart, of the California Institute of Technology. He was ill for only a few hours, and the cause of death was cerebral hemorrhage. Prof. Carhart, who was 76 years of age, went from Harvard in 1881 to the University of Berlin, where he did research work in the laboratory of Prof. von Helmholtz. In 1893 he was chosen by the International Electrical Congress as one of a commission of three to formulate the details of the standard Clark cell. In 1886 he became professor of physics at Michigan University. He later became an expert of world repute on voltaic cells, and in recognition of his eminence in this particular direction he was made president of the American Electrochemical Society. He was a member of the International Jury of Awards at the Paris Exhibition of 1881, and was also a judge at subsequent great exhibitions at Chicago, &c. He was U.S. delegate at the Electrical Units Conferences at Berlin in 1905 and in London in 1908. He was a well-known author of books on physics. Dr. Carhart designed and established the first Physical Laboratory, and later developed the electrical engineering department at the State University of Michigan, where he was Professor of Physics until his retirement therefrom. He was well known in this country, where he took a very prominent part in scientific public life. A correspondent writes: "He was a man of a very lovable disposition that endeared him to all who had the pleasure of his acquaintance."

MR. C. G. GUMPEL.—We regret to record the death, which occurred on March 5th, at Beckenham, of Mr. Carl Godfrey Gumpel, who was formerly well known in the electrical industry.

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NEW COMPANIES REGISTERED.

Rashleigh Phipps & Co., Ltd.—Correction: For W. A. Edelstein (see Elec. Rev., March 5th, p. 309) read W. A. Edelsten. All the directors of the company are British.

Read & Partners, Ltd. (164,776).—Private company. Registered March 3rd. Capital, £20,000 in £1 shares (10,000 preferred). To carry on the business of consulting, electrical, mechanical, gas, hydraulic, sanitary, and general engineers, &c. The subscribers are: H. J. Read, Lismore, Alma Road, St. Albans, electrical engineer; H. J. Butcher, 66, Broomfield Avenue, Palmer's Green, N.13, electrical engineer. The first directors are: H. J. Read (chairman), H. J. Butcher, W. J. Bransom, and D. Dunham. Qualification £500. Registered office: 71, Caversham Road, Reading.

Bourne End and District Electricity Corporation, Ltd. (164,689).—Private company. Registered March 2nd. Capital, £50,000 in £1 shares. To take over the business of the Bourne End Electric Installation Co., Ltd., and the business of a supplier of electric light and energy lately carried on at Bourne End by T. G. Lunnon, to acquire certain property for extending the said businesses, to adopt an agreement with H. S. Dennington, &c. The subscribers (each with one share) are: R. S. Taylor, 14, Cavendish Mansions, Portland Place, W., manufacturer; E. W. Lean, 1, Whitehall, Ray Park Avenue, Maidenhead, C.A. The first directors are: R. S. Taylor, E. W. Lean, and H. S. Dennington. H. S. Dennington may retain office while holding £10,000 shares. Solicitors: A. E. & G. Tooth, 37, Lincolns Inn Fields, W.C.

A.B.C. Manufacturing Co., Ltd. (10,993).—Private company. Registered in Edinburgh February 26th. Capital, £5,000 in £1 shares. To carry on the business of electrical, mechanical, and motor engineers, iron and brass founders, tinplate makers, &c. The subscribers (each with one share) are: J. Anderson, 144, Kenilworth Avenue, Shawlands, Glasgow, contractor; A. B. Campbell, 302, Cross Road, Glasgow, engineer. The first directors are: J. Anderson, A. M. Anderson, 121, York Drive, Hyndland Glasgow; J. J. Christoe, Balgownie, Westwood Avenue, Giffnock; and J. W. Lynhurst, 52, Linn Terrace, Muirend, Cathcart, Glasgow. Qualification £100. Registered office: 14, Douglas Street, Glasgow.

Electrical & General Sundries, Ltd. (164,619).—Private company. Registered February 28th. Capital, £500 in £1 shares. To carry on the business indicated by the title. The provisional directors are: H. W. Cole, 114, Trinity Road, Upper Tooting, S.W.17, electrician; Evelyn Whittle, 23, Stirling Road, Clapham Rise, S.W.9, clerk. Secretary, Evelyn Whittle. Registered office: 14, Victoria Street, Westminster.

International Automatic Telephone Co., Ltd. (164,393).—Registered February 23rd. Capital, £920,000 in £1 shares (200,000 preferred, 300,000 ordinary, and 300,000 deferred). To acquire (1) all or any of the shares or securities, and all or any of the assets and liabilities of the Automatic Telephone Manufacturing Co., Ltd., and any other company, whose objects include the business of manufacturers of or dealers in automatic or other telephones, telegraphs, or other electrical contrivances or apparatus connected therewith, and (2) licences from the Automatic Electric Co., of Chicago, to operate, use, and exercise in Europe and elsewhere inventions relating to such contrivances or apparatus, &c., and to adopt an agreement with T. G. Frank, H. Woods, A. F. Adams, H. L. Gary, J. B. Russell, J. Taylor, and D. Sinclair. The subscribers (each with one share) are: G. Dickson, 4, London Road, Benfleet, clerk; E. J. Alldis, 12, Macdonald Road, Forest Gate, E., clerk; and five other clerks. Minimum cash subscription 7 shares. The subscribers are to appoint the first directors. Solicitor: H. H. Atteridge, 2, Bond Court, Walbrook, E.C. Registered office: Royal Liver Buildings, Liverpool.

Solar Electrical Co., Ltd. (164,727).—Private company. Registered March 2nd. Capital, £2,000 in £1 shares (1,000 10 per cent. preference). To carry on the business of electrical engineers, electricians, dealers in electrical apparatus, &c. The first directors are: L. S. Challis, 6, Dungarvon Avenue, Putney, S.W.; E. Kilpin, 14 and 15, Conduit Street, W. Registered office: 53, Haymarket, S.W.

A. C. Sparking Plug Co., Ltd. (164,744).—Private company. Registered March 2nd. Capital, £20,000 in £1 shares. To acquire from the Champion Ignition Co., of Flint, Michigan, U.S.A., the concessions, patents, patent rights and trade marks of the A.C. Sparking Plug, and the business therein for any of the following countries: U.K., Holland, Belgium, Denmark, Norway, Sweden, Finland, and any other country in the Eastern Hemisphere, and any British Colony or dependency. The subscribers (each with one share) are: R. A. Chalmers, 37, Craven Terrace, W.2, engineer; A. Peters, 4, Mount Road, Wimbledon Park, S.W.19, solicitor's clerk. The subscribers are to appoint the first directors. Qualification 100 shares. Solicitors: Kenneth Brown, Baker, Baker, Lennox House, Norfolk Street, W.C.2.

Hesco, Ltd. (164,790).—Private company. Registered March 3rd. Capital, £10,000 in £1 shares. To carry on the business of mechanical, electrical, aeronautical, and general engineers, electricians, &c., and to adopt an agreement with H. E. Spencer. The subscribers (each with one share) are: G. T. Little, 7, Dorncliffe Road, Fulham, S.W., clerk; A. Hall, Parkland Grove, Ashford, Middlesex, solicitor. The subscribers are to appoint the first directors. Solicitor: A. Barrie, 1, Church Court, Clements Lane, E.C.

J. Hopkinson & Co., Ltd. (164,767).—Private company. Registered March 3rd. Capital, £600,000 in £1 shares (250,000 preference). To carry on the business of mechanical and electrical engineers, machine and engineering tool makers, manufacturers of boilers, flues, boiler mountings and fittings, electrical, hydraulic, and pneumatic apparatus, &c., to acquire the business of J. Hopkinson & Co., Ltd. The subscribers (each with one share) are: A. H. Hopkinson, Copt Hill Court, Burgh Heath, Tadworth, Surrey, engineer; L. H. Hopkinson, Cleveland House, Huddersfield, engineer. The first directors are: A. H. Hopkinson, L. H. Hopkinson, R. Kilburn, and F. Murgatroyd (ordinary directors), J. H. Hanson (representing "A" shares), and R. V. Bigby (representing "B" shares). Holders of preference shares No. 1-134,563 and ordinary shares No. 1-12,456 ("A" shares) and holders of preference shares Nos. 124,564-350,000 and ordinary shares Nos. 124,564-250,000 ("B" shares) have the right to appoint a director as representative of the "A" and "B" shares respectively. Solicitor: W. Ramsden, Station Street Buildings, Huddersfield.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Westinghouse Morse Chain Co., Ltd.—Mortgage on factory, Works Road, Letchworth, registered February 16th, 1920, to secure all moneys due or to become due from company to Barclays Bank.

Enfield Ediswan Cable Works, Ltd.—Debenture dated February 17th, 1920, to secure £40,000 charged on the company's undertaking and property, present and future, including uncalled capital, subject as to certain freehold land with buildings thereon to a prior charge for £60,000 ranking *pari passu* therewith. Holders: London County Westminster and Parrs Bank, Ltd., 21, Lombard Street, E.C.

Trafford Power & Light Supply (1902), Ltd.—Satisfaction in full on February 17th, 1920, of mortgage debenture dated March 30th, 1910, securing £25,000.

Hart Accumulator Co., Ltd.—Debentures for £40,000, registered February 11th, 1920, charged on the company's undertaking and property, present and future, including uncalled capital. Holders: London County Westminster & Parrs Bank.

Switchgear & Cowans, Ltd. (formerly Switchgear and Cowans (1911), Ltd.—Satisfaction registered February 11th, 1920, of charges for £250, registered April 14th, 1913, and £2,350, registered February 11th, 1920. Issue registered February 11th, 1920, of £2,350 "B" debentures, part of a series of £3,000 already registered.

Implitico, Ltd.—Return dated November 17th, 1919. Capital, £3,000 in £1 shares. All shares taken up and paid for in full. Mortgages and charges: Nil.

India-Rubber, Gutta-Percha & Telegraph Works Co., Ltd. Return dated January 1st, 1920. Capital, £822,000 in £10 shares (50,000 ordinary, 25,000 preferred, and 6,200 unclassified), 50,000 ordinary and 25,000 preferred shares taken up. £750,000 paid. Mortgages and charges: £400,000.

Lamp Manufacturing Co., Ltd.—Return dated February 9th, 1920. Capital, £10,000 in £1 shares. 5,400 shares taken up. £5,400 paid. Mortgages and charges: £2,500 debentures.

Yorkshire (West Riding) Electric Tramways Co., Ltd.—Return dated February 14th, 1919 (filed February 19th). Capital, £600,000 in £5 shares (70,000 preferred and 50,000 ordinary), 46,261 preferred and 40,977 ordinary shares taken up. £436,190 considered as paid. Mortgages and charges: £272,373.

Tilney Manufacturing & Testing Co., Ltd.—Debentures for £1,000, registered February 13th, 1920, charged on the company's undertaking and property, present and future, including uncalled capital. Holder: M. J. E. Tilney, The Knowles, Watford.

C. H. Hare & Son, Ltd. (110,911).—Capital, £16,000 in 8,000 preference and 8,000 ordinary shares of £1 each, of which, to December 31st, 1919, 6,200 preference and 8,000 ordinary had been taken up. £6,702 paid on 6,200 preference and 502 ordinary. £7,498 considered as paid on the remaining ordinary. Mortgages and charges, nil. The Lamson Paragon Supply Co., Ltd., holds a large block of shares.

Electrical Contracts & Maintenance Co., Ltd. (101,757).—Capital, £3,000 in £1 shares. Return dated December 18th, 1919. All shares taken up. £1,331 paid. £1,669 considered as paid. Mortgages and charges: £10,000.

Ferranti, Ltd. (83,718).—Capital, £130,000 in 60,000 preference, 60,000 ordinary, and 10,000 deferred shares of £1 each, of which, to December 19th, 1919, 53,374 preference, 60,000 ordinary, and 10,000 deferred had been taken up and credited as fully paid. Mortgages and charges: £110,785.

East India Tramways Co., Ltd. (74,457).—Capital, £100,000 in 15,000 preference, 35,000 ordinary, and 50,000 deferred shares of £1 each, of which, to December 30th, 1919, 7,476 preference, 33,433 ordinary, and 50,000 deferred had been taken up. £7,483 paid on 7,476 preference and 7 ordinary. £83,426 considered as paid on the remainder. Mortgages and charges: Nil.

CITY NOTES.

Charing Cross, West End and City Electricity Supply Co., Ltd.

West End Undertakings.—Gross earnings for 1919 £265,856, against £193,858 for 1918; expenses, excluding depreciation, £167,242, against £132,946; net earnings £98,614, against £60,912. Including £162 brought forward and interest accrued £5,056, the available total is £103,832. Out of this debenture interest absorbs £17,829, and there is set aside for depreciation £22,000; preference dividend for the year £18,000; ordinary dividend 7 per cent. for the year £28,000; to general reserve £10,000; leaving to be carried forward £8,002. There are now connected to the West End mains the equivalent of 775,563 (30-watt) lamps: Lighting 459,809, heating 80,777, power 234,977 (9,449 H.P.).

City Undertaking.—Gross earnings for 1919 £331,323, against £238,075; expenses £273,722, against £199,250; net earnings £57,601, against £38,825. Including £9,075 brought forward, the available total is £66,676. Out of this, interest on debentures, loans, and advances absorbs £31,458, leaving £35,217. Preference dividend £18,000; to general reserve £10,000; carried forward £7,217. There are now connected to the City mains the equivalent of 851,515 (30-watt) lamps: Lighting 334,925; heating 120,323; power 396,267 (15,936 H.P.). The report contains references to the Electricity Supply Bill in the same terms as were used in the Westminster report (Elec. Rev., February 20th, p. 245).

West End Undertaking.—Units generated, 723,704; bought, 16,804,856; units sold, 12,649,228; used on works, &c., 4,879,332.

City Undertaking.—Units generated, 41,178,630; sold, 34,349,326; used on works, &c., 6,829,304.

Underground Electric Railways Co. of London, Ltd.

Lord Ashfield, presiding at the annual meeting on March 5th, reviewed the financial position of the company, and said that the result was as disappointing as it was unexpected. In the first half of 1919 the gross receipts of the operating companies increased faster than the expenses, and they were thus able to increase their interim dividends, and in consequence their payments to this company, but in the second half the expenses increased much faster than the gross income, and since the close of the year expenses had still continued to rise. The return upon the capital of the London underground railways had during the lifetime of this company averaged only 3.3 per cent. It could not be argued that there had been any profiteering. If those railways had to be built to-day it would cost much more than twice their present capital to build

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them. They were at the moment inadequate for the traffic which needed to be carried. There were essential improvements needed, and they were ready to go ahead with the full programme of important extensions and improvements immediately, at an estimated cost of £6,000,000, but until the position was altered it was hopeless to contemplate raising such a sum. The £6,000,000 was only the beginning; it would only produce additions to and improvements of existing railways, whereas in his judgment London urgently needed, and must have before long, entirely new underground railways, including at least one, probably two, high-speed lines. How and where these new railways should be constructed would need long and careful consideration. The crucial question was not construction and location, however, but how the required money was to be raised. The speaker went on to refer to the Bills that the companies were promoting in Parliament dealing with extensions and the increasing of fares. They were asking for power to charge 2d. per mile and for the abolition of workmen's fares. If the undertakings were not put on a self-supporting basis the only alternative was that London traffic should be subsidised either out of national taxation or out of local rates.

Oxford Electric Co., Ltd. Sir Henry Mance, presiding at the annual meeting, referred to the effect of the removal of restrictions and the return to normal conditions. There was an increase of nearly 25 per cent. in business, enabling them to recover lost ground and to submit a satisfactory balance sheet. They believed that this very satisfactory increase would be maintained; the prospects for the future were highly encouraging. After referring to the increased costs, the chairman explained the main outline of the Electricity Supply Bill. He did not think the Bill was likely to affect them to any material extent for many years, as Oxford was not a manufacturing centre, and generating stations were rather scattered. If superstations could supply them with current as cheaply as they could make it they would be very glad to take it from them. If the company retained the distributing part of the system, either independently or in amalgamation with other undertakings, their tenure would probably be established in perpetuity. They proposed to call the shareholders together in the near future to sanction either an increase in capital or an increase in the rate of interest on the preference capital that had not yet been issued. There might have to be some delay in connecting up new consumers, as it was impossible to get delivery of the necessary materials. The boom was likely to continue until the industrial world had made up its leeway. At present it appeared to him that most manufacturers had at least six months' work ahead of them. He hoped that electric lighting installations would be put into all the new houses now being erected throughout the kingdom. The report of the chief engineer (Mr. F. H. Francis) showed that the increased demand had necessitated more plant. They had secured an existing high-speed engine which would ensure their position for the winter, and orders had been placed for an additional alternator and two boilers, which were due before next winter.

South London Electric Supply Corporation, Ltd.—Capital expended during 1919 £9,210. Balance from revenue, less costs, £40,879; interest on investments and sundry receipts £2,111. Including the amount brought forward there is available £46,258. Debenture and other interest £6,880; depreciation £8,000; general reserve £2,500; written off leasehold account, &c., £667; 6 per cent. on cumulative preference shares; dividend on the ordinary shares 6 per cent. for the year. Balance carried forward £10,810, against £3,717 brought in. Mr. H. B. Renwick has become chairman and managing director in place of Mr. Braithwaite resigned. Sir E. Wyldbore-Smith has been appointed a director. Applications received during the year equivalent to 2,351 KW. (total 18,083 KW.). Units sold 7,565,639, increase 453,387.

Bournemouth & Poole Electricity Supply Co., Ltd.—Capital expended during 1919 £9,473. Available revenue, including £1,299 brought forward, £38,573. Debenture and loan interest £7,640; leasehold and special redemption funds and interest £2,293; to reserve for depreciation £8,000. Dividends on the 4½ per cent. and 6 per cent. preference shares are paid, and a total of 6 per cent. on the ordinary, leaving £4,628 to carry forward. Total applications 14,291 KW.; increase 1,695 KW. Units sold 4,680,347.

British L. M. Ericsson Manufacturing Co., Ltd.—Net profit for 1919 after charging £12,582 for depreciation, £12,616 for income tax, and £2,500 for debenture interest was £25,877, plus £51,279 brought forward. Dividend of 10 per cent., free of tax, on the ordinary shares. Reserve £10,000, to reserve for depreciation of investments £2,500, £48,65 6is carried forward subject to excess profits duty.

Tyneside Electrical Development Co.—For the year ended January 31st the profit was £4,533, plus £815 brought forward. Dividend 6 per cent. per annum on preferred ordinary; 10 per cent. on deferred ordinary; to general reserve £1,000; carried forward £849.

Stewarts & Lloyds, Ltd.—Dividend for 1919 2s. per share and a bonus of 6d. per share on the deferred shares. £100,000 to general reserve, £10,000 to employés' benefit reserve. Carried forward £100,000.

Automatic Telephone Manufacturing Co., Ltd.—The report for 1919 states, says the *Financial Times*, that the profit amounts to £15,724, plus £11,281 brought forward. Directors' fees absorb £2,664, depreciation on patents, &c., £3,000, and dividend on preference shares £12,000, carrying forward £9,341. The directors regret that the profits for the year will not allow of a dividend being paid on the ordinary shares. The decrease in profits is due chiefly to reduction of estimated profits on all the company's manufactures sold and delivered during the greater part of the year, due to the gradual inflation in labour rates and raw material prices, and to reduction of output, due to the Government placing no orders for automatic telephone equipment during the period under review. The reduction of output was further accentuated as regards the general manufactures of the company owing to the impossibility of obtaining delivery of the necessary raw materials in sufficiently large quantities to ensure economical production and to other difficulties encountered in reorganising the factory after the special war work on which the company has been engaged. In the light of these facts, the directors felt that advantage should be taken of the offer submitted to shareholders in a circular letter dated February 7th, 1920, and as holders of a majority of the shares have agreed to exchange their shares on the terms set forth in that letter the new company has been formed and all other necessary steps taken to complete the transaction.

Stock Exchange Notices.—Application has been made to the Committee to allow the following to be officially quoted:—

Petters, Ltd.—112,500 ordinary shares of £1 each, fully paid; and 200,000 7½ per cent. cumulative preference shares of £1 each, fully paid.

The committee has specially allowed dealings in the following securities under Temporary Regulation 4 (3):—

General Electric Co., Ltd.—1,600,000 7½ per cent. cumulative "B" preference shares of £1 each, 7s. 6d. paid, Nos. 1 to 1,600,000; and 400,000 ordinary shares of £1 each (issued at 28s., of which 7s. 6d. is paid), Nos. 1,225,001 to 1,625,000, after issue of allotment letters.

Mann, Egerton & Co., Ltd.—48,793 ordinary shares of £1 each, fully paid, Nos. 11,208 to 60,000, and 21,832 preference shares of £1 each, fully paid, Nos. 83,064 to 104,895.

Waygood-Otis, Ltd.—40,000 ordinary shares of £1 each, 5s. paid, Nos. 250,001 to 290,000, after issue of allotment letters.

The committee has ordered the following to be officially quoted:—

Westminster Electric Supply Corporation, Ltd.—39,964 ordinary shares of £5 each, fully paid (Nos. 310,001 to 350,054).

Smithfield Markets Electric Supply Co., Ltd.—Sir H. S. Leon, speaking at the annual meeting, said that the increase in total expenses in 1919 was £2,700, but the sale of current had produced £8,000 more. The use of electric heaters was becoming increasingly popular. The company was at present buying its current in bulk under an arrangement which provided that when the price of fuel exceeded a certain figure the charge per unit against them rose proportionately. They did not see any prospect of costs of production falling for some time to come, and until they did a reduction in rates was out of the question. They must therefore continue the cautious policy of building up the reserves.

Commonwealth Edison Co.—The report for 1919 states that the electric operating revenues were $30,366,426; expenses (including amortisation and depreciation, $2,880,254), $19,519,507; net electric operating revenues, $10,846,919; other charges, uncollectable operating revenues, $119,938; taxes, $2,355,000; municipal compensation, $895,193; leaving net operating income $7,476,787; other income, $619,802; gross income, $8,096,589; deductions from gross income, $950,213, leaving $7,146,376. Interest on funded debt took $2,299,236, leaving available $4,847,138. Dividends paid amounted to $3,942,340; balance carried to surplus, $904,798.—*Financial Times.*

Chelsea Electricity Supply Co., Ltd.—Profit for 1919, £33,038, plus £1,106 brought forward, and £2,324 interest, making £36,467. Debenture interest £5,480; 6 per cent. preference dividend; reserve, renewals, and contingencies £16,688; written off cost of extinction of founders' shares £1,089; 4 per cent. on the ordinary shares for the year; carried forward £1,523; 5,593 new lamp connections (8 C.P.), making 345,527. Units sold 4,224,505, being 266,033 less than in 1918.

Newcastle & District Electric Lighting Co., Ltd.—Net profit for 1919, after charging interest on debenture, &c., and allowing £16,000 for depreciation, £8,494, plus £13,099 brought forward. Dividend 4 per cent., less tax; carried forward £13,263. Capital expenditure during the year for buildings, plant, and mains, £19,001. A large number of applications has been received for energy for all purposes, and a rapid expansion of business is expected.

British Insulated & Helsby Cables, Ltd.—Final dividend of 8¾ per cent., making 12¼ per cent. for the year, plus a bonus of 2½ per cent. To reserve and depreciation £105,000; carried forward £103,000.

General Electric Co., Ltd.—It is announced that the issue of preference and ordinary shares was over-subscribed, and the list closed on Tuesday.

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Northampton Electric Light & Power Co., Ltd.—At the annual meeting Ald. F. H. Thornton said the year had been interesting and critical. Never before had there been such fluctuations in the demand for current. Early in the year the whole of the power used for munition work was disconnected, and there was a substantial drop in the output. In March came an unexpected call to supply current for a portion of the Corporation tramway system. This partly helped to make up for the decrease in output, but it was succeeded by a reduction in the hours of employment in the factories of the town, with the result that the output continued to be below the preceding year until the end of October, when, with the removal of the lighting restrictions and what appeared to be steadier demands for industrial power, the weekly output began to exceed that of the previous year. This was further helped by the demand at the end of the year to supply the whole of the current for the Corporation tramways. The five years' contract for this supply commenced on March 1st, 1920. In April, 1919, the company purchased the Wellingborough Electric Supply Co., not merely with the view of rejuvenating a moribund undertaking, but also as a part of a much wider scheme for supplying current for rapidly increasing industries on that side of the county. Unfortunately, the County Council decided to impose such conditions as to make it impossible for the company to proceed, but the matter was still under consideration. It was hoped that something would be done with the help of the Electricity Commissioners. They had made a profit of £300 on the Wellingborough undertaking instead of the loss of £600 in the previous year.

County of London Electric Supply Co., Ltd.—Capital expended during 1919 £130,043. Total available revenue £232,989, including £15,516 brought forward. Deduct debenture and loan interest £44,177; written off preliminary expenses £5,000; to reserve for depreciation, &c., £50,000; to general reserve £45,000. Preference dividend 6 per cent., less tax, for the year; ordinary dividend 8 per cent., less tax, for the year. Carried forward £19,188. The report states that the Electricity Supply Act as passed should be of material assistance in connection with the electricity supply industry of the country, and should assist in solving the question of London electric supply. Mr. C. P. Sparks resigned the position of engineer-in-chief at the end of 1919. Mr. A. R. Bacon has been appointed chief station engineer and Mr. J. D. Dallas, chief mains engineer. Applications received during the year 8,532 kw., making the total 82,224 kw. Units sold 42,487,672, an increase of 2,161,409. Consumers increased from 28,400 to 31,390. The Coatbridge and Airdrie Electric Supply Co., Ltd., showed a decreased output during 1919 owing to falling off in war demands. This is temporary, and the load is rapidly overtaking the previous demands.

Prospectuses.—*The Fife Tramway, Light & Power Co., Ltd.*, are issuing 200,000 ordinary shares of £1 each at par to be applied in payment of loans in connection with the extensions and additions to the generating station, cables, and plant.

W. G. C. Haywood & Co., Ltd.—Applications are being invited until to-day for an issue of 160,000 10 per cent. participating shares of 10s. each at par. The company was registered in 1916 with £5,000 capital to carry on general engineering work (its address is Beaufort Works, Twickenham), and during the war was engaged on the production of aeroplane parts. The nominal capital is now £120,000, the business having been converted into a public company with the object of turning its organisation and equipment to account, for the provision of motor scooters, cycle cars, "Blue Bird" steam turbine fans and power plants (this is an Austrian design purchased with the business of Michael Pal and Co., Ltd.), the E.C. electric iron (which is being manufactured for Sumner Vaughan & Co., who have received orders *and inquiries* for over 150,000, on which a net profit of £18,750 to this company is estimated), and the "Feyens" engine. In the prospectus as printed in the daily Press, there is no information given as to the purchase price, and the profit figures are estimates on business booked or inquired for. The plant, premises, stock, &c., at Twickenham are valued at £30,470.

Rushden & District Electric Supply Co., Ltd.—At the annual meeting Ald. F. H. Thornton said that the reduction in the price of crude petroleum resulted in a saving of over £500 in the cost of fuel, notwithstanding a slightly increased output. An additional generating set was being installed to cope with the more urgent demand for power pending the completion of arrangements for bulk supply from Northampton.

Telegraph Construction & Maintenance Co., Ltd.—Net profit of £124,184 for 1919, plus £110,296 brought forward. Further dividend 7½ per cent., free of tax; to reserve fund £20,000, and £10,000 to pension fund; £114,840 carried forward.

Metropolitan-Vickers Electrical Co., Ltd.—The directors recommend a dividend on the ordinary shares at the rate of 8 per cent. per annum to December, 1919.

Mirrlees Watson Co., Ltd.—Dividend of 10 per cent. and a bonus of 7½ per cent. for 1919.

STOCKS AND SHARES.

Tuesday Evening.

The extraordinary flood of new issues is one of the principal causes which tend to check business in existing securities, and to render the investor delicate in his choice of purchases. The fear of the Budget appears to have been fairly well discounted, and whatever may be announced, the Stock Exchange is prepared for it—up to a point. Confidence shows a little disposition to return, as improvement in the War Loan indicates. In regard to the new issues, each week brings more tempting offers than the previous one, and it is noticeable that even in such cases as those where a heavy over-subscription is secured, this does not necessarily imply a premium after allotment. In fact, the reverse has been the case in several instances lately, showing, of course, that the stag is extremely busy in this particular branch of Stock Exchange transactions at present. The prudent man is therefore rather inclined to wait until after allotment before venturing into new companies.

The eighth ordinary general meeting of the Automatic Telephone Manufacturing Co. is called for next Tuesday, March 16th, at Liverpool, and is likely to be of a lively character. The report shows a profit for last year of £15,723, and after necessary deductions, there remains £9,341 to go forward. The decrease in the profits is stated to be due to several causes, the most important of which were completely beyond the control of the company, and the directors felt that advantage should be taken—we quote the report—of "a very important and favourable offer" to exchange shares on the terms set forth in the circular issued to the shareholders a month ago. We venture to think that the board will be told very plainly at the meeting that proprietors are by no means unanimous in thinking that the offer was "very important and favourable," and that they, the shareholders, will demand to know why the opportunity was not afforded them for discussing the whole affair in general meeting. The price of the shares remains about 20s.

The Eastern Extension, Telegraph and Westerns are all ex rights, but no dealings have yet taken place in the new issues, as it is understood that the letters of allotment will not be out for a few days. The stocks and shares were quoted ex rights on the closing of the companies' books. Prices keep very hard, and the only noticeable feature in cable shares is the substantial fall which has taken place in most of the dollar securities, owing, of course, to the upward movement of the American exchange brought about by the forthcoming repayment by this country to the United States of part of its war debt. The full recovery in exchange was not held, but prices are considerably lower than they were a week ago.

Rights on Eastern ordinary stock are valued about 18, on Globes and Eastern Extensions at 45s., and on Western Telegraphs at 65s. Deductions of these amounts have given the various securities a cheap appearance, on the 10 per cent. dividend basis.

General Electric ordinary have gone back to 1 15-16 ex rights, and the preference to 18s. 6d., owing to the evident desire on the part of holders to apply for as many as possible of the new shares in order to provide the funds, they have been selling their existing shares. The rights are quoted 4s. 9d.-5s. 9d. premium over the issue price of 28s. Siemens at 30s. and Cromptons at 22s. are both 6d. lower. British Aluminium ordinary have further risen to 2 3-16, on the announcement regarding the new shares that are to be given, for nothing, to the proprietors. This came as a pleasant surprise. Although something of the kind had been expected, the terms are more generous than many looked for. Callender's are ¼ lower at 9½, apparently in sympathy with the dulness in Telegraph Constructions. In the engineering group, Babcock & Wilcox shed ½, and on the whole the iron and steel shares are a trifle down. With so much competition from the new issues, it is a little surprising that prices of the existing stocks and shares should hold their ground as well as they are doing, and the fact that there has been comparatively little fall in the latter argues the public's capacity for investment on a large scale, Budget or no Budget. Greenwood & Batley are £3 up at 13½, on the scheme of capital rearrangement just proposed.

The principal improvement in the electricity list has been secured by Brompton ordinary, which have risen 10s. to 6¾. For this the advance of 50 per cent. in the dividend is, of course, responsible. Charing Cross at 3¾ are another ¼ higher, demand being stimulated in their case by the excellent yield obtainable at the current price, a consideration which applies also to St. James' and Pall Mall, causing in their case a rise of 5s. to 6¾. Westminsters are also better at 5¼. With such shares paying about 9 per cent. on the money, it only needs a little appreciation on the part of the public for further improvements to occur, but the market is always a quiet one, therefore receiving little advertisement from financial guides. London Electrics receded to 25s.

Metropolitans at 22 are a little better. Undergrounds keep heavy as a whole. Underground Income Bonds have gone back to 72, no interest being taken in the stock, while the

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labour conferences this week have not tended to encourage purchases of Home Railway issues. Attention is being called to the recent speeches of railway chairmen in which references have been made to the position of the companies. At the recent meetings of proprietors of the Great Western and North-Western companies, the chairmen, Lord Churchill and Sir Gilbert Claughton respectively, spoke with unwonted hopefulness of their expectations in regard to the possible Government action. London Electric £10 shares have eased off to 2⅜, at which the yield on the money comes to about 6¼ per cent. In our tables, we give the return on Underground Electric Income Bonds as £5 11s. per cent., free of tax, calculating the dividend for 1919 as 4 per cent.

Calcutta Trams are lower at 8s. 8d. Bombay Trams maintain their extraordinary prices. The British Columbia group continues to shrink. Mexicans are flat again, it being reported that General Villa is once more in active brigandage. A rise of 2 points in Brazilian Tractions will not surprise those who took notice of the well-informed buying mentioned here as being in progress last month. London and Suburban Traction 4 per cent. debenture is down 3 at 46½.

Marconis enlivened the market with a jump of 7s. 6d. to 4 3-16. Buying apparently drew stimulus from the announcement as to a possible telephone service between this country and New York. Concurrently, Anglo-American Telegraphs gave way rather sharply, for the same reason. Dealings in American Marconis cease this week, and will re-start in April in American Radio shares. Canadian Marconis have further stiffened to 14s. bid.

Rubber shares are in a lack-lustre condition, and the raw material gives no immediate indication of that rapid rise prophesied for it by those who are optimistic concerning substantial orders for the produce at an early date by Germany.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1918.	Dividend 1919.	Price March 9, 1920.	Rise or fall.	Yield p.c.
Home Electricity Companies.					
Brompton Ordinary	8	12	8⅞	+ ¼	£8 16 10
Charing Cross Ordinary	4	7	8¼	+ ⅛	9 0 8
do. do. do 4½ Pref.	4½	4½	2⅝	—	8 8 8
Chelsea	3	4	3½	—	6 3 1
City of London	8	10	14	—	7 2 10
do. do. 6 per cent. Pref.	6	6	9⅜	—	6 4 8
County of London	7	8	9⅞	—	8 2 2
do do. 6 per cent. Pref.	6	6	9	—	6 13 4
Kensington Ordinary	6	7	5½	—	6 13 4
London Electric	Nil	2½	1½	+1/8	5 19 9
do. do. 6 per cent. Pref.	6	6	8⅝	—	8 11 6
Metropolitan	5	6	3⅞	—	7 14 10
do. 4½ per cent. Pref.	4½	4½	2⅜	—	7 16 6
St. James' and Pall Mall	10	12	6⅜	+ ¼	8 16 10
South London	5	6	2⅝	—	7 12 8
South Metropolitan Pref.	7	7	19/6xd	—	7 3 7
Westminster Ordinary	8	10	5½	+ ½	8 10 6
Telegraphs and Telephones.					
Anglo-Am. Tel. Pref.	6	6	89½	—1	6 14 1
do. Def.	33/6	1½	19	—2	7 18 0
Chile Telephone	8	6	6½	—	*4 13 2
Cuba Sub. Ord.	7	7	10⅝	—	*6 18 4
Eastern Extension	8	10	16½	—	*6 1 3
Eastern Tel. Ord.	8	10	167½	—	*5 19 5
Globe Tel. and T. Ord.	8	10	16½	—	*6 1 8
do. do. Pref.	6	6	9⅞	—	6 8 1
Great Northern Tel.	22	—	24	—	9 3 4
Indo-European	18	—	48½	—	6 18 4
Marconi	25	—	4 3/16	+ 3/16	5 19 4
Oriental Telephone Ord.	10	—	2 7/16	—	4 16 0
United R. Plate Tel.	8	—	8	—	*5 0 3
West India and Panama	1/8	—	1 1/16	— 1/16	5 19 0
Western Telegraph	8	10	17xd	—	*5 17 8
Home Rails.					
Central London Ord. Assented	4	4	47½	—	8 8 6
Metropolitan	1	1½	22xd	+ ½	5 13 8
do. District	Nil	Nil	18	—	Nil
Underground Electric Ordinary	Nil	Nil	3⅜	+ ⅛	Nil
do. do. "A"	Nil	Nil	6/6	—	Nil
do. do. Income	5	4	71xd	—1	5 10 0
Foreign Trams.					
Anglo-Arg. Trams. First Pref.	Nil	Nil	3⅝	—	—
do. do. 2nd Pref.	—	—	3¼	—	—
do. do. 5 Deb.	5	5	63½	—	7 15 0
Brazil Tractions	—	—	55	+2	—
Bombay Electric Pref.	6	6	18⅝	—	8 4 0
British Columbia Elec. Rly. Pfce.	5	5	61½	—1	8 2 8
do. do. Preferrred	2½	5	52½	—1	9 10 6
do. do. Deferred	Nil	3	43½	—2	6 18 0
do. do. Deb.	4½	4½	60½	—1	7 0 6
Mexico Trams 5 per cent. Bonds	Nil	Nil	38½	+1	Nil
do. 6 per cent. Bonds	Nil	Nil	29½	—	Nil
Mexican Light Common	Nil	Nil	17½	—5	Nil
do. Pref.	Nil	Nil	30½	—2	Nil
do. 1st Bonds	Nil	Nil	51½	—1	—
Manufacturing Companies.					
Babcock & Wilcox	15	—	3⅜	— ⅛	*4 5 9
British Aluminium Ord.	10	—	2 5/16	+ 1/16	4 11 4
British Insulated Ord.	12½	15	2 1/16	—	7 5 3
Callenders	25	—	3⅛	— ⅛	6 17 0
,, 6½ Pref.	6½	6½	4⅞	—	6 16 10
Castner-Kellner	20	—	4	—	—
Crompton Ord.	10	—	22/-	— 6d.	9 1 10
Edison-Swan, "A"	10	—	1½	—	8 0 0
do. do. 5 per cent. Deb.	5	5	79½	—	6 5 9
Electric Construction	10	—	1½	—	8 0 0
Gen. Elec. Pref.	6½	6½	18/6	— 1/-	7 0 6
do. Ord.	10	—	1 1/16xd	— ⅛	*5 3 0
Henley	25	—	2½	—	5 0 0
do. 4½ Pref.	4½	4½	8⅜	—	6 4 2
India-Rubber	10	—	16	—	*6 5 0
Met.-Vickers Pref.	—	8	3 1/16	— 1/16	5 6 8
Siemens Ord.	10	10	90/-	— 6d.	*6 13 4
Telegraph Con.	20	20	28	—	*4 5 0

* Dividends paid free of Income Tax.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Tuesday, March 9th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Oxalic	per lb.	1/5	...
a Ammoniac Sal	per ton	£95	...
a Ammonia, Muriate (large crystal)	,,	£75	...
a Bisulphide of Carbon	,,	...	...
a Borax	,,	£42	...
a Copper Sulphate	,,	£52	£1 inc.
a Potash, Chlorate	per lb.	11d.	...
a ,, Perchlorate	,,	1/8	...
a Shellac	per cwt.	£42	£2 dec.
a Sulphate of Magnesia	per ton	£15	...
a Sulphur, Sublimed Flowers	,,	£28	...
a ,, Lump	,,	£25	...
a Soda, Chlorate	per lb.	6d.	...
a ,, Crystals	per ton	170/-	...
a Sodium Bichromate, casks	per lb.	...	...
METALS, &c.			
g Babbitt's Metal Ingots	per ton	£118 to £345	...
c Brass (rolled metal 2" to 12" basis)	per lb.	1/4	...
c ,, Tubes (solid drawn)	,,	1/6½ to 1/6¾	1d. dec.
c ,, Wire, basis	,,	1/4¾	...
c Copper Tubes (solid drawn)	,,	1/9¼	¾d. dec.
g ,, Bars (best selected)	per ton	£168	£5 dec.
g ,, Sheet	,,	£168	£5 dec.
g ,, Rod	,,	£168	£5 dec.
d ,, (Electrolytic) Bars	,,	£124	£6 dec.
d ,, ,, Sheets	,,	£156	...
d ,, ,, Wire Rods	,,	£139	£6 dec.
d ,, ,, H.C. Wire	per lb.	1/5½	½d. dec.
f Ebonite Rod	,,	8/-	...
f ,, Sheet	,,	2/6	...
n German Silver Wire	,,	3/-	...
h Gutta-percha, fine	,,	18/-	...
h India-rubber, Para fine	,,	2/7	...
i Iron Pig (Cleveland Warrants)	per ton	Nom.	...
l ,, Wire, galv. No. 8, P.O. qual.	,,	£57	£4 10/- inc.
g Lead, English Pig	,,	£52 10/-	15/- dec.
g Mercury	per bot.	£24 10/- to £25	...
e Mica (in original cases) small	per lb.	6d. to 4/6	...
e ,, ,, ,, medium	,,	5/- to 10/-	...
e ,, ,, ,, large	,,	12/6 to 25/- & up	...
g Phosphor Bronze, plain castings	,,	1/8 to 2/-	...
g ,, ,, rolled bars and rods	,,	2/2 to 2/6	...
g ,, ,, rolled strip & sheet	,,	2/3 to 2/9	...
d Silicium Bronze Wire	per lb.	1/11½	...
r Steel, Magnet, in bars	,,	1/8	...
g Tin, Block (English)	per ton	£369 to £370	£44 dec.
n ,, Wire, Nos. 1 to 16	per lb.	5/5	...
White Anti-friction Metals	per ton	£90 to £345	...

Quotations supplied by—

a G. Boor & Co.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
r W. F. Dennis & Co.

Electrically-propelled Ships. — The Winton Engine Works, of Cleveland, Ohio, which have attained considerable success with their four-cycle Diesel engines, have decided, says the *Motor Ship and Motor Boat*, to concentrate upon 500-B.H.P. sets direct-coupled to electric generators, and to employ them with a system of electric transmission in ordinary cargo vessels, up to 10,000 or 12,000 tons. The engine-room plant is to consist of multiple sets furnishing power at high speeds, and driving electric propelling motors at very low speeds. By placing a number of sets in the ship, immunity from breakdown can be guaranteed. Moreover, the cylinder sizes are small, the engines are easy to handle and are quickly repaired, and the general source of supply is not affected should a breakdown occur to one engine. The propelling motor, or motors, can have a speed variation of from 0 to 65 B.P.M., which is ideal for merchant vessels. The Winton Engine Works are now undertaking a number of installations of this type.

The Channel Tunnel.—Speaking at a meeting of the Anglo-French Society, on March 6th, Baron Emile B. d'Erlanger said that now the League of Nations had been formed, it was most desirable that a Channel Tunnel company should be registered under its ægis, such a company to hold all the share capital and debentures of the English and French companies, and to nominate a number of members on the directorates of these. The majority of directors would be elected under the auspices of the two Governments. Sir Arthur Fell, M.P., said that in two or three weeks' time the decision of the British Government would be made known, and he had not the slightest doubt as to the ultimate construction of the Tunnel.

The E.T.U. and Plumbers.—The Secretary of the Blackburn branch of the Electrical Trades Union has informed the Electricity Committee that cable jointers who are members of the Union have received instructions not to connect up to the mains any installation erected by a plumber or a non-Unionist. The Committee has referred the matter to the Divisional Whitley Council for consideration.

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Exports and Imports of Electrical Goods during October, November, and December, 1919.

The official returns of our foreign electrical trade for the last quarter of 1919 shows very satisfactory totals, the export values of electrical material for October, November, and December being £812,257, £906,035, and £849,149 respectively, a total of £2,567,441, as compared with £727,041 for July, £872,649 for August, and £652,857 for September, a total of £2,252,547, an increase of £314,000 for the quarter. The totals for the December quarter give a monthly average of, roughly, £855,000, as compared with an average of £750,000 for the preceding quarter, the monthly average of electrical exports for the 12 months of 1919 working out at £636,000, and the aggregate for the year being £7,635,001.

The principal increases in export values for the past quarter occurred in electrical goods, £180,000; insulated wire, £123,000; batteries, £25,000; telegraph and telephone material, £41,000; a falling off taking place in electrical machinery, £40,000, and meters, £20,000.

The electrical imports for the last three months of 1919 totalled £641,583, as compared with £428,563 for the September quarter, an increase of about £210,000, the figures being:—October, £220,222; November, £90,374; and December, £330,987; and July, £152,091; August, £116,656; September, £159,756. The increased values are:—In electrical machinery, £100,000; telegraph and telephone material, £110,000. The electrical imports for the 12 months amounted to £2,066,784, a monthly average of about £172,000.

The re-exports of foreign and Colonial electrical material for the three months under review totalled £30,183, the figures being for October, £9,685; November, £7,733; and December, £12,765; as compared with July, £14,456; August, £9,871; September, £10,221. The total value of the electrical re-exports for the year was £129,215, a monthly average of nearly £11,000.

Below are given comparative figures of the values of electrical exports for 1913, the year previous to the war, and for 1919.

TABLE I.—Electrical Exports for 1913 and 1919 Compared.

	1913.	1919.	*Inc. or dec.*
Electrical goods	£696,607	£1,332,432	+ £635,825
Insulated wire	967,746	1,906,660	+ 938,914
Glow lamps	153,865	150,357	— 3,508
Arc lamps and parts ...	62,889	18,176	— 44,713
Batteries	221,865	435,357	+ 213,492
Meters	172,767	239,794	+ 67,027
Machinery	2,209,724	1,975,194	— 234,530
Carbons	20,772	13,194	— 7,578
Teleg. & telep. material...	3,062,320	1,563,837	— 1,498,483
Totals	£7,568,555	£7,635,001	+ £66,446

TABLE II.—Values of Electrical Exports and Imports. Last Quarter of 1919.

	October.			November.			December.		
	Exports. £	Imports. £	Re exports. £	Exports. £	Imports. £	Re exports. £	Exports. £	Imports. £	Re-exports. £
Electrical goods	182,844	45,689	3,668	163,831	27,061	2,833	144,718	50,848	5,983
Insulated wire	197,610	2,941	1,479	240,981	3,291	—	235,454	5,638	—
Glow lamps	15,038	51	550	12,745	—	114	10,557	98	189
Arc lamps and parts ...	1,124	8,124	—	1,495	1,265	472	803	4,748	584
Batteries	28,480	5,141	39	53,210	1,481	8	28,052	5,084	—
Meters	21,013	3,406	648	18,656	3,561	344	22,211	3,744	489
Machinery...	233,781	138,641	2,168	224,980	40,707	3,292	222,036	189,255	972
Carbons	2,588	1,233	151	2,765	434	—	996	3,053	—
Teleg. and telep. material	138,779	149,996	982	187,392	12,574	670	184,322	68,519	4,548
Totals	£812,257	£220,222	£9,685	£906,035	£90,374	£7,733	£849,149	£330,987	£12,765

THE BRITISH INDUSTRIES FAIR.

(*Concluded from page* 316.)

BIRMINGHAM.

The Midland Electric Manufacturing Co., Ltd., Birmingham.—In display arrangement this stand exemplified the company's policy in the manufacture of ironclad switch and fuse gear, "simplicity with efficiency"; all its products were mounted in the working switchboard manner, and good use was made of the space of the exhibit. The specimens were well designed, well finished, and included not only the final product as sent out, but separate component parts, special features and elements of M.E.M. switch and fuse gear, with sectional specimens of the many parts and details that go to the making of the complete article. A complete selection of the firm's specialities were staged, including switches, fuses, fuseboards, fuse elements, and accessories, from a study of which it was seen that the safety aspect was fully covered from the point of view of the regulations laid down by the responsible authorities. Illustrated herewith is a leading M.E.M. line, the "Kantark" ironclad fuse, fig. 4, as incorporated in the "Paragon" combined switch and fuse. The merits of both these lines are well known; in the fuse the arcing chamber is of adequate capacity, amply ventilated at the sides and lined with a non-arcing absorbent material which prevents firing. A wide range of patterns and capacities was shown, and in every case where porcelain is used this is of British manufacture.

Fig. 4.—Kantark Ironclad Fuse.

Fig. 5.—Orbit Electric Fire. Fig. 6.—Brazier Pattern Fire.

The Falkirk Iron Co., Ltd., Falkirk.—The representative exhibit of the firm's domestic heating and cooking devices included the well-known electric cooking ranges and heating apparatus. The "Orbit" electric fire, fig. 5, is a stove of large heating capacity and chaste design; it is of elliptical shape on plan, and the finish at the back as well as at the

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front lends itself to being placed in the centre of a room. Roller castors are concealed in the lion paw feet to facilitate removal, but when the fire is supplied for ship work fixing clamps are provided for screwing down to the floor. The extreme height is 30 in., breadth 27 in., and depth 16 in. A humidifier consisting of a water pan is fitted underneath the dome, access being obtained by lifting off the dome cover. An induced draught convector effect is obtained by the sliding air ventilator in front. The heating elements are made easy of access and arranged for heat regulation by switches mounted in the housing of the fire; all connections are made and carried to main terminals with an earthing terminal. The brazier pattern of fire, fig. 6, is constructed of cast iron with an ornamental brass frieze and solid brass pillars and feet; its overall size is 16 by 18 in. diameter, and its weight is 30 lb. The heating elements are of the red-hot radiant type, mounted upon a framing with an aluminium reflector, all concealed under the pierced dome cover. Two heat-regulating switches are mounted in the frieze. An enhanced glowing effect may be obtained by the addition of an amber-coloured lamp concealed in the base of the fire, which throws a glow on the floor covering; a separate switch is provided for this lamp so that it may be used independently of the heating element.

Messrs. Robinson & Hands Electrical Co., Ltd., Birmingham, exhibited four main lines, namely, lampholders in variety, 5 and 10-amp. capacity tumbler switches, lighting and power fuseboards, and accumulator switchboards. The latter consisted of an enamelled slate panel on which were mounted a voltmeter and two 6-in. dial ammeters of the dead beat gravity type; a 2-way D.P. voltmeter switch; a charge and discharge switch; two D.P. knife switches; four S.P. porcelain fuses; and an automatic cut-in and cut-out switch for charging the battery. The boards are supplied complete with all connections and sweating sockets, all terminals being plainly labelled. The 5-amp. lighting and 10, 25, 50, and 100-amp. power fuseboards were all of the shock-proof design, the former being in hardwood and the latter in steel-clad cases.

Messrs. J. A. Crabtree & Co., Ltd., Walsall, showed their tumbler switches of a quick make and quick break pattern, and kindred accessories of various types to meet general requirements for electric lighting, heating, cooking, motor car ignition, &c. These switches have a positive action, the insulation is of mica, and the contacts are of copper; they are made watertight in cast-iron cases.

Messrs. Quead, Ltd., London, exhibited a selection of their well-known electric fires and heaters. They were also showing a table cooker combination, electric flat irons, soldering irons, fans, &c., the stand and exhibits being very similar to that seen at the recent exhibition at Olympia.

The Benjamin Electric, Ltd., London, exhibited industrial lighting fittings. Shop window fittings and reflectors as well as street lighting lanterns, vapour and gas-proof fittings, hand lamps, &c., were on view besides electric battery horns for motor cars.

Messrs. W. Canning & Co., Birmingham, had on view a selection of apparatus for electroplating, cleaning, and drying out in revolving and other barrels, including plating dynamos and chemicals, also polishing and grinding apparatus.

Messrs. Premier Electric Heaters, Ltd., Birmingham, showed a selection of domestic heating and cooking devices, some of which were seen in operation, such as kettles, radiators of various types and sizes, irons, hot plates, &c.

The Sun Electrical Co., Ltd., London.—This exhibit comprised a number of electric fires with robust elements, as recently described in our pages. Also standard and protected types of switchgear and fuseboards in iron and wood cases; reflectors for industrial lighting, electric signs and flashers, "Lesco" lampholders, and "Xcel" irons and heating apparatus. The "Kalkos" system of conduit wiring was also to be seen on this stand.

Messrs. Litholite Insulators, Ltd., London, exhibited moulded electrical insulators and insulating material for all purposes, including terminal blocks, bushes, and bush spindles, terminal caps, lamp holders and adaptors, &c.

Messrs. Donovan & Co., Birmingham, showed ironclad power and lighting distribution boards, switches, and wall plugs, besides motor regulators and starters, and a number of electrical accessories, such as conduit, insulators, and domestic appliances.

The General Electric Co., Ltd., Birmingham.—On this stand were seen lighting fittings, lamps, and accessories; switchgear, flexible wire and cable, accumulators, medical apparatus, cooking and heating, as well as ventilating apparatus and electric measuring instruments.

The Edison Swan Electric Co., Ltd., Ponders End, Middlesex.—This stand comprised a large selection of the firm's manufactures, including heating and cooking apparatus, switchgear, and complete boards for country house lighting, wire, cable, and conduit, electric indicating and house service meters, and many other devices. An electrically-driven vacuum cleaner shown on this stand differed from the usual type inasmuch as the switch was incorporated in the handle. The latter is in a vertical position when the machine is not in use, but when pulled forward starts the motor or stops it when returned to the vertical position.

Messrs. Player & Mitchell, Ltd., Birmingham, had on view ships', yacht, river, and motor boat fittings, lamps, and navigation lights; also railway lamps, tramcar and railway brass work, &c.

Messrs. F. & C. Osler, Ltd., Birmingham, had a noteworthy stand showing electric lighting fittings in wrought and cast metals, as well as in cut glass. The firm specialises in the reproduction of historic models from the originals in the various museums, and many beautiful examples were exhibited.

The Tok Manufacturing Co., Ltd., London, exhibited rotary snap switches with capacities of from 500 to 5,000 watts, in single and double-pole, 2 and 4-way, 2 and 3-circuit, and series-parallel types. A heavy duty type suitable for heating and cooking or medical purposes was on view, as well as a lighter type as commonly used on the Continent instead of tumbler switches.

The Jackson Electric Stove Co., Ltd., London, showed various cooking and heating apparatus, including water heaters and radiators, also apparatus for medical, dental, and industrial uses. The firm manufactures cooking outfits up to any size for ships, restaurants, &c., as well as for private house use.

Messrs. Venner Time Switches, Ltd., London.—On this stand several time and other automatic switches for controlling electrical circuits were seen in operation. Demand limiters for the flat rate system of charging as used in housing schemes and switches for restricted-hour, 2-rate, Merz-demand, and other systems, were also on view.

The Improved Solidite Co., Ltd., Wandsworth, London, exhibited a cheap insulating material which can be moulded into any shape or form, and is made in nearly every colour. Metal fittings can be moulded into the article to be made, and the material is supplied in a number of grades and also in qualities suitable for machining.

The Semaphore Engineering Co., Ltd., Wandsworth, London, had on view dry batteries for all purposes, large and small, as well as complete electric lighting sets for use on motor cars and cycles.

The Frederick Crane Manufacturing Co., Ltd., Birmingham, exhibited celluloid lacquers and varnishes for all purposes, also coloured and frosting lacquers for lamps, &c.

The Damard Lacquer Co., Ltd., Birmingham, showed lacquers for general brass work, as well as "formite" and "bakelite" insulating materials for preparing moulded insulation, which is claimed to be acid resisting.

Messrs. Greenwood & Batley, Ltd., Leeds, exhibited "Bipol" accumulators, (as supplied to the Metropolitan Police) in which the paste is carried in wood frames, without lead grids, and the electrolyte is absorbed by glass wool; the complete battery is 25 per cent. lighter than the ordinary type.

Messrs. Wm. Goodyear & Sons, Ltd., Dudley, exhibited, amongst other things, the "Greenbat" electric industrial truck, which, as its name indicates, is manufactured throughout, including the motor, by Messrs. Greenwood & Batley. The motor is of the enclosed series-wound type, arranged for series-parallel control. The drive is by differential gear worm transmission shaft and universal coupling, all drives being taken by squares on the shafts. The battery is of the Chloride Ironclad Exide type. Every part of the truck is interchangeable; it will attain a speed of 5 M.P.H., three speeds in either direction being given. The pedal cut-out is interlocked with the controller, the latter must be brought to the neutral position to restart after once stopping, thus taking current through the resistance coils and starting on first speed again, which insures smooth running and avoids overloading the motor.

The British Ever-ready Co., Ltd., London, showed electric cycle lamps and motor car accessories, such as roof, hood, dashboard, and steering pillar lamps, switches, plugs, inspection lamps, ignition, and other batteries, &c.

The Western Electric Co., Ltd., Birmingham, representing British Electric Vehicles, Ltd., exhibited battery trucks for carrying half-ton and one-ton loads, also a battery locomotive for hauling 10 tons on rails. The exhibit also included intercommunication telephones from 2 to 25 lines, switchboards, and magneto and central battery telephone instruments.

Messrs. Industrial Appliances, Ltd., London, exhibited three types of battery industrial trucks, one having a capacity of 15-20 cwt., and the others each with a capacity of 2 tons, being box and drop-frame trucks. Three speeds are given in either direction with speeds ranging from 5 to 8 M.P.H. "Railodok" trucks are of all-British manufacture, and they are capable of hauling from 3 to 5 tons over and above the load according to the type.

Messrs. Alloy Welding Processes, Ltd., London, showed arc welding plant, using alternating current, in actual operation. The exhibit included samples of various types of electrodes and numerous sample welds and welded articles.

The Simoon Engineering Co., Ltd., London, showed D.C. motors and ironclad and switchboard type fuses. The motors

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are manufactured in the open protected, semi, and totally-enclosed types, being either shunt, series, or compound wound. All parts are standardised and interchangeable; ball bearings are fitted. The coils are former wound, and the windings are of the barrel type. The copper commutator bars are mica insulated with micanite cone rings.

The Relay Automatic Telephone Co., Ltd., London.—On this stand, besides throat transmitters for use in noisy positions, the Marconi relay automatic telephone system was shown, which employs relays only, complicated electro-mechanical switching devices being unnecessary. It is claimed that the maximum movement in any part of the switchboard is only 1/32 in., resulting in a high degree of reliability.

Messrs. Attwater & Sons, Preston, exhibited mica for all electrical insulation purposes. The firm imports and cuts mica and makes micanite and bakelite in all forms, the latter especially for transformer oil switch gear.

Messrs. Electrical Conduits, Ltd., Walsall, showed tubes and fittings for the protection of electrical conductors in ships and buildings, including heavy gauge tubes with screwed ends and plain for grip or bored fittings, also junction and switch boxes, &c.

The London Electric Wire Co. & Smiths, Ltd., London.—On this stand a selection of the company's manufactures of wire and cable, insulated with different materials, as used in the manufacture of electrical apparatus of all kinds was to be seen.

Messrs. Vickers, Ltd., London, who had one of the largest stands, had a representative show of engineers' small tools, alloy steels, "Cosmos" electric lamps and case showing process of manufacture, various domestic heating and cooking devices, wires and cables, measuring instruments, rubber gloves, and rubber-proofed fabrics.

Messrs. May & Padmore, Ltd., Birmingham, had two stands on which, amongst other exhibits, were shown Bastian electric fires and heaters, irons, ovens, and electrically-heated water tanks.

Messrs. Edgar A. J. Hooper, Ltd., Birmingham, showed electric lighting fittings, comprising lanterns, brackets, single drop lights, pendants, standards, &c., a speciality being made of polished and satin brass, antique brass and copper, and oxidised silver finishes.

Messrs. Berry's Electric, Ltd., Birmingham, exhibited a number of the well-known "Magicoal" electric fires which were shown in operation.

Messrs. Watertight Fittings, Ltd., Chesterfield, exhibited a range of fittings and brackets in cast iron and brass for use with electric lamps; also conduit boxes and 5-amp. switches and fuses in cast-iron boxes.

The Electric Appliances Co., Ltd., Birmingham, showed "Imperial-Eureka" vacuum cleaners, including the electrically-operated model.

LONDON.

Messrs. Siemens Brothers & Co., Ltd., Woolwich, showed a remarkable variety of primary cells, ranging from the Minotto type, once so familiar, to the most up-to-date pattern of improved Leclanché. Both wet and dry cells were shown, but the latter formed the great majority, including bell cells of various forms and sizes, medical cells, flash-lamp batteries of many different sizes and shapes, and the well-known "Inert" cells, which are particularly suitable for export, not being liable to deterioration in stock or in a tropical climate. We wede specially interested in the application of the "Inert" principle to refills for pocket lamps, a valuable innovation; it is not intended that these small cells should be charged by the ultimate buyer, who would probably bungle the job—they are to be filled by the retailer at the time of sale to the user. Thus the tradesman is protected against loss in storage, and the user gets what is in effect a brand new freshly-made battery, no matter how long it has left the maker's hands. Another interesting new type was the "G.R.3" ignition battery giving 4½ or 6 volts, which is intended mainly for a reserve or stand-by to the usual magneto ignition. Other exhibits were flash-lamp cases and materials of all sorts and sizes.

The Artistic Shade Co., London, had an exhibit of exceptional interest and attractiveness—one to which, we understand, the Queen gave special attention and commendation, and which the lay Press singled out for prominent notice. The company specialises in silk shades on wire frames, though parchment and linen are also used. The standards are in many cases of wood, turned and carved, and the shades are designed to match them. The shades are all made by hand to the designs of an artist, and many of them are hand-painted. For the convenience of customers the company's artists are available to prepare artistic colour schemes and design appropriate shades, bowls, &c. It is pleasing to add that the shades are moderate in price.

Messrs. James Pitkin & Co., Ltd., London, had an interesting exhibit, including the Holden electric chronograph for measuring the velocity of projectiles, of which a large number were made during the war; this instrument utilises the fall of a long rod under gravitation to give the time element, the distance traversed by the rod during the flight of the projectile between two screens being recorded on it, and accurately measured with a vernier device which is graduated in terms of velocity. The details of construction of the device are ingenious and interesting. An exhibit of wider industrial application was a new automatic coil winder; this machine is provided with automatic stop mechanism, length and convolution recording devices, and various adjustments to suit different sizes of bobbins, to control the tension of wire, &c. Samples of a new line of moving-coil measuring instruments, in which the operation of changing the range causes a corresponding number to appear on the dial, and many other instruments of non-electrical character, were shown.

The Vulco Manufacturing Co., London, showed samples of their accumulators, coils, battery boxes, and Ford parts, &c.

Messrs. Newton & Wright, Ltd., London, had a very good exhibit of standard X-ray and electromedical apparatus for hospitals, &c., including "Snook" transformer, induction coils, interrupters, and other apparatus for radiology, and electrotherapeutic apparatus. A novel feature was an X-ray apparatus for dental surgeons, having an oil-immersed transformer in the base with two secondary windings for the Coolidge tube, one to feed the filament and the other to generate the rays. The penetrative power of the rays was controlled by a small rheostat, in the filament circuit, and the tube, which was completely shielded with a lead-glass enclosure and a lead alloy funnel, was mounted on a parallel-motion frame and provided with a stereoscopic movement, as well as vertical and angular adjustments. The apparatus was designed to work off the public supply mains, the tube taking 5 milliamperes with an equivalent gap of 5 inches. The latest radiographic screen with convenient adjustments was shown; the tube was mounted in a lead-covered box, covered with lead-rubber, and the fluorscopic screen, carried by an integral aluminium casting, with suitable adjustments, was surrounded with an ample protective apron of lead-rubber.

Messrs. Henry G. Richardson & Sons and Messrs. Thos. Webb & Sons, Ltd., of Stourbridge, showed glassware for electric fittings. These and other firms testified to the extraordinary demand for such goods which prevails at present.

ELECTRIC POWER SUPPLY IN THE RHINE VALLEY.

The following is an abstract of the lecture by Lieut.-Col. F. C. Aldous and Mr. A. E. L. Scanes, delivered at the North-Western Centre of the Institution of Electrical Engineers on February 10th, and at the Liverpool Sub-Centre on February 16th.

Electrical power supply in the Rhinelands has been developed to a very high degree, which is immediately made evident by the extensive use of overhead transmission lines, and by the installation of electric light and power even in small villages.

An attempt is made in this paper to give an idea of the general development during the last three years.

The power supply in the whole of the Rhine Valley, from Essen to Ahrweiler, is in the hands of one company, the Rheinisch Westfalisches Electricitatswerk, Essen (the R.W.E.) This is a private company, about a third of the shares being held by the Communes which receive light and power.

The R.W.E. is sub-divided into subsidiary companies, but while these are administered independently, the generating stations are all interlinked, and the feeders are carefully laid out so as to form a series of ring mains. The connections between the different stations are made partly by underground cables, but in most new work by overhead lines. All power is generated at the same periodicity, *i.e.*, 50 periods.

The Communes have a union in order to treat with the R.W.E. with regard to prices, and have also representatives on the board of the R.W.E.

Power is in general transmitted at 25,000 volts, 3-phase, and is transformed in the company's sub-stations to 5,000 volts, at which voltage it is distributed to consumers.

Besides the anthracite in the Essen district there is an area west of Cologne where there are large beds of lignite, close to the surface, and in seams of great thickness. The possibility of the conversion of this fuel into electric power had been proved as a commercial proposition, and it was, therefore, decided to erect a station of large size employing nothing but large units. The objects were, first, to transmit power to the Essen district and to reinforce the stations in that area; it was also proposed ultimately to transmit power much further north, for which reason a 100,000-volt transmission line was constructed to Osterath and Reisholz. Secondly, to develop electrical power supply in the southern area. This is being done by feeding into the old system by 25,000-volt underground mains, also by overhead transmission designed for 100,000 volts.

A large generating station known as Goldenbergwerk was begun in the year 1911, and at the outbreak of war there was one set in operation, a 15,000-kw. turbo-generator. The fuel burned in this station is lignite, obtained from an open

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mine, close to the station. The mean thickness of the coal seam is 40 yards, and it is excavated by means of bucket machines, each driven by a 90-KW. motor. An electrically driven conveyor brings the trucks, of ½-ton capacity, under a hopper, and the coal is discharged into successive trucks. By other conveyors the trucks are brought to four crushing houses, where they are automatically tipped into bunkers, from which the coal descends by gravity to the crushers. The machines are capable of dealing with 3,000 trucks in an 8-hour shift. At this rate the station could take in 18,000 tons of coal a day, which is sufficient for a continuous output of 125,000 KW.

Owing to the low calorific value of lignite and the large quantity of water which it takes up, a very large amount of fuel has to be dealt with, probably four or five times the weight that would be burned in a station using hard coal.

The station is built principally of ferro-concrete, and is arranged for extension on the western side. Since, however, the original design of the station has been departed from, any great extension will lead to considerable difficulties with regard to the connection between the generators and the transmission lines. There are at present four boiler houses, each about 300 ft. long, in each of which ten boilers are installed. Whereas the original design with six 15,000-KW. sets allowed for two boiler houses on the south side, in the latter extension the turbines are fed with steam from both sides.

The water-tube boilers are of the Stirling type, of 8,300 sq. ft. heating surface, evaporating 46,000 lb. of water per hour mean, 70,000 lb. per hour maximum, specially designed for burning lignite. Each boiler has five furnaces, giving a total grate surface per boiler of 530 sq. ft. The fuel contains as much as 67 per cent. of water, and as it descends it is heated, and gas and steam are driven from it. The gas passes through holes and burns over the incandescent fuel, which lies on the fire bars to a depth of 6 to 10 in. If the fuel becomes too dry it is apt to burn back in the shoots. Green economisers of standard type are used. Both electrically and turbine-driven rotary boiler fuel pumps are installed.

Natural draught is provided by eight chimney stacks, 360 ft. high, giving a draught on the boilers of about 1 in. of water, the temperature of the furnace gases in the uptake being about 450 deg. F. Only about 2½ per cent. of ash remains, which is dealt with by a central vacuum plant.

Steam is delivered at a pressure of about 215 lb. superheated to about 660 deg. F., to a 16-in. main, whence it is fed to the turbines. The engine room, about 500 ft. long, is equipped with 70-ton electric cranes for the small sets, and 120-ton cranes for the large ones. The turbines are seven in number, five of 15,000 KW. and two of 50,000 KW.

The 50,000-KW. turbine runs at 1,000 R.P.M., and is designed with one velocity wheel having two rows of blades, and nine Rateau wheels. The turbine weighs 250 tons, of which the rotor alone weighs 49 tons. The generator scales 225 tons and the generator rotor 106 tons. The turbine wheels vary in mean diameter from 134 to 150 in., which gives a mean velocity of 590 to 725 ft. per second. The design is very similar to the A.E.G. 15,000-KW. sets.

Owing to the war, the manufacturers were compelled to make the disks and blades of carbon steel, both on the 50,000-KW. sets and also on some of the 15,000-KW. sets, but it is understood that up to the present they have suffered no trouble from corrosion or erosion.

The consumption, about 12.5 lb./KW., is of course not good, owing to the low vacuum obtained, and the area of the exhaust branches is considerably less than is allowed for the 18,750-KW. sets now being installed at Glasgow by the Metropolitan-Vickers Electrical Co.

The air filters are enclosed in separate ferro-concrete buildings, each unit having a capacity of 30,000 KW.

The generators, with direct-coupled exciters are arranged with partly radial and partly axial ventilation, with a fan at one end. In case of fire in a generator, it is quickly extinguished by means of a hose pipe and compressed CO_2.

In the 50,000-KW. set the condensers are of the surface type placed with their axes parallel to the axis of the turbine, and each has a surface of about 34,000 sq. ft. In order to obtain a proper distribution of steam to the surface of the tubes, the shells are filled not more than two-thirds up, and very large gaps are left between the banks of tubes to allow the steam to pass well into the centre. This design would appear to be very extravagant in material, owing to the low tube plate efficiency. It is far better practice to reduce the diameter of the shell and carry the tubes nearly to the top, at the same time putting an ample steam dome at the inlet to distribute the steam. The tubes are about 1 in. bore.

Following the usual Continental practice there is no water box on either end of the condenser, and as these are two-flow, all the pipe connections are made on one cover; should it be necessary to remove this, the pipework must be dismantled.

It is general practice throughout the station, with the exception of the 50,000-KW. sets, to have one motor-driven and one turbine-driven set of pumps. The turbine-driven sets are direct-coupled without the use of gears.

There are two sets of turbine-driven pumps to each main turbine. The sets run at 1,000 R.P.M., direct coupled to circulating air and extraction pumps, the rating being 1,000 B.H.P. per set, giving a total of 2,000 B.H.P. for 50,000 KW. Any of the four auxiliary sets serving the two main units can be used on any of the four condensers. The circulating pumps in the same manner are connected to a common bus-pipe running under both condensers.

Cooling towers are used, and as the water is very hard, about 15 degrees, the whole of the make-up water is passed through a battery of 12 Permutit water softeners.

The loss of vacuum on the condensing plant was very serious due to the rapid deposit of lime, and at the end of six months, it was impossible to introduce a finger into the tubes. With the present Permutit system it is possible to run for three years without cleaning a condenser. The greatest care is taken throughout the station to keep the feed water from contact with the air, and provision is made for removing all CO_2 from the water, it being the impression in Germany that most corrosion of boilers is due to CO_2 rather than to air.

In the part of the station occupied by the two 50,000-KW. sets the depth from the engine-room floor level to the basement level is nearly 33 ft. This involves very costly buildings. Under each of the 50,000-KW. generators there is a large chamber hollowed out, to which the air is admitted by means of a sliding door. The entrance to this chamber is by means of a double air-lock door. One side of the chamber is almost entirely occupied by the end of the surface condensers, which are hermetically sealed into the wall. It is thus possible to clean and withdraw the tubes in what is substantially the air duct of the plant.

The two chief reasons for placing the Goldenbergwerk on its present site, which involves the use of cooling towers, rather than on the Rhine, were: the amount of coal used daily amounts to 7,000 tons at the present time, which will be increased as the station is extended; and the natural water in the Rhinelands is excessively hard, sufficiently so to substantially close up the tubes.

Each 15,000-KW. machine is directly connected to a 6,300/25,000-volt transformer, and synchronisation is done at 25,000 volts by electrically operated oil switches fitted with overload releases, each switch consisting of three separate single-phase switches, each in a fire-proof chamber. Automatic synchronising is not used. Bare copper conductors are used from generator to transformer and from transformer to switch. Emergency 6,000-volt conductors, or busbars, are installed by means of which any machine can be connected to any transformer.

The busbars are in duplicate and are normally worked on two separate sections, so that in case of a breakdown on the mains, only part of the station is affected. By means of selector switches, a machine can be thrown on to either set of busbars. About half the power from the station is distributed at 25,000 volts, the remainder at 100,000 volts. The whole of the 100,000-volt apparatus—busbars, switches, transformers, lightning arresters, &c.—is contained in a separate building.

The 100,000-volt transmission lines are interconnected at a point about 25 miles away, so that in the event of a breakdown on one line, power can be obtained by another route. Outgoing transmission lines are connected through air-break switches to lightning arresters of the horn type, connected to earth through water resistances, there being two separate resistances in series for each phase. In parallel with the lightning arresters are high-resistance choke coils connected to earth.

The 50,000-KW. sets are directly connected to A.E.G. transformers of 60,000 K.V.A., 6,300/110,000 volts, synchronisation in this case being done at 100,000 volts. From each transformer the high-pressure conductors are led by overhead wires to the transmission house, where they pass downwards through air-break switches to two 100,000-volt electrically-operated oil switches, fitted with overload and no-volt release. These switches have been successfully tested to break a load of 100,000 KW. The cumbrous nature of this switch is certainly an argument against the use of sets as large as 50,000 KW.

The overhead transmission lines are some of iron and some of aluminium, with a steel core .13 sq. in. cross section, and are carried on steel towers, with concrete foundations.

The insulators are porcelain and of the suspension type, and the line is typical of American practice. Where the lines leave the station the towers are about 130 ft. high, but the usual height is about 80 ft., and the span about 150 yards. Where a line crosses the Rhine, it is carried on towers 260 ft. high, the span being about 500 yards. The lines are taken across open country, which is largely agricultural, electrical power companies having special rights to demand wayleaves for power lines. These lines cross roads, electric railways, telegraph lines, &c., with no protective net.

In order to balance the phases, the wires are crossed over three times on each circuit.

Besides the motor and lighting load, there are important electrical furnaces supplied by this station, including about 10,000 KW. in the neighbourhood of the station, and 8,000 KW. at Erftwerk for the manufacture of aluminium. As a result the power factor of the station is kept fairly high, about 0.8, and no special arrangements to improve this are made. The load factor of the station is between 0.6 and 0.7. There are in the Reisholz area large electrically driven rolling mills.

For lower voltages, 5,000 and under, though a large amount of cable work is used, wherever possible wires are run overhead, especially on new work. A usual practice is to run overhead wires up to a village where the current is transformed

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down to 220 volts, and distributed through the village. The low pressure wires are run on short tubular poles, which are carried on brackets on the houses. Lighting leads are then carried into a porcelain cap on the pole, down the tube, and through an insulator into the house.

Another lignite station of similar dimensions was built during the war at Zsabornewitz, near Bitterfeld, where eight 22,500-K.V.A. turbo-generators are installed. Power is generated at 6,600 volts, and is transmitted at 110,000 volts, a distance of 132 km., to Berlin, and at 82,500 volts to important nitrate factories.

The Troisdorf factory is owned by the Rheinisch-Westfaelische Sprengstoff-Actien-Gesellschaft, and at the end of the war it was manufacturing about 80 tons of guncotton and about 40 tons of smokeless powder per day, also detonators, celluloid, &c. All the power used here is electric; steam plant is used only for heating and drying, the electric power being taken from the mains of the R.W.E. The consumption in 1918 is said to have been 40 million units. The factory receives power by two 25,000-volt 0.08 sq. in., 3-core cables at the main sub-station; distribution is effected at 5,000 volts, and at 220 volts for lighting.

The motors in this factory, 800 in all, from 300 to 70 H.P., are wound for 5,200 volts, and below this size for 220 volts. They are built in general for medium speeds and for belt drive. The average power factor of the system under normal working is about 0.7.

The Cologne-Bonn railway is supplied from its own power station, and operates at 1,000 volts D.C. A standard train consists of two motor cars and two trailers. Each motor car has two 130-H.P. motors, and the maximum speed is 45 M.P.H. Current is collected from a double trolley wire by two pantograph bows on each motor car. On entering the town area, the train operates on the town circuit of 600 volts D.C. Westinghouse air brakes are installed.

The Sieglar sub-station of the Sieglar-Zündorf light railway is operated entirely by mercury vapour converters, the original motor-generators being kept as a standby. The three mercury converters were built by the Gleichrichter A.G. Glarus, Zürich, each for 200 KW., 6-phase, 800 volts D.C. They occupy less floor space than motor-generators or rotaries, and the first cost is said to be less. Similar converters are built by Brown, Boveri up to a size of 500 KW.

Discussion at Manchester.

The Chairman (Mr. J. A. Robertson) remarked that the lecturers did not seem to be overflowing with admiration for everything they had seen, and Mr. Scanes had been severely critical with regard to some points. It was not usual for a discussion to take place on a lecture such as this, but the members might like to ask questions in order to get further information on matters that had been touched upon.

Mr. G. Sills said in 1914 he saw some big 100,000 volt switches in Berlin which had buffer resistances inserted in the bottom of the tanks. Had buffer resistances been introduced into the 100,000 volt switches to which Col. Aldous referred?

Mr. J. Drummond Paton said he had been in the district and had seen the brown coal made into briquettes under pressures of 10,000 to 12,000 tons. In that form there was no need to use such a large quantity as Col. Aldous stated in order to secure the desired thermal efficiency. He thought that there was probably a lack of briquetting material, and the lignite was, therefore, used in a crude semi-dry state. An interesting point was the extent to which the administration was determined by the influence of the communes. He had earnestly advocated with regard to the proposed super stations that the representatives who were to administer the electricity supply should be chosen from the people.

Mr. Ellis, criticising the diagram of a station which had been shown, said it appeared to him the lay-out was absolutely spoiled by jamming together two 50,000 KW. generators on opposite sides of the engine room. To his mind it completely spoiled the extension of the station in the future.

Col. Aldous, in replying, said he was not able to get a photograph of the 100,000-volt switches. There were three tanks, one for each phase, each tank being about 5 ft. broad, 6 ft. high, and 9 or 10 ft. long. The current was broken at four points in series, and between the two middle points there was a buffer resistance. All three tanks were quite close together, so that a breakdown might have disastrous results. He noticed that on the smaller switches each phase was in a separate compartment. The lignite was used not in briquettes but in the crude form. That was the reason why the calorific value was so low. Measured in pounds of steam per pound of fuel it was from 1.5 to 1.8, whereas when the lignite was compressed into briquettes it was about 5.5. They seemed to get on very well with the crude lignite, and he rather doubted whether it would pay to install plant to compress the fuel into briquettes.

With regard to Mr. Ellis's criticism, the diagram might be mistaken in showing the two 50,000-KW. generators so close together, but it was a fact that in the position shown it completely altered the lay-out of the station, and it would have to be considered when the time came to extend. The only way of getting power out was by overhead transmission. He supposed the transformers were built up on site. Some of the 60,000 K.V.A. transformers were built by the A.E.G. and others by Siemens.

Mr. S. L. Pearce, in moving a vote of thanks to the lecturers, said he believed a good deal of the capital of the Rhenish Westphalian Company was held by the municipalities, but that the operations were entirely carried out by the company's staff. It was well known that the Electricity Supply Act of 1919 made provision for the inclusion of the consumers to take a share in the administration of the district authority. He agreed with the criticism of the lay-out of the station with the two 60,000-K.V.A. generators, but in all fairness it should be remembered that obviously the station had been extended beyond the limits for which it was originally designed. That was the case to-day with a good many stations in this country. The ratio of heating surface to grate area seemed to be abnormally low. Doubtless it was occasioned by the quality of the fuel which was being used. The same observation applied to the cooling surface in the condenser. The switchgear lay-out, as it appeared on the screen, was certainly exceedingly complicated. That arose from the fact that two secondary distribution pressures were employed, one at 25,000 and one at 100,000. The step-up transformer and the generator should be treated as one unit, and there should be one step-up pressure only if it could possibly be arranged. He still remained unconvinced as to the merits of overhead lines.

Discussion at Liverpool.

Dr. E. W. Marchant (chairman) said the paper gave a remarkably complete description of the new power stations which the Germans had succeeded in putting up during the war. They would like to have some more information, especially with regard to the mercury converters.

Mr. H. Dickinson said he had been in the district in June, 1914, and was told that coal could be delivered to the boilers at 1s. 3d. per ton. The Power Co. had a 50 years' contract. The 50,000-KW. machine was not as difficult a proposition, considering the speed, and the vacuum, as some that were now being undertaken in this country, for instance, the 2,000-KW. set for the new station on the Wear, which was running at 2,400 R.P.M. with a vacuum of 29¼ in., whereas the 50,000-KW. set was only running at 1,000 R.P.M.

Mr. T. D. Clothier said the proposition clearly was to utilise an almost unlimited supply of fuel in the form of soft coal—fine stuff to work with in one respect, as there was only 2½ per cent. of ashes, compared with 35 to 40 per cent. of ashes here. The distribution from these large power stations required most careful consideration. The difficulties of transmission in this country were more important than the difficulty of getting coal and water. If the use of mercury converters proved a sound proposition it would raise the question whether the present tendency to turn over from D.C. to A.C. low-pressure distribution was necessary and proper.

Mr. Ohlson said the Germans in this instance had erected their station on the coal fields, whereas in this country stations were placed in the middle of the consumers, and coal and water were brought to them. For the conditions prevailing in this country the latter course was the most suitable.

Mr. W. Lang said the location of the stations always cropped up. He was of opinion that they could leave out the cable question altogether, and go on with the station. The cable makers would always be ready to fill in any gaps.

Mr. S. E. Povey asked a number of questions, and on the subject of burns-out of large generators, said the use of an automatic switch to break the excitation current and kill the exciter field was to be recommended as likely to minimise the risk of the insulation of the generator catching fire. The switch should operate automatically after the main oil switch had been operated, and not be left to an attendant.

Mr. A. E. L. Scanes, in the course of his reply, said the calorific value of brown coal varied from 3,000 to 3,400 B.TH.U. per lb. The exhaust steam from the auxiliaries could be partly used either in the main turbines or diverted to the condensers. Owing to the inefficiency of the small turbines, it was probable that there would be too much steam for the whole of it to be used for feed heating. Referring to the question of wages, at the present time when the men asked for a rise they might get a reasonable one. If, on the other hand, they did not think it was reasonable, the military governor appointed a referee, and both the masters and the men had to appear before him. As the referee was entirely unprejudiced, his decision was usually accepted. In any case there was no appeal, and the referee's decision was enforced.

Lieut.-Col. Aldous said that no definite figures were available as to the cost and efficiency of mercury converters, but these were believed to compare favourably with the rotary converter. He had no definite figures as to the price of coal, but the price had gone up as well as everything else, and if they had a contract for 50 years, this contract must have been revised. He believed all the stations in the Essen district were linked up, some with 25,000-volt lines, and others with 100,000 volts. The power used on one section of busbars would appear to be from 30,000 to 50,000 KW. They did not appear to use reactances in the generating circuits. He thought they had no special system of protection for generators or for feeders, but relied on the overload release, with time limit on the oil switches, and this country was very much ahead of them in this respect. Horn type lightning arresters were used almost throughout.

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NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

A Marconi Wireless Telephone Cabinet.

The accompanying illustration, fig. 1, shows the new Marconi ½-kw. wireless telephone and telegraph cabinet, which was briefly mentioned in our last issue in connection with the British Industries Fair; it measures about 4 ft. high by 2 ft. deep and 4 ft. wide, and is supplied with power at 85 volts, 150 cycles, by a rotary converter or motor generator. The minimum daylight range for telephony is 100 nautical miles; for telegraphy by "tonic train" (interrupted continuous wave)

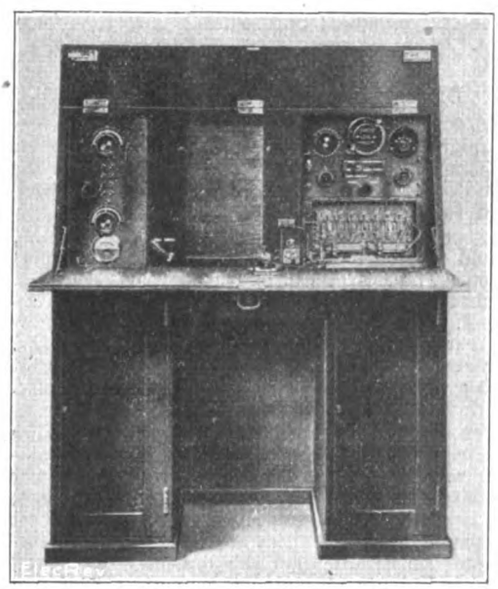

Fig. 1.—Marconi ½-kw. Cabinet.

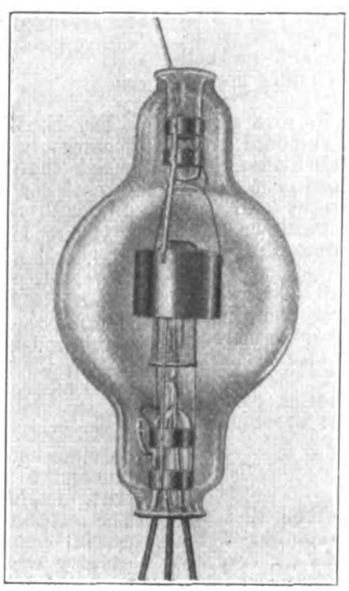

Fig. 2.—Transmitting Valve.

the range is 130 n.m., and for telegraphy by uninterrupted c.w., 300 n.m., with aerials at least 100 ft. high and 220 ft. long. The source of high-frequency energy for transmission is a Marconi patent three-electrode valve (fig. 2), which is maintained in oscillation by a reaction coupling; for telephony a similar valve is used to control the amplitude of the oscillations, and by switching over from the microphone to a buzzer and key the change to "tonic train" telegraphy is made. The high pressure for the anodes of the valves is provided by a step-up transformer through a two-electrode rectifying valve,

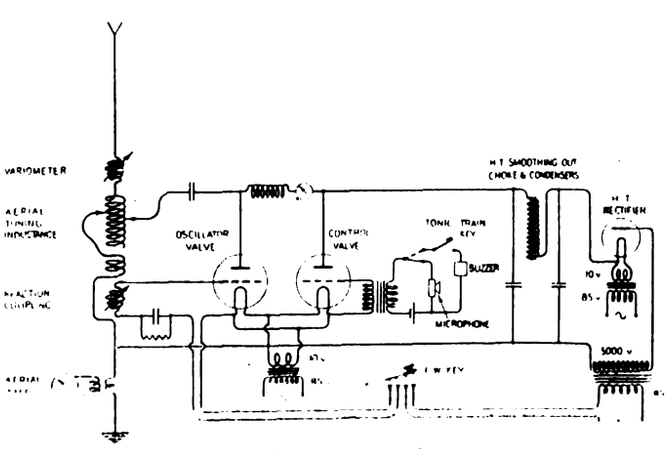

Fig. 3.—Diagram of Transmitting Circuits (simplified).

in circuit with smoothing-out choking coils and condensers, and a step-down transformer with two secondaries supplies current to the filaments of all three valves. The receiver is provided with a standard Marconi seven-valve amplifying detector, and the change-over from transmitting to receiving is effected by the movement of a single multiple-contact switch. It will be observed that the whole of the work is done with valves, and that no discharger is required. The apparatus is made by Messrs. Marconi's Wireless Telegraph Co., Ltd., of Marconi House, Strand, London, W.C. 2.

Inspection Tube Fittings.

Messrs. Isaac Griffiths & Sons, Imperial Tube Works, Friar Street, Wednesbury, have recently introduced a labour-saving invention in the form of inspection tube fittings (fig. 4). These fittings are designed to take the place of "draw-in" boxes in conduit work, and consist of tubes possessing outlets twice the length of the opening in the boxes. As the overall diameter of these tubes is only slightly greater than that of the conduit, less space is taken up, and the appearance of the system is greatly improved. The sizes of these fittings range from ⅜ in. diameter to 2 in.

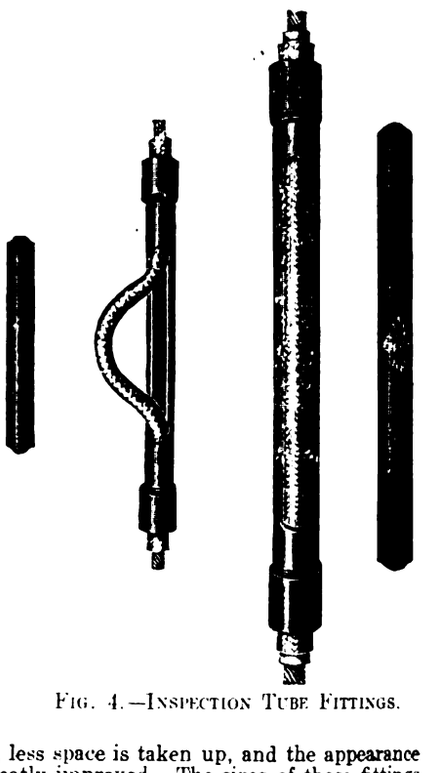

Fig. 4.—Inspection Tube Fittings.

A New Electric Bed Warmer and Food Warmer.

Mr. Leoline Edwards, 81, St. Margaret's Road, Twickenham, is the manufacturer of a simple but effective device for warming a bed. As will be seen from fig. 6, the device consists of a metal cylinder closed at one end. Within this case is a sleeve which can be moved up or down, and to this is

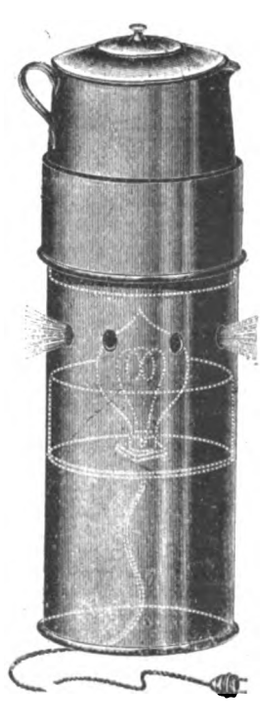

Fig. 5.—Foot Warmer Adapted to Food Warming.

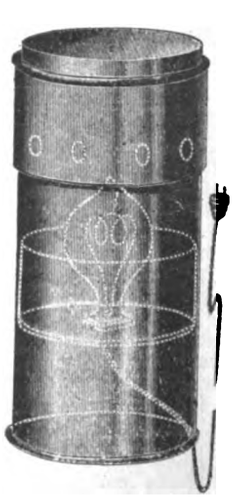

Fig. 6.—Foot Warmer.

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fixed a 2½-c.p. carbon lamp, together with a length of flex and an adapter. The mouth is closed by a metal cover. The cylinder is covered with flannel.

This warmer can be adapted to food warming (fig. 5), and will also serve as a night light when the flannel cover is removed, the cylinder being perforated at the middle. Food may be kept at a temperature of 100 deg. F. for any period by means of this device, the cover being in the form of a small pan with handles.

A series of readings taken by means of a thermometer in bed showed that a temperature of 114 deg. F. was reached in half an hour. After eight hours the reading was 220 deg. Water (1½ pints) was boiled and placed on the heater; the temperature after nine hours was 105 deg. F. Half a pint of cold water was brought to 115 deg. F. in eight hours.

LEGAL.

A Profiteering Inquiry.

The Complaints Tribunal of the Central Committee which was established to investigate charges of profiteering on the part of wholesale dealers, held a sitting at the Hotel Windsor, Victoria Street, S.W., on Thursday last week, under the presidency of Mr. W. Marshall Freeman, when a complaint was investigated which had been lodged by Messrs. H. Underwood & Co., of 37, Kilworth Avenue, Southend-on-Sea, regarding the price charged by Messrs. J. Sellar & Co., Ltd., of 1, Cheapside, London Road, Southend-on-Sea, for electrical slip conduit elbows. The complainants stated that the trade price charged by the respondents for elbows of ⅝ in., electric wiring conduits or tubing, of stamped metal, was 6s. a dozen. The same article, it was said, could be purchased locally at Southend at 3s. 6d. a dozen, while a better elbow of solid metal had been bought from the Edison & Swan Electric Co. at 2s. 4d. a dozen.

Mr. Harold Underwood, who appeared for the complainants, said he made a purchase from the respondents of three ⅝-in. wire conduits on December 20th. He was charged 6d. each for the elbows, and complained that in any other shop in Southend he could buy the same article for 3s. 6d. a dozen. He had previously purchased the same article from the respondents at 6s. a dozen, and had complained to them of the price charged.

Asked whether he had the letter, Mr. Sellar, who appeared for the respondent company, said he never received it.

Mr. Underwood added that he never received any reply to his letter. He had purchased better articles from the Edison-Swan Co. at 2s. 4d. a dozen; the goods sold by them were of solid metal. He had also obtained a quotation from Messrs. Young & Martin, Ltd., dated February 9th, who asked 4s. a dozen.

The Chairman; The ones complained about are described as split elbows?

Mr. Underwood: Yes. He went on to say that the previous Wednesday he went to the General Electric Co., Ltd., who quoted him 15s. a gross for the elbows, plus 50 per cent.

The Chairman: In other words, 22s. 6d. a gross, or 1s. 10½d. a dozen.

Mr. Underwood: Yes. He also produced a quotation from Electric Installations, who asked 3s. 3d. a dozen for stamped elbows with cast sleeves, and 3s. 9d. a dozen for malleable cast elbows.

The Chairman: What was the price of these things before the war?

Mr. Underwood: About 1s. a dozen. That, of course, was the trade price.

In answer to Mr. Sellar, it was stated by Mr. Underwood that he had done a good deal of business with the respondent company.

Mr. Sellar: Who paid the accounts?

Mr. Underwood: I did.

Was it your mother?—No; My father has paid accounts to you.

Have you ever paid us any money direct yourself?—Yes.

I think you pretty well know that we don't want your orders, as we don't assume that you are properly in the trade. Further, we don't consider three conduits a trade purchase, do we?—Yes.

Your mother has begged me not to have any dealings with you?—I have not heard of it.

The complainant said that before the war his mother was a bit scared about his being in business on his own account, owing to his age. He had not got a shop of his own—he could not get premises, and was carrying on the business from his private house.

Mr. W. Cuff, assistant manager in the conduit department of the General Electric Co., said that his firm manufactured and supplied elbows similar to those referred to.

The Chairman: What is the proper price?

Witness: The trade price for the stamped elbows is 15s. a gross, or 1s. 3d. a dozen, plus 50 per cent.

What about the solid elbows?—They are 2s. 9d. a dozen to-day, plus 75 per cent.

What was the price in November?—2s. 9d. a dozen, plus 33⅓ per cent.

What was the price of the stamped elbows in November?—It was the same.

Do you understand the trade custom regarding the supply of goods to gentlemen like the complainant?—We heard that he undertook jobs at houses. If he came to our counter and gave his card we should give him the trade terms, which would be the ones I have quoted to you.

Even if he only wanted a quarter of a dozen?—Yes.

The Witness went on to say that he agreed that a firm like the respondents reselling such goods should make a profit. The usual profit in the trade was 33⅓ per cent. on the cost price, or 25 per cent. on the selling price.

Mr. Sellar said that last year it was very difficult to get such goods, and he had messengers running about trying to get them.

Witness: You should have come to us.

Mr. Sellar, in putting the case for the respondent company, said that the business had been in existence for many years. He admitted the sale to the complainant at the price mentioned. He produced an invoice from the British Thomson-Houston Co., which showed that he purchased two gross of elbows at 40s. a gross, plus 20 per cent. Owing to the shortage last year in such goods, he had asked customers to let him have elbows, and had allowed them 4s. 6d. a dozen for such goods.

Questions were asked by the Chairman as to the extent of the respondent company's business, and Mr. Sellar said that during the war the turnover dropped to about £2,690. It had since increased, and last year amounted to something like £5,000. In the company's shop was a list which showed that ⅝-in. elbows were sold by them at 5s. a dozen.

The Chairman: Then why did you charge the complainant 6s. a dozen?

Mr. Sellar: I didn't want his custom.

You don't want the custom of a man who pays cash?—I charged him a penny extra for the three elbows.

The Chairman called attention to a letter which Mr. Sellar wrote to the Secretary of the Tribunal on February 18th, which stated "On two occasions he had asked for credit, and we have had to collect through our solicitors, and that is probably the bottom of the trouble."

The complainant declared that the statement was untrue, and the chairman said it was a serious matter.

Mr. Sellar further stated that he regarded the accused, not as a trade customer, but as a private buyer.

Mr. Geoffrey Green, of Leigh-on-Sea, spoke of the excellent reputation held by the respondent company. He had purchased elbows from the company at 5s. 6d. a dozen.

The Chairman: Did you think you were paying a good price?

Mr. Green: I could not get them elsewhere.

Mr. Sellar declared that there was no profit on the electrical branch of the company's business.

In giving the decision of the Tribunal, the Chairman said that the matter came before them as a wholesale transaction, which it was. The complainant had made out his case. By the custom of the trade, and the general practice adopted by the respondents, the complainant was given wholesale prices. The respondents put on 1s. a dozen, and therefore were guilty of profiteering, and had broken the law. The Tribunal considered that a reasonable and liberal price to have charged was 4s. a dozen. They, therefore, ordered a refund of one-third of the price charged. The chairman added that they did not consider that the case was of sufficient importance to justify any further action, but they hoped that the respondents would be more careful in future.

The Lighting of Underley Hall.

An application was made to Mr. Justice Eve, in the Chancery Division, on March 4th, by the Duke of Portland and Mr. R. D. Upton, trustees of a deed of settlement made by the late Earl of Bective on the marriage of his daughter, the present Lady Olivia Cavendish-Bentinck, of Underley Hall, Kirkby Lonsdale, for an order to raise capital by the sale of land, subject to the trusts of the settlement for the purpose of installing a new system of electric lighting and electric bells at Underley Hall.

It was explained to his Lordship that the present installation was put in under an order, similar to that now asked for, made by Mr. Justice Kekewich in 1898, but the engineer was advised that it was not adequate, or even safe.

His Lordship said the trustees had the power to raise the necessary capital, and made the declaration asked for.

Engines for Alcohol Fuel.—Reminding us that many years ago it conducted extensive experiments with regard to alcohol fuel engines, the Parsons Motor Co., Ltd., Southampton, writes expressing disappointment that in spite of the reports of Committees on this subject, up to now the Government has done nothing at all, except to appoint an Alcohol Fuel Investigation Officer. Feeling, however, that something must be done soon, the company last year carried out further experiments on alcohol and alcohol-benzol mixtures, and is now executing orders for engines using these fuels for countries where there is already a supply of power alcohol available. Some of our own Colonies are using alcohol fuel extensively. Alcohol fuel can be used in the ordinary petrol engine with very little modification, and alcohol-benzol even more easily still, but to get power and consumption results comparable with the paraffin engine numerous details have to be altered and attended to; the company's tests show results which are entirely favourable to alcohol fuel when these points have been duly carried out. If the restrictions on its use in this country could be removed, says the Parsons Motor Co., private enterprise would soon find a way to place large quantities of home-produced fuel alcohol on the market, with advantage to everyone concerned, avoiding exporting capital, utilising shipping, and at the same time helping home industries in many directions.

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NEW PATENTS APPLIED FOR, 1920.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. Sefton-Jones, O'Dell and Stephens, Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

5,340. Arc lamp electrodes for production of violet and ultra-violet light. B. M. Young and H. C. Ross. February 23rd.

5,360. Means for starting, lighting, ignition and warming motor-cars, motor-cycles, &c. R. H. Playfoot. February 24th.

5,364. Ignition devices for internal-combustion engines, &c. W. Pickard and D. R. Dobson. February 23rd.

5,381. Ignition sparking plugs. F. L. Rapson. February 23rd.

5,384. Arrangement for high-speed automatic printing telegraphy. M. D. Dimitrievitch. February 23rd.

5,388. Electrical, &c., signs. E. W. Chamberlain. February 23rd.

5,389. Thermal electrical switches. E. W. Chamberlain. February 23rd.

5,411. Device for preventing removal of lamps from holders. A. G. Cornwell. February 23rd.

5,423. Thermionic tubes for wireless transmission systems. S. Brydon, A. G. T. Cusins, S. Johnson, and J. H. Whittaker-Swinton. February 23rd.

5,424. Vacuum tubes, &c. S. Brydon, E. Cummings, and A. G. T. Cusins. February 23rd.

5,429. Device for replacing fuse wire and indicating blown-out electric circuits. P. Davies. February 23rd.

5,431. Circuit-breaker for electrically-heated utensil. E. C. R. Marks (Landers, Frary & Clark). February 23rd.

5,432. Electrically-heated utensil. E. C. R. Marks (Landers, Frary & Clark). February 23rd.

5,433. Electrically-heated device. Landers, Frary & Clark. February 23rd.

5,434. Electrically-heated device. Landers, Frary & Clark. February 23rd.

5,435. Controlling device. Landers, Frary & Clark. February 23rd.

5,437. Controlling device for electrically-heated utensils. Landers, Frary & Clark. February 23rd.

5,438. Electrically-heated utensil. Landers, Frary & Clark. February 23rd.

5,440. Contact devices. Siemens & Halske Akt. Ges. February 23rd.

5,442. Carbon brushes for dynamo-electric machines. W. W. Jarvis and Morgan Crucible Co. February 23rd.

5,467. Electric switches. S. Kobzy. February 23rd.

5,476. Means for securing incandescent electric lamps in holders. L. Myers and A. J. Nicolls. February 24th.

5,485. Electrical integrating meters. Electrical Apparatus Co. and A. J. Martin. February 24th.

5,496. Ignition devices for internal-combustion engines. D. R. Dobson and W. Pickard. February 24th.

5,534. Instrument for transmitting and receiving telephonic communications on aeroplanes, &c. Stols Electrophone Co. and W. A. Saxby. February 24th.

5,549. Process for electro-deposition of alloys of copper and zinc. S. O. Cowper-Coles. February 24th.

5,555. Operating tipping-gear upon vehicles electrically. E. H. Dine, P. F. Smith, F. R. Stocks. February 24th.

5,560. Ignition magnetos for internal-combustion engines. H. W. F. Ireland and H. Lucas. February 24th.

5,565. Spark plug cleaner. Champion Spark Plug Co. February 24th.

5,566. Electric foot rest and foot warmer. I. Panza and A. Zacchini. February 24th.

5,578. Field systems of dynamo-electric machines. G. Schroeder. February 24th.

5,585. Electric switches. Benjamin Electric Manufacturing Co. February 24th.

5,586. Circuit-closer. Benjamin Electric Manufacturing Co. February 24th.

5,609. Electrically controlled steering gear for ships. H. Morris-Airey, J. W. S. Dorling, W. P. Gandell and A. K. Macrorie. February 24th.

5,611. Electrical control apparatus for lighting systems. Igranic Electric Co. (Cutler Hammer Manufacturing Co.). February 25th.

5,619. Electric lamps. Flandem Co., A. H. Williams. February 25th.

5,643. Electric switches. R. W. Hills. February 25th.

5,650. Electric incandescent lamps for projection, &c. M. J. Mason. February 25th.

5,669. Sound-locating apparatus. British Thomson-Houston Co. (General Electric Co., U.S.A.). February 25th.

5,671. Thermo-cells for electrical measuring apparatus. Westinghouse Lamp Co. February 25th.

5,697. Wireless direction finders. H. J. Round. February 25th.

5,703. Process for production of metallic parts. S. O. Cowper-Coles. February 25th.

5,715. Multi-step amplifiers. M. I. Pupin. February 25th.

5,728. Receivers of high-frequency sound waves of electrical oscillations. M. I. Pupin. February 25th.

5,729. Adjustable setting lever for electric ignition devices. Bosch Akt. Ges. R. February 25th.

5,736. Apparatus for charging and discharging electric storage batteries. H. C. Hodges. February 25th.

5,737. Sound generators. M. I. Pupin. February 25th.

5,738. Automatic telephone exchange systems. Sterling Telephone and Electric Co. and W. C. Davey. February 25th.

5,740. Receivers for signalling by sound waves. M. I. Pupin. February 25th.

5,741. Device for automatically advancing ignition in internal-combustion engines. J. E. Tuscher. February 25th.

5,743. Electric toaster. E. P. Taylor. February 25th.

5,748. Brake mechanism for electrically propelled vehicles. P. A. H. Mossay, Mossay & Co., and Ransomes, Sims & Jeffries. February 25th.

5,749. Electric controllers for electrically propelled vehicles. P. A. H. Mossay, Mossay & Co., and Ransomes, Sims & Jeffries. February 25th.

5,763. High-tension battery. F. Richardson. February 26th.

5,774. Aerial systems for wireless telegraphy. C. T. Wilkinson. February 26th.

5,777. Suspension of electric light fittings. H. C. Busbridge. February 26th.

5,782. Automatic electric lighting system. T. Ferguson and J. R. Johnstone. February 26th.

5,785. Call indicators for telephone systems. Automatic Telephone Manufacturing Co. (Automatic Electric Co.) February 26th.

5,786. Railway signalling systems. Automatic Telephone Manufacturing Co. February 26th.

5,796. Selecting devices for automatic telephone systems. J. E. Collyer, E. A. Petithory, and Siemens Bros. & Co. February 26th.

5,802. Connection for permitting simultaneous use of several electrical burners for soldering or welding. H. Fritze. February 26th.

5,807. Electrical accumulators. C. Saunders and Saunders Electrical Co. February 26th.

5,813. Receivers for wireless telegraphy and telephony. E. Hoghton. February 26th.

5,816. Production of light electrically. Siemens & Halske Akt. Ges. February 26th.

5,845. Fuse and junction or terminal boxes for electric lighting installations. J. Stone & Co. and M. Walton. February 26th.

5,846. Circuit-breaker with automatic variation of ignition for internal-combustion engines. J. E. Tuscher. February 26th.

5,857. Testing armatures of electric machines. H. C. M. Patten. February 26th.

5,859. Electro-magnetic generators and motors. L. Robertson, R. Lacon, H. W. Lee, and Sir W. G. Armstrong, Whitworth & Co. February 26th.

5,868. Automatic telephone exchange system. Sterling Telephone & Electric Co. and W. C. Davey. February 26th.

5,869. Automatic telephone exchange system. Sterling Telephone & Electric Co. and W. C. Davey. February 26th.

5,890. Methods of transmitting power from windmill to dynamo. &c. A. L. Macnamara. February 27th.

5,895. Electric illuminating devices for theatrical stages, &c. T. H. Rochford. February 27th.

5,899. Electron tube apparatus. Westinghouse Lamp Co. February 27th.

5,904. Electric fuse boxes, switchgear, &c. F. W. Abbott. February 27th.

5,907. Device for attaching electric conducting wires to pipes, rods, &c. G. Turnock. February 27th.

5,909. Magneto to sparking plug switch with combination lock. J. W. Cliffe. February 27th.

5,916. Electric spark and plug tester. W. T. Bayley. February 27th.

5,925. Telephone systems. Automatic Telephone Manufacturing Co. February 27th.

5,942. Safety controlling-gear for electrically-propelled vehicles. R. Garrett & Sons and H. R. Simpson. February 27th.

5,945. Electric control of dynamo-electric machines driven by prime movers. British Thomson-Houston Co. and J. Hutt. February 27th.

5,949. Alternating-current electric instruments for indicating synchronism, power factor, phase difference, &c. C. L. Lipman and Nalder Bros. & Thompson. February 27th.

5,950. Glass vessels for incandescent lamps, &c., and method of producing them. H. G. C. Fairweather (Fabrique Suisse de Lampes à Incandescence). February 27th.

5,951. Device for testing sparking plugs. C. C. H. Williams. February 27th.

5,978. Detector tubes. Westinghouse Lamp Co. February 27th.

5,987. Aerial masts for wireless telegraphy, &c. S. Mochl. February 27th.

5,988. Machines for generating electrical energy. K. F. Ries. February 27th.

5,989. Electrical apparatus. K. F. Ries. February 27th.

6,010. Magneto-electric machines. E. G. C. Barton and G. E. Barton. February 27th.

6,055. Electrically-driven blocks, hoists, &c. F. Ogden. February 28th.

6,056. Ignition devices for internal-combustion engines. J. Bossan. February 28th.

6,059. Cable gripping device. J. A. Hogan. February 28th.

6,060. Self-regulating constant-current variable-speed dynamo. J. A. Hogan. February 28th.

6,063. Electrical signalling apparatus for railways. J. Gardner. February 28th.

6,065. Lampholders and screw caps. N. Kilian. February 28th.

6,079. Wireless telephony. W. T. Ditcham. February 28th.

6,082. Electric switches. C. A. Dancy and R. K. Dancy. February 28th.

6,084. Brush holders for electrical machines. H. G. Andre. February 28th.

6,085. Electrical voltage regulators. H. G. Andre. February 28th.

6,086. Electrical regulators. H. G. Andre. February 28th.

6,087. Electro-magnets. H. G. Andre. February 28th.

6,090. Rotary electric hand drills. Siemens-Schuckertwerke. February 28th.

6,091. Heat-measuring appliance for electrical purposes. Siemens-Schuckertwerke. February 28th.

6,101. Apparatus for subjecting molecular matter, &c., to electrostatic stress of high-tension electric discharge. F. O. Nicce and R. M. Legge. February 28th.

6,106. Printing telegraph systems. Western Electric Co. February 28th.

Electric Ploughing in Italy.—In view of the necessity for improved methods of cultivation in Italy, considerable interest is being displayed in the possibility of utilising some system of electric ploughing on a large scale. In this connection trials were recently held in the vicinity of Rome of the apparatus designed and manufactured by Violati-Tescari Bros., at which the King of Italy, the Italian Minister of Agriculture, and other prominent officials were present. It is reported that the results of these trials were very satisfactory, a triple plough being employed in the first instance, which operated perfectly, and in the second place, a single plough, with which a depth of about 20 in. was reached in spite of the difficult character of the ground on which the trials were held. Conditions in Italy are very favourable to the adoption of electric ploughing. Not only is the necessary power available in almost every section of the country, but the fields are comparatively small, and in many instances level. It is claimed that by the Violati-Tescari system a hectare (2.471 acres) can be ploughed for about 80 lire (£3 4s. 4d.), including in this sum the increase which has already taken place in the wages of workmen, possibilities of further increases, interest on invested capital, amortisation, &c. The cost per hectare, using tractors or other mechanical means, is estimated at 300 lire (£12 1s. 3d.), owing principally to the extremely high price of the fuel. The Violati-Tescari system of electric ploughing is a comparatively simple one. At one corner of the field to be ploughed a powerful electric capstan or winding apparatus is established, from which wire cables are stretched entirely enclosing the field in question. At the two near corners these cables pass through pulleys which are securely anchored, while at the far corners they are connected with two movable anchor-wagons. Between these two, a duplex plough mounted on wheels is drawn backwards and forwards across the field by means of the cable, and each time a furrow is ploughed the anchor-wagons move up a sufficient distance to bring the plough into position for the next operation. The plough is provided with an equal number of shares on each side of the wheels, facing each other, so that no turning is necessary; when one side is working the shares on the other side are lifted clear of the ground. A seat is provided for the operator.—*U.S. Commerce Reports.*

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THE

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ELECTRICAL REVIEW.

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BRITISH AGENTS ABROAD.

A SHORT time ago we drew attention to certain cases in which British merchant houses having long experience and connections in South America were unable to fix up arrangements with British manufacturers. Disappointed, or, perhaps, we ought to say disgusted, at the apathetic attitude of the latter, they abandoned the idea of trying to sell British electrical products, and as they wished to settle to business without further delay, they made terms with a Continental manufacturer, and sent their travellers off on an expedition to sell Continental stuff. The British merchant has so often been attacked because he has sold foreign products, that it is only fair to show that sometimes he cannot help himself. We hope and believe that such instances are very exceptional, and we are aware that the works are over-full of orders. But exceptions are none the less distressing whatever the cause, and when the workers are able to settle down to that larger productivity that we believe they will give before long, we may want more orders.

There is another aspect of this question of British merchanting abroad that has lately been brought under attention in dispatches received by the Department of Overseas Trade, from H.M. Minister at Pekin, and the Commercial Counsellor at Shanghai. The Associated British Chambers of Commerce in China and Hong-Kong held a conference in Shanghai a few months ago to discuss certain matters affecting British trade in China. A number of resolutions were passed, one of which registered the earnest hope "*that British manufacturers and exporters in the United Kingdom and the Dominions will, where practicable, use British agents for the sale and distribution of their goods.*"

We believe that most British exporters in a sufficiently large way of business prefer to send their own representatives out from home; but even such, unless they know the peculiar nature of the ground, and the local methods of conducting trading operations, are likely to encounter disappointment or to run serious danger by reason of the pitfalls that await the inexperienced. If they are attached to some existing organisation that has been brought together and developed through long and close contact with commercial life, they can act with greater hope of local inexperience being unable to render their own peculiar efficiency ineffective.

The last thing in the world that British firms should do is to entrust their business to a house which is not British in personnel, or, at any rate, in sympathy. It is not likely to be forgotten, after all that happened during the war, that Mr. "Smith" did not always spell his name so. The purely British firms and agents on the spot have the first claim upon us, and if we do not avail ourselves of their offers of service, we must not be surprised if they sell the products of other countries, and sell them more readily *because they are Britishers* while British prestige and name stand so high. After all, a merchant is in business to sell things, and he is going to do it. A Britisher prefers to sell British manufactures if our works turn out what is required. Price may sometimes compel him to do otherwise. Cheap and nasty quality may satisfy the consumer, and, much as it may be to the agent's distaste to handle foreign goods, he may find it policy to do so in order to retain a connection; but let it not be said that British agents sold foreign goods because British manufacturers made the deplorable mistake of letting their selling be done for them by a German, or any other, if there was a suitable Britisher at hand waiting to serve them.

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Small Motors: A Hint.

So far there has been a limited business in small electric motors for driving sewing machines and light polishing work, stirring liquids, and similar household jobs; but there appears to be a latent market for a somewhat more robust and adaptable appliance on the following lines:—

An enclosed motor of about ½ H.P. with self-contained starter and covered terminals, stout flexible cord connection, heavy rubber feet, and a substantial handle for lifting; the machine to be provided with extended spindle at each end, screwed cone on one side to take emery wheels, polishing mops, and buffs, and on the other some provision for fixing a simple drill chuck, and friction or belt pulleys. An appliance of this kind, if well balanced, would work on a table or floor without fixture, or with a simple vice clamp, but probably would be still more useful if attached to a stout iron tripod; one end of the spindle could be arranged to drive a small fan of the "Sirocco" type, with sheet-iron housing and hood, to draw dust from the polishing end, and discharge it into an air porous bag under the stand. This addition would make a practical polishing machine useable for many purposes, and a real labour saver, which a polishing bob without any device to collect dust certainly is not, so far as household use is concerned. Motors of this kind, but somewhat larger in size, have been employed with success for farm and dairy work, being easily moved and coupled to any small machinery—in fact, there would appear to be a good business to be done in a complete range of such semiportable machines, which, in association with some form of wheeled stand, could easily be fitted with cone pulleys or a speed-reducing gear, and find a sphere of usefulness even in a well-equipped workshop.

District Industrial Councils for Electricity Supply.

The various District Industrial Councils for the Electricity Supply Industry are now mostly well under way. But there is one point which is perhaps a little difficult to arrange. These District Councils should consist, of course, of Trade Unions on one side of the table, and of Employers' Associations on the other. The Employers' Associations are the I.M.E.A., the Provincial Electric Supply Committee, and (for London only) the Conference of Chief Officials of the London Companies. In the constitution of the National Council, this arrangement was rigidly adhered to. But in the formation of some of the District Councils, the actual course followed seems to be for the representatives on the employers' side to act directly for the individual undertakings. Not designedly so, of course; it is a case rather of there being some difficulty in doing otherwise. But a really important principle is involved, and it would certainly seem advisable for the formal constitution to be strictly adhered to.

It was specifically laid down in the Ministry of Labour handbook on the question that the intention was that the Councils should be composed only of representatives of Trade Unions and Employers' Associations. The reason why the apparent anomaly is cropping up is the difficulty of the two Associations, which are naturally centralised, acting in the various provincial districts, and the tendency has been to leave the districts to some extent to look after their own affairs. But, however much this may be done in practice, owing to the exigency of circumstances, it is very necessary that throughout all the formal proceedings the representatives of employers should always take the stand of acting for the two properly constituted Associations of Employers (I.M.E.A. and P.E.S.C.)

A further point that will need decision is the question of Works Committees. The District Councils will have to decide to what extent these are to be made an essential part of the scheme. Up to the present, very little has been done in the way of appointing Works Committees in the various individual undertakings. It is not, of course, an indispensable condition that Works Committees shall be formed, but it certainly seems advisable. Unless Works Committees are formed, it is difficult to see how the individual workmen are to be brought as directly and personally into contact with the Whitley scheme as is desired by the promoters of the Industrial Councils. Otherwise, some of the most valuable features of the scheme may be lost, and the District Councils become merely courts of arbitration on wage disputes.

Apropos of Works Committees and the scheme generally, interesting support is given to this in an article by Mr. J. A. R. Marriott in the *Nineteenth Century*. Mr. Marriott writes: "I closely investigated and cordially commended experiments in the establishment of Works Committees and Joint Councils before the Whitley Committee reported or Whitley Councils were heard of." He says further: "I would raise the status of labour to that of partnership wherever and whenever it is possible," and he agrees with Dr. Murray that "those who work with their hands, like those who work with their brains, and those who work with their savings, are entitled to take part in the organisation and direction of the industry, and to have a voice in determining the conditions under which their co-operation shall be given and continued." The opinion of Mr. Marriott is valuable since apart from being Member for Oxford (in which *rôle* he did valiant work in connection with the Electricity Supply Act), and a writer of authority on industrial and social history, he can also speak as one in direct practical touch with industrial problems. Possibly, therefore, his words may be of value in reinforcing the convictions of those in the industry who are still somewhat tepid in their enthusiasm on this subject.

Railway Construction in Berlin.

One of the results of the war has been to retard the work of constructing the high-speed electric railway in Berlin, known as the A.E.G.-Schnellbahn, which was commenced in the former period of peace. The company, which was constituted by the A.E.G., recently informed the City of Berlin and the Union of Berlin local authorities that owing to the economic revolution, the company was no longer able to continue the building of the railway on the conditions and financial presumptions which were fixed before the war. The local authorities, however, insist upon the work being continued, and legal action in the matter is proceeding. It appears that the ordinary shares, amounting to 20,000,000 marks, are held chiefly by the A.E.G. group; the preference shares for 28,500,000 marks are of the 4½ per cent. class, but have a rate of interest of 5 per cent. guaranteed by the A.E.G. to 1923 inclusive: and the service of the obligation loan of 48,500,000 marks has been undertaken by the City of Berlin, in respect of both interest and redemption. Under the circumstances, the preference shareholders, who solely possess a cumulative right to dividends after 1923, are now forming an association to protect their interests.

The Austrian Electrical Industry.

The Austrian Association of Coal, Iron and Steel and Engineering Works, whose annual meeting was held recently, submitted a report regarding the situation of these industries in 1919. In the case of the electrical industry the report states that no material changes took place as compared with the preceding year. Owing to the "strangulation" of the works and the difficulties experienced in obtaining raw materials, it was impossible for the production to keep pace with the demand, particularly for export destinations, as foreign buyers gave preference to Austrian works in consequence of exchange being unfavourable to the latter. It was found necessary further to increase sale prices, owing to the advances in wages and salaries and the cost of raw materials, but the export prices were still substantially lower than the former quotations for export. These circumstances explain why the financial results of the works have considerably declined, notwithstanding the more favourable possibilities for transacting business. It is added that the cable factories are well supplied with orders for the near future, but suffer from a scarcity of coal and other raw materials. Moreover, the metals available in the country are becoming more scanty, and it is reckoned that imports from other countries will have to take place soon, which will necessitate the payment of higher prices.

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THE MANCHESTER-SALFORD BULK SUPPLY.

The usefulness and the advantages of linking up two or more electricity supply undertakings or areas as a means of mutual assistance, and for the purpose of utilising the plant available in the several districts in the best possible and most economical manner, are perhaps too well known to necessitate any further elaboration. But it will be remembered that such a policy has been adopted in Lancashire and elsewhere, undertakings being interconnected to work in parallel as occasion demands for the common good, and one of the most interesting interlinking schemes in the Manchester district is that, which we recently had the opportunity of inspecting, by which it is made possible for the Manchester Corporation to furnish the County Borough of Salford with an extra-high-tension supply of electricity in bulk up to 4,000 KW., which may be increased to 10,000 KW., as required.

The existing county borough generating station at Frederick Road, Salford, like many others of its kind, gradually became too small to cope with the needs of the borough, and although, by scrapping the out-of-date original plant and substituting for it modern turbo-alternators, it was possible for a time to meet the demands made, eventual conditions necessitated an arrangement being entered into between Messrs. J. A. Robertson, borough electrical engineer, Salford, and S. L. Pearce, chief engineer and manager, Manchester, which resulted in the establishment of the "link" described below, which at the time of our visit had been in regular operation for five months, and has given entire satisfaction, the amount of power transmitted varying from about 1,000 to 3,700 KW.

The bulk supply is delivered by means of an underground cable from the Moss Side sub-station of the Manchester Corporation to the Frederick Road power station of the County Borough of Salford. In the former sub-station the 6,600-volt supply is stepped up to 33,000 volts for transmission, all the switching being done on the primary side, and at Frederick Road it is stepped down again before connection is made to the existing 6,600-volt bus-bars in the station.

Energy is transmitted through a three-core 0·15-sq. in cable, paper insulated, copper taped (12 copper tapes, each separately insulated), lead sheathed, single-wire armoured, and taped overall. It was manufactured by Messrs. Callender's Cable and Construction Co., Ltd., for a working pressure of 33,000 volts, with the centre point earthed; the total length of cable is 5,780 yards, of which 3,000 yards are in the Manchester area and the remainder in Salford. The cable was drawn into a 6-in. earthenware pipe, steel tape being substituted for the wire armouring on those lengths which are laid direct. The straight joints are of a special type, enclosed in cast-iron boxes, the latter being made in two halves split transversely. The cast-iron boxes themselves are placed in brick pits, covered with cast-iron plates or flag stones. The dividing boxes at the ends are of aluminium, and special sets of 33,000-volt isolating switches were supplied. The cable, on completion, was subjected to a direct-current pressure test at 67,500 volts between conductors and between the conductors and earth.

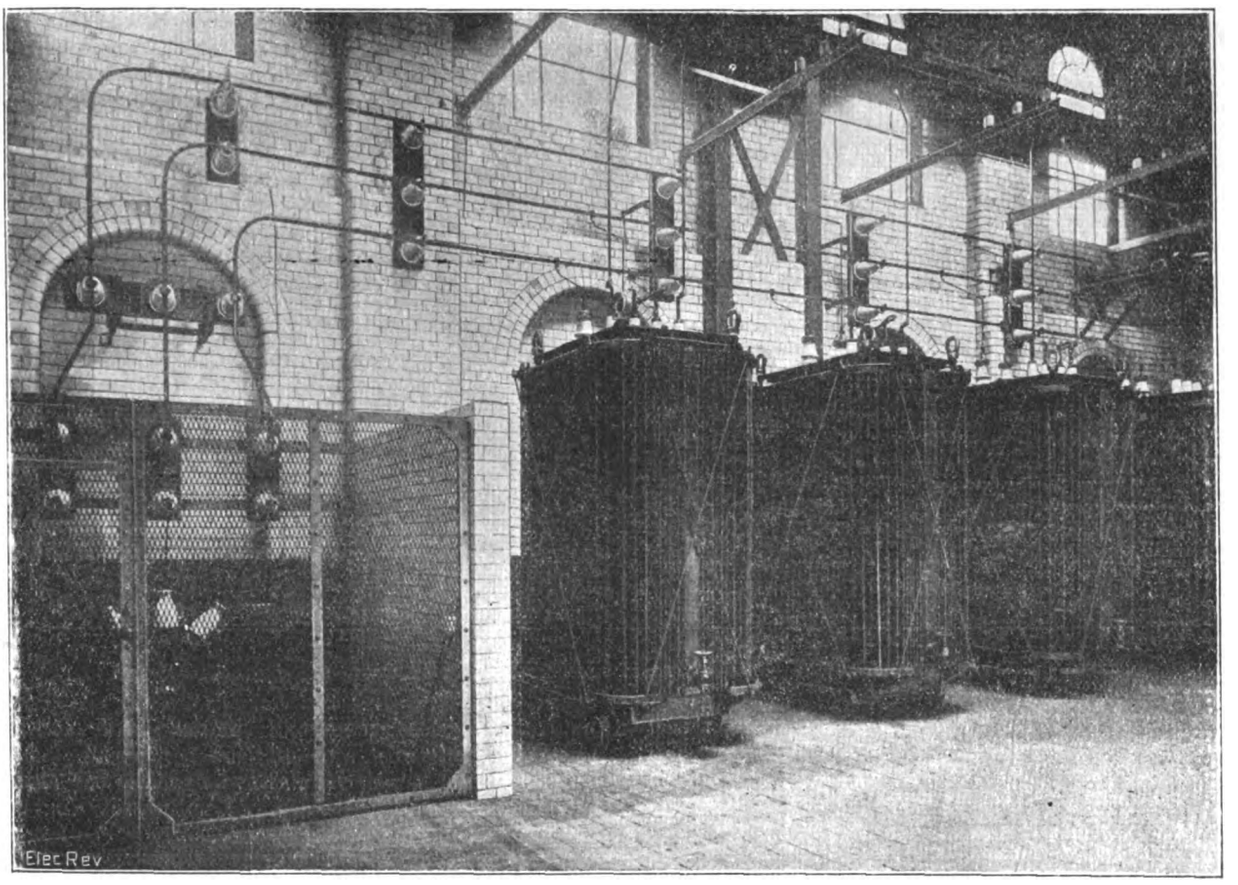

Fig. 1.—Transformer Room at Frederick Road, Salford, Showing 33,000/6,600-Volt Transformers

At the Moss Side sub-station, Manchester, two three-phase 3,000-K.V.A. transformers are installed. Fig. 1 shows the transformer room at the Frederick Road station, Salford. The high-tension cable is brought in through a three-way dividing box and the isolating switches, shown on the left-hand side of fig. 1, the connections to the step-down transformers being made by means of bare copper strip held by porcelain insulators. As will be seen, four oil-cooled transformers are installed, one being provided as a spare; they were manufactured by the Metropolitan-Vickers Electrical Co., Ltd., and have a capacity of 1,666 K.V.A. each, transforming from 33,000 to 6,600 volts at a frequency of 50 cycles, both sides of the transformers being connected in delta. Spacing blocks separate the coils of the same winding, thus preventing movement, and by keeping the turns in direct contact with the oil ensure efficient cooling. The problem of insulation has received

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special attention; two hollow rectangles of laminated sheet-steel form the iron circuits with which the coils are interlinked to form, so to speak, three links of a chain. Hardwood blocks separate the windings from the shell; the windings are held vertically against short-circuit by an adjustable clamping device.

Fig. 4 shows part of the control board in the station-control room, the control panel for the incoming feeder from Manchester being shown on the extreme left-hand side of the board.

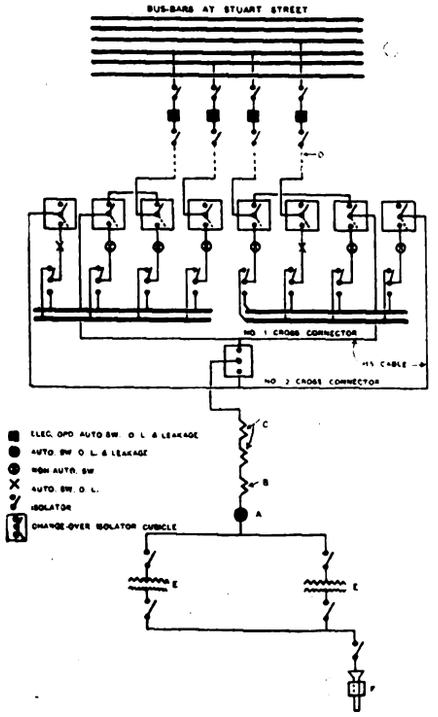

Fig. 2.—Outgoing Connections at Manchester.

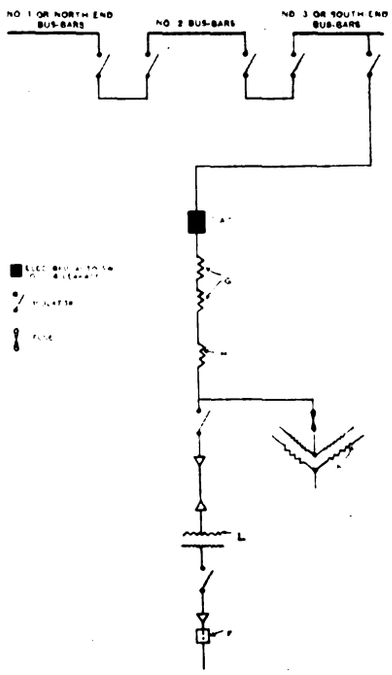

Fig. 3.—Incoming Connections at Salford.

Fig. 2 shows the outgoing connections at Manchester; A is an auto switch, the three current transformers for which are situated at B, while four current transformers, two for each watt-hour meter, are shown at C; D is one of the 0·15 sq. in. cables from Stuart Street generating station to Moss Side sub-station. At E E are shown the two three-phase delta-star connected transformers with neutral earthed without resistance on the 33,000-volt side. Switch A is operated by leakage and overload on the 6,600-volt side, and by the Ferranti field relay F, on the 33,000-volt outgoing cable to Salford. At Stuart Street power station reactances are inserted between the sections of the bus-bars.

Referring to fig. 3, which shows the incoming connections at Salford, the switch A is operated by leakage by means of relay F on the 6,600 or 33,000-volt side. The four 500/5-ampere current transformers G comprise one set of two each for each three-phase watt-hour meter, while the three 600/5-ampere ones at H are provided for the overload and leakage relays and instruments. The two single-phase 6,600/110-volt potential transformers at K supply the voltmeter, synchroscope, and watt-hour meters for this feeder. The four single-phase oil-cooled transformers shown in fig. 1 are located at L.

The transformers on the 6,600-volt side of the system are connected through a three-way connecting box, and by means of a three-core cable to a panel on the existing high-tension bus-bars in the switch-gallery. From the diagrams it will be seen that on two of the phases potential transformers are fitted, and on each phase there is a switch and a fuse, together with current transformers for the watt-hour meters, instruments, and protective gear.

The switchgear, which was supplied by the Metropolitan-Vickers Electrical Co., Ltd., is housed in concrete cells, and is of the firm's usual design for this class of work. At the top of the panel self-contained cells are placed, through which the bus-bars pass, forming part of the general high-tension switchgear of the station. The main switch, fitted with closing and tripping coils, is of the Metropolitan-Vickers "H" pattern, and cannot be closed on short-circuit, it being fitted with "loose handle" gear. The switch is shown on the extreme right-hand side of fig. 5, page 357. The switchgear is operated by means of direct current at 230 volts from the control board, fig. 4, in the generating station. When in the off position the isolating switches are earthed through an earthing bus-bar, which, similarly to the others, runs the whole length of the board.

The energy taken at peak-load periods is registered by two watt-hour meters in series, in conjunction with two Venner time switches, which cut in or out the maximum demand attachment of the "peak-load" or "off-peak load" meter as required, in accordance with the system of charging. The control panel, fig. 4, is provided with a control switch which is capable of being placed in the closed, open, or neutral positions. The closing contact of the control switch is fitted with a blow-out coil, and on account of the large current involved, it does not directly operate the closing coil of the main switch, fig. 5, but energises an intermediate coil, which in turn energises the closing coil. In case of a breakdown on the 33,000-volt side, additional protection is afforded by a Ferranti field relay. A leakage relay, combining all three secondary currents in one coil on the 6,600-volt side, is provided, as well as a Metropolitan-Vickers overload relay on each of two phases.

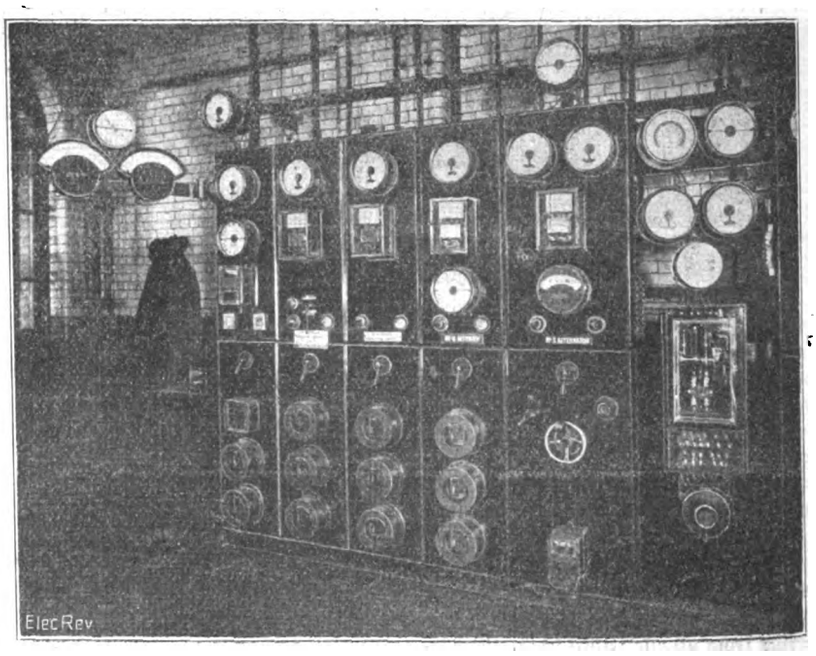

Fig. 4.—Incoming Control Panel at Frederick Road Station.

In conclusion, our thanks are due to Mr. J. A. Robertson, borough electrical engineer, Salford, and to Mr. S. L. Pearce, chief engineer and manager, Manchester, for permission to visit their respective stations and to publish the details set out above.

We are also indebted to Mr. J. Williams, technical assistant to Mr. Robertson, for kind assistance with the drawings and for conducting us over the works on the occasion of our visit to Salford.

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THE MOTOR-BOAT EXHIBITION.

Lovers of the sea and river found many attractions at the International Motor Boat and Marine and Stationary Engine Exhibition, promoted by the Society of Motor Manufacturers and Traders, Ltd., in collaboration with the Ship and Boat Builders' Association, Ltd., and the British Electrical and Allied Manufacturers' Association, which was inaugurated at Olympia, W., on Friday last and closes to-night. The river enthusiast was delighted by the excellent specimens of the boat-builders' art, from canoes to luxurious launches. Internal-combustion engines ranged in size from 2 H.P. to 500 H.P., from the single-cylinder to the 18-cylinder class; in fact, the exhibition was a triumph for the internal-combustion engine as applied to river and sea-going craft.

Among the countries represented were Great Britain, France, Sweden, Denmark, and the U.S.A., and out of a total of 145 stands, about 40 were devoted either entirely or partly to electrical or allied exhibits. A noticeable feature was the large number of craft shown that were fitted throughout with electric lighting, both for interior and navigational lights. In this connection there would seem to be considerable room for improvement in the design and installation of such lighting equipments, particularly the wiring.

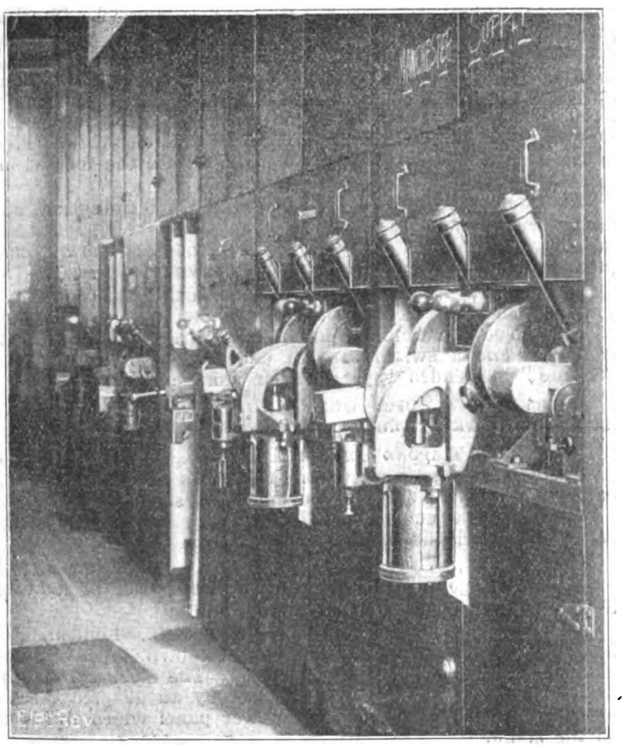

Fig. 5.—Metropolitan-Vickers 6,600-volt Oil Switches at Salford.
(See p. 356.)

Another noteworthy point was that although a comparatively large number of engines were fitted with electric self-starting equipment, magneto ignition was by far the more common practice, and it seems difficult to understand why this method of ignition is adopted in vessels that are fitted throughout with electric lighting and electric self-starters.

Messrs. Short Bros. (Rochester & Bedford), Ltd., in addition to other craft, exhibited an electrically-propelled canoe with ample accommodation for six persons. The canoe, illustrated in fig. 1, the ideal craft for river work, was handsomely fitted, and capable of cruising at 4 knots at half power for a period of 12 hours. It was single skin, carvel built in mahogany, its overall length being 24 ft. 10 in., beam over plank 4 ft. 6 in., depth amidships 2 ft., and draft 1 ft. The "Submersible" 2.5-H.P., series-wound motor is reversible, and of the protected type, 70 volts, 650 R.P.M., 83 amps., one hour rating. The control is fitted in a convenient position at the stern of the boat, and gives half and full speeds ahead and astern. The motor and accumulators are concealed under the deck, the latter comprising 32 two-volt, 122-amp. Chloride "Exide" cells in ebonite cases. The main switch, which can be locked in the off position when the canoe is not in use, is of the double-pole, quick-break, ironclad type for 30 amps., and is fitted on a switchboard in the stern of the boat together with a voltmeter and two 30-amp. fuses are placed in the circuits. Steering is by means of a wheel conveniently placed aft to a double balanced rudder, which protects the brass propeller; the latter is driven by a 0.75-in. steel shaft through a ball bearing plummer block, a brass stuffing box and lignum vitæ bush. The electric lighting

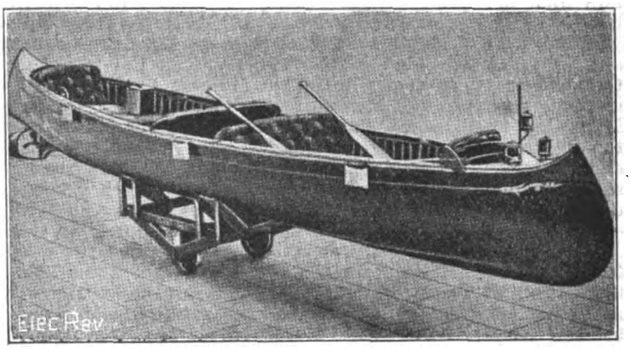

Fig. 1.—Electrically-propelled Canoe.

installation consists of a port and a starboard lamp on hinged brackets, a head lamp on fixed brackets, and two plugs and switches for the lamps, operated from the lighting board fitted in the bows.

Messrs. North & Sons, Ltd., Watford, had on view a variety of 4 and 6-cylinder magnetos, also revolution indicators.

Messrs. Brown Bros., Ltd., London, showed accessories which included accumulators, Brolt lighting and starting equipment, lamps, sparking plugs, distributors, H.T. and L.T. wires, switches, and ignition coils.

The Apollo Plug Manufacturing Co., Ltd., Birmingham, exhibited a selection of sparking plugs of various types and sizes, as well as a number of electric horns and warning signals.

Messrs. Thomas Reid & Sons, Paisley, showed capstans, steering gear, and an electric anchor windlass suitable for a yacht, with two independent cable lifters fitted with a cone friction brake. The hand gearing is single and double purchase; the motor is installed below deck, the control gear being operated from above deck. Windlasses of this type are made in all sizes suitable for ⅜-in. to 1-in. cables.

The British Thomson-Houston Co., Ltd., Coventry.—This exhibit comprised a selection of magnetos, including one type fitted with an impulse starter which will start the engine by turning the handle slowly instead of having to swing the engine. Component parts showing the method of manufacture and a complete range of Mazda lamp bulbs were also on view.

The Igranic Electric Co., Ltd., Bedford, exhibited a battery-charging panel consisting of a standard iron frame with five 180-amp. charging units; a 30-amp. panel; a control drum for electrically-propelled boats; grid and carborundum types of Diesel engine ignition plugs; an automatic switch for engine starting; electric heater units and soldering irons, and a variety of switches.

The Garage Service Co., London, included in its selection of accessories electric drills and valve grinders.

Messrs. W. A. Gamage, Ltd., London, also showed sparking plugs, lamps, and accessories.

Messrs. Bruntons (Sudbury, 1919), Ltd., Suffolk.—This exhibit included a half-section model and a complete 1-KW. self-contained "Lalley Light" electric lighting set, made by Studebaker, Ltd., which is suitable for ship and yacht lighting, as well as for country house use.

Messrs. Edison Accumulators, Ltd., London, showed a range of nickel steel accumulators illustrating the different sizes and arrangement of cells in crates.

Messrs. Lodge Plugs, Ltd., Rugby, besides types of sparking plugs, had working exhibits of complete coil ignition gear for large and small multi-cylinder engines.

Messrs. S. Smith & Sons (M.A.), Ltd., London.—This collection of accessories included rustless sparking plugs, electric telegraphs, magnetos made by the M.-L. Magneto Syndicate, Ltd., and electric lighting and starting equipment. In the Smith constant current variable speed dynamo the desired regulation is obtained by making use of the magnetic effect of the current circulating in the armature winding of the machine to alter the strength and direction of the main magnetic field of the dynamo. The dynamo output is thus

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regulated by armature reaction, and the dynamo is said to possess inherent electrical regulation, since no complicated external regulating devices are required. The construction of the machine is very similar to that of an ordinary two-pole shunt-wound dynamo, but it is provided with four brushes, viz.: two main and two auxiliary brushes disposed equally round the commutator, the main brushes being connected to the auxiliary brushes half a pole pitch in advance through suitable resistances. It is by the particular disposition and interconnection of the brushes that the required distribution of current in the armature winding at different speeds is obtained, which also greatly reduces the heating which occurs in the armature conductors. The current rises very rapidly when the dynamo commences to charge the battery, until the full output is attained; it then remains constant no matter how high the speed becomes. At speeds from 0 to 550 R.P.M., before the dynamo is connected to the battery, the current gradually rises. The dynamo is then connected to the battery and commences to charge it, the current in the resistances then falling off to zero. A further increase in speed results in the current through the resistances reversing and gradually increasing until, when the dynamo reaches its full output, the current in the resistances is half of that value. The output can be adjusted within limits by rotating the four brushes, so that while they still remain equally spaced they occupy different positions with regard to the poles. This causes the effect of the armature reaction on the magnetic field to vary. Moving the brushes in the direction of rotation of the armature reduces armature reaction and increases the value of the full output of the dynamo. Moving the brushes against the rotation of the armature increases the reaction and reduces the full output. Although the dynamo output is 10 amperes only two sections of the armature winding carry current. This means that the heating in the armature is only half what it would be in a dynamo of the ordinary type, and constitutes an advantage as the heating of the machine is much reduced, and the current output does not fall off to such a marked extent when the machine is hot after a run. The chief advantages claimed are: low cutting-in speed; rapid rise of current, with full output at a low speed; reduced heating; small drop in output when hot; light weight for a given output; extreme simplicity and reliability.

The British Lighting & Ignition Co., Ltd., Birmingham, showed a large range of H.T. magnetos for stationary and marine engines of all sizes, and an assortment of finished component parts for all the patterns shown.

Messrs. Vickers, Ltd., London.—This exhibit of marine engines, launches, small tools, drop forgings, stampings, &c., included a "Wolseley" 6-cylinder, 1,000 R.P.M. engine, developing 60 B.H.P. on petrol or 52 B.H.P. on paraffin, and fitted with an (Elma patent) electrically-operated reverse gear. This gear is of the enclosed bevel type, controlled by magnetic clutches, which are themselves controlled by switches automatically operated by the engine throttle lever. Thus the engine can be driven ahead or astern at any speed, or run slow in the neutral position by the movement of a single lever. In large installations deck control is claimed to be greatly facilitated, since wire connections only are required between controller and engine. The clutches operate at 12 volts, which is obtained from a battery forming part of the standard electric starting and lighting system with which these engines are equipped.

The British Marine Motor & Launch Co., Ltd., Old Kilpatrick, near Glasgow.—A feature of the ship's motor lifeboat with accommodation for 34 persons, exhibited on this stand was the installation of a Marconi wireless telegraph outfit.

Messrs. Norris, Henty & Gardners, Ltd., Patricroft, near Manchester.—This show of crude oil engines included a 9-KW. ship's emergency lighting set and a 0.5-KW. country house lighting set, which plant comprised a generator direct coupled to the oil engine.

The Parsons Motor Co., Ltd., Southampton.—This exhibit included a 7-H.P. and a 60-H.P. engine and dynamo sets employing the usual direct-coupled plant, a feature being the type of coupling which, whilst being positive, allows for axial movement of the armature.

Messrs. Dixon Bros. & Hutchinson, Ltd., Woolston, Southampton, exhibited, amongst others, electric generator sets and a 4-cylinder model suitable for driving an electric welding generator.

Messrs. Cox & King, Wivenhoe, Essex, had on view a 26-ft. standard ship's towing launch, built to B.O.T. requirements, and fitted with a Gardner engine, the feature of the launch being the inclusion of Marconi wireless telegraph equipment.

Messrs. John I. Thornycroft & Co., Ltd., Southampton and Basingstoke.—This exhibit of marine engines included an electric power generating set, with a normal output of 8 KW., the pressure being 110 volts, and a ship's emergency lighting set, having a normal output of 25 KW., or 30 KW. maximum, at 750 R.P.M. These sets are built to B.O.T. and Lloyds' requirements, and fulfil the conditions called for by the International Convention for the safety of life at sea.

The National Gas Engine Co., Ltd., Ashton-under-Lyne, exhibited four engines, one being of the 6-cylinder vertical type, suitable for burning petrol, oil, or town gas, and capable of developing 60 B.H.P. at 650 R.P.M. This type is specially constructed for driving dynamos.

The Aster Engineering Co. (1913), Ltd., Wembley.—These exhibits were presented on two stands. In the case of the larger stand the exhibits included a special portable set comprising a two-cylinder engine developing 16 B.H.P. at 1,000 R.P.M., direct coupled to a suitable dynamo; the entire set being mounted on wheels and provided with a special canopy of sheet steel with hinged sides capable of being locked. The set is entirely self-contained, cooling being by means of a radiator, and the necessary switchgear is also fitted inside the lock-up case. A standard 15/16-KW. emergency ship lighting set to B.O.T. requirements, comprised a four-cylinder engine developing 28 B.H.P. at 1,000 R.P.M., direct coupled to a suitable dynamo. These sets can be supplied to run on petrol or paraffin, and are usually supplied for emergency purposes with radiator cooling, in which case the radiator is mounted over the flywheel, the complete set being entirely self-contained. The second stand was occupied by a light semi-automatic set, which is suitable for yacht or house lighting. In the case of yacht-lighting sets an enclosed battery is supplied in a teak or ebonite box, as required, and not the open type of battery as exhibited, the latter being supplied for country house work and similar purposes.

Mr. A. Picard, London.—Besides a number of other accessories, two types of Paris-Rhone dynamotor were shown, as well as electric starters, generators for lighting, sirens, lamps, &c.

Messrs. James Pollock, Sons & Co., Ltd., London, representing Messrs. J. & C. G. Bolinders Co., Ltd., Stockholm, exhibited a number of engines, including a 2.5-KW. direct-coupled electric lighting set. This model is made in various types, from 5 up to 320 B.H.P., being two-stroke, single-acting engines with hot-bulb ignition and crank-case compression working satisfactorily on paraffin, residue, heavy, or tar oils.

Messrs. Jones, Burton & Co., Ltd., Liverpool.—On this stand was shown a vertical petrol-paraffin engine, direct coupled to a 25-KW. dynamo, being self-contained for ship lighting purposes, and fitted with an extra large radiator for tropical climates. The firm also showed a "Premier" electric welding plant self-contained in a van body, also samples of work done, welded material and electrodes. Frequent demonstrations were made to illustrate the method of operation on various classes of work.

The Austin Motor Co., Ltd., Northfield, Birmingham, exhibited fully automatic house lighting plant, being self-starting, regulating, and stopping. The plant was shown complete with battery and working on town gas.

Messrs. F. S. Bennett, Ltd., London, exhibited the American "Delco-Light" electric lighting plant, which consists of an air-cooled, paraffin-driven engine, direct coupled to a generator and a switchboard in one complete unit with an "Exide" suspended type glass jar storage battery.

Messrs. Simms Motor Units, Ltd., London, exhibited H.T. magnetos, sparking plugs, and magnetic petrol gauges.

The New Pelapone Engine Co., Ltd., Leeds, showed a complete lighting plant, comprising an engine, dynamo, battery, and switchboard. The engine is started by pressing a button, and the current is self-regulating. When the battery is fully charged the engine is stopped automatically.

Messrs. Fyfe, Wilson & Co., Glasgow, had on view several direct-coupled generating sets suitable for power or lighting purposes.

The Telephone Manufacturing Co., Ltd., London, exhibited a complete range of its well-known types of automatic intercommunication telephones. The electrical energy for the working exhibits was supplied by an adapted C.A.V. dynamotor, accumulators, and a power panel which was seen on the stand.

Electricity Workers' Wages.—The Bradford Electricity Committee has reported to the War Wages Committee that the cable jointers (members of the Electrical Trades Union) in the electricity department have agreed to accept the rates fixed by the District Joint Industrial Council for the Electric Supply Industry as from the time agreed upon by that council, namely, payments to be made as from the first payday after January 1st, 1920, and to be made payable in respect of the pay period for which payment is made on that day. The Electricity Committee recommends that the district rates when fixed by the Joint Industrial Council be ratified and adopted. The War Wages Committee has approved the recommendation, and also a recommendation from the Electricity Committee agreeing to the termination forthwith of the arrangement dated May, 1915, under which electrical fitters and wiremen were to be regarded as coming within the scope of the engineering trades awards, to the payment of such workers at the district rate of the electrical trades of 1s. 10d. per hour inclusive, and to future claims by such workers in the employ of the electricity department being met only through any revision of rates made by the District Joint Industrial Council (No. 2 Area) for the Electricity Supply Industry.

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NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

A New British Motor.

Messrs. Matthews & Yates, Ltd., of Swinton, Lancs., have recently placed upon the market the motor illustrated in fig. 1 This is a totally enclosed D.C. machine made in two sizes—

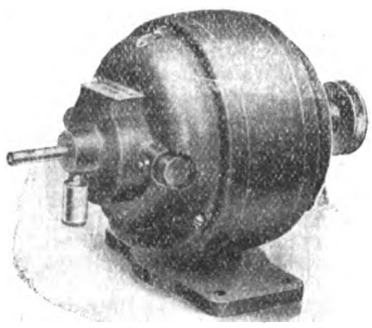

Fig. 1.—Fractional H.P. Motor.

1/6th and 1/8th H.P. The commutator is rendered easily accessible by means of an inspection cover. The motor is fitted with a double-ended shaft.

A Silvertown Inert Cell.

The inert cell manufactured by the India Rubber, Gutta Percha & Telegraph Works Co., Ltd., is a very useful type of primary cell. It can be kept in stock for practically any length of time without deteriorating. To render the cell active, a cork in the top of a tube fitted in the body is re-

Fig. 2.—Silvertown Inert Cell.

moved, and water poured in until it reaches the top. The cell is then left for eight or ten hours, at the end of which period any free liquid is shaken out, the cork replaced, and the cell is ready for use. Each cell is fitted with two brass terminals.

Organ Blowing Machinery.

Fig. 3 illustrates a typical multi-stage centrifugal organ blower, as manufactured by the Rockingham Engineering

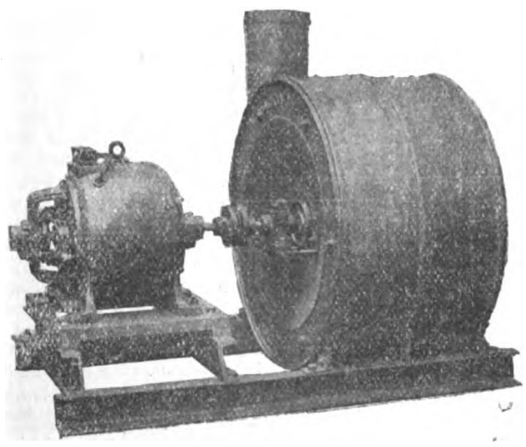

Fig. 3.—Organ Blowing Plant.

Co., Beulah Road, Thornton Heath. This blower is constructed of built-up diaphragms of cast iron and sheet steel castings, and can be designed to give any volume or pressure of air. The motor driving the blower is direct-connected by means of a flexible coupling, and the two parts are fixed on one bedplate. The air is conveyed to the organ by means of a wind trunk, and the output can be regulated by a roller pallet valve actuated from the organ reservoir.

Lanterns for Street Lighting.

The British Thomson-Houston Co., Ltd., Mazda House, 77, Upper Thames Street, E.C. 4, have recently published details of new designs for street lamps, three of which are

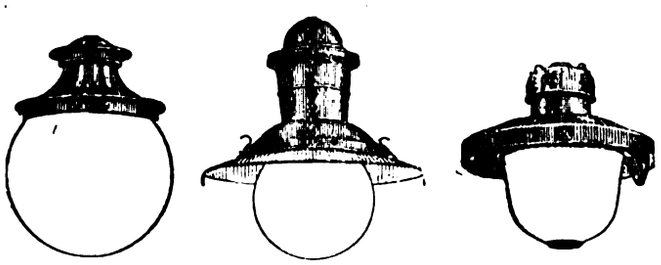

Fig. 4.—Weather-proof Lanterns.

here illustrated. These weather-proof lanterns are all designed for use with "Mazda" half-watt lamps. The reflectors are of the vitreous enamelled type, and the globes are made of opal glass.

A Dental X-ray Outfit.

At the British Industries Fair, amongst the apparatus exhibited by Messrs. Newton & Wright, Ltd., of 72, Wigmore Street, London, W. 1, was the "Simplex" dental unit, a complete self-rectifying piece of apparatus, designed in the first place for the use of the dental profession, but eminently

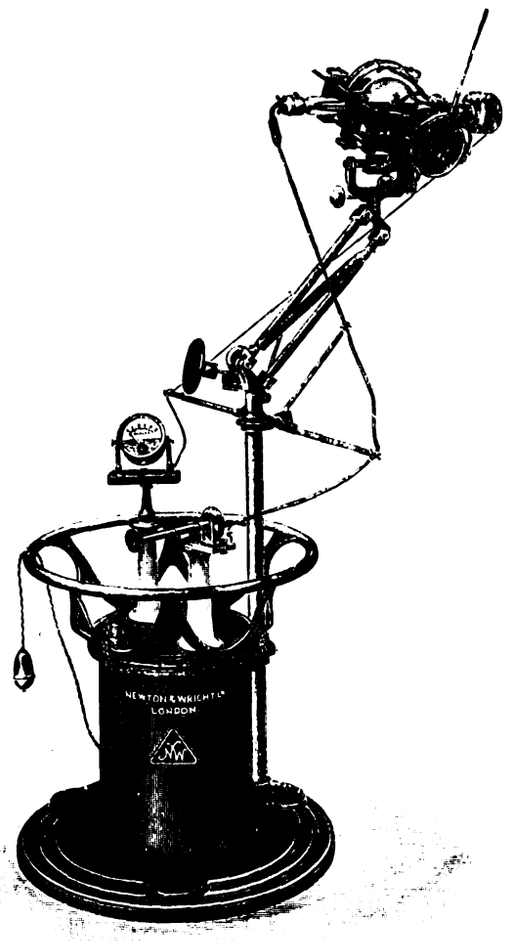

Fig. 5.—"Simplex" Dental X-ray Apparatus.

suitable for all cases where a fixed output is required. It is constructed for use with the new Coolidge radiator pattern rectifying tube, and will work from any ordinary lighting

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socket. There are practically no adjustments, and the output is a fixed amount. The base of the apparatus is a hollow aluminium casting forming both the tank for the high-pressure, oil-insulated transformer and the support for the whole installation. The tube stand is extremely rigid, though light, being made throughout of steel, and is provided with universal movements, mechanically controlled. The whole forms a compact and powerful little outfit, and is being produced in considerable quantities It is illustrated in fig 5 on p. 361

Messrs Newton & Wright's apparatus is supplied to the trade only, the firm taking the view that X-ray apparatus should be installed and maintained by utilising the services of local engineers.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

The Einstein Theory.

With reference to your comments on Mr. Hering's letter on the theory of relativity, is not the following generalisation valid?

A plane (two dimensions) figure moved in those two dimensions generates a plane figure. To obtain a volume (three dimensions) it must be moved in a third dimension.

By analogy, a volume (three dimensions) generates a volume when moved about in three dimensions. To obtain a four-dimension figure we must move it in the fourth dimension.

It is easy to move a solid without introducing the fourth dimension. We only have to refrain from using any but the three dimensions of our world "the space of experience."

A. Hinderlich.

London, W.
March 9th, 1920.

Mr. Carl Hering points out in his letter of February 13th that since a line is generated by the movement of a point, a surface by the movement of a line, and a solid by the movement of a surface, it should follow logically that the movement of a solid generates something possessing four dimensions, the general law being that the movement of anything possessing n dimensions can generate something possessing $n+1$ dimensions. But, as pointed out in your editorial comment, a line *can* be moved without generating a plane, and a plane *can* be moved without generating a solid, and herein would appear to lie the explanation. A point has no dimensions, and in order to generate a line it must move in one dimension, which may be called the first dimension. A line has this one, or first, dimension, and in order to generate a surface it must move in another, or second, dimension—if it simply moves along its own length, *i.e.*, in the first dimension, it generates nothing. Similarly a plane can move in two dimensions without generating a solid—to do this it must move in the third dimension. Hence, in order that a solid may generate something having four dimensions, *it must move in the fourth dimension*. Simple movement in three-dimensional space will generate nothing new.

A. P. A.

Paris, *March 9th*, 1920.

"QUOD, ERGO, ERAT TEMPUS?"

I thank you for inserting my note, but am sorry you misunderstood me. You seemed to be in doubt as to "whether time is a dimension," and my object was to secure your help in getting rid of much metaphysical and other nonsense that has been talked ever since St. Augustine put his famous question, which he answered (?) himself thus: "I know, if you do not ask me." As Alliston has said of him and many teachers "for that at bottom they confessedly know and understand nothing, is with certain parties a reason that we must accept the notions they have spun out of their heads."

Phrases in common use, such as "a short space of time" and "we have loads of time," show that people do not think clearly of what they are saying; and, without quibbling about mere words, I again invite your kind attention to the *idea* of duration (or distance divided by velocity = time) which could never have occurred to anybody unless something moved! You may be right in stating that "time is associated with motion," but not with motion alone.

W. H. M.

March 13th, 1920.

Radiators for Bathrooms.

I am interested in Mr. Nobbs's letter re the glazed earthenware fires. These go a considerable way towards providing a satisfactory bathroom radiator, but I think the protection is not quite complete. For instance, the switches on a bathroom radiator should be very completely insulated, so that they will be safe if operated by anyone with very wet hands.

The elements should also be protected so that drops of water cannot fall on to the glowing wires. I think it is generally found that the elements are liable to be damaged if water gets on them. It is also desirable that bathroom radiators should be wired with something better than ordinary flex; tough rubber insulated flex would probably be found satisfactory.

Radiators.

March 15th, 1920.

The Commercial Efficiency of Fuel.

On reading your account of the discussion between the South Midland Centre of the Institution of Electrical Engineers and the Midland Junior Gas Association in your last issue, we were struck by the fact that whereas quite a lot was said about fuel efficiency on both sides, very little indeed was said about the value of service rendered.

For example, Dr. Walter declared that on account of cost of energy the use of electric furnaces would be confined to specialised industries and laboratory work. As we are the largest manufacturers of electric furnaces for the heat treatment of steel, and as our furnaces are being very largely used for mass production as well as for jobbing work, we venture to think that Dr. Walter has omitted certain important factors from his consideration. These may be summarised as follows:—

Cost of labour, which is nearly always greater than the cost of energy or fuel.

Quality of work turned out, and avoidance of scrappage.

The health and welfare of the operators.

It is our general experience that when all these factors are taken into account, the balance in favour of "doing it electrically" is generally beyond criticism.

Automatic and Electric Furnaces, Ltd.,
E. P. BARFIELD,
Managing Director.

London, W.C.
March 3rd, 1920.

[We fully agree with our correspondent. The case for electricity was by no means adequately presented.—EDS. ELEC. REV.]

Situations Vacant.

I regret to see the prevalence of box numbers under this heading, and should, I think, be doing some service if I, through your most excellent columns, could put a stop to this ever-increasing practice.

I notice for the last four weeks there have been more than 50 per cent. over box numbers under the above, as follows:—

February 20th.—88 vacancies, 47 box numbers.
February 27th.—71 vacancies, 36 box numbers.
March 5th.—91 vacancies, 54 box numbers.
March 12th.—111 vacancies, 59 box numbers.

Over 50 per cent in each case.

I think it is grossly unfair to all concerned that employers should hide themselves behind such a screen. If they are ashamed of their names, why advertise at all? Or is it because they will only pay such miserable salaries or wages that their names are so well known in the trade, as to require the inspector of nuisances around? Not only do I think it very unfair to prospective applicants, but to their brother employers, and I sincerely trust that in future this practice will be eliminated. If the advertisers cannot refrain from doing it, I hope the prospective applicant will completely ostracise such adverts., and treat them with the contempt they merit.

Pro bono publico.

March 13th, 1920.

Sensitive Plants.—Sir Jagadis Bose delivered a striking lecture on "Plant and Animal Response," with demonstrations of growth by the magnetic crescograph, at the Royal Society of Medicine last week. The crescograph is an instrument invented by Sir Jagadis Bose which magnifies minute movements in the growth of plants so enormously that they can be observed and measured. The lecturer said that the activities which underlay life were imperceptible, but he had been successful in devising various instruments of extreme sensibility which recorded the twitching throb under a shock, the time it took the plant to perceive it, and the rate of impulse at which the message was being sent along the conducting path of the plant; automatic records were also made of the living pulsation and the stupor that came under the action of narcotics, and a definite signal was obtained at the exact moment of death under various poisons. The investigations thus rendered possible had demonstrated the unity of life-reactions in plant and animal. This similarity was so real that, after discovering certain phenomena in plants, he had been able to predict their occurrence, hitherto unsuspected, in the animal. The unexpected revelations in the life of the plant had thus opened out new fields of inquiry in physiology, in agriculture, in medicine, and even in psychology.—*The Times.*

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LEGAL.

Workmen's Compensation Claim.

An explosion at the Marsh Lane, Bootle, electricity works in November last had a sequel at the Liverpool County Court on 12th inst., when George Sharpe (aged 20) claimed compensation from the Bootle Corporation for total disablement. The claim was resisted on the ground that applicant had been guilty of serious misconduct by smoking a cigarette in the electric battery premises. Sharpe called evidence showing that no notices were displayed on the premises forbidding smoking, and that it was a common occurrence. His Honour, Judge Thomas, said that applicant's smoking was dangerous, yet it did not amount to such dangerous and wilful misconduct as to deprive him of compensation. As his disablement would cease on the 31st inst., he suggested that a lump sum might be agreed. The sum of £27 10s. was agreed upon, and an award was given for that amount with costs.

Direct U.S. Cable Co., Ltd., v. Western Union Telegraph Co., Ltd.

In this case Mr. Justice Peterson, in the Chancery Division of the High Court on March 10th, delivered an important reserved judgment bearing on the Courts Emergency Powers Act upon a contract between the two companies for the lease of a cable which it was sought to determine in consequence of an alleged breach of an obligation to repair and maintain continuity of communication, extending over a period of 18 months.

His Lordship said that this was an action under the Courts Emergency Powers Act for the purpose of obtaining a declaration that the defendants were not entitled to determine a lease of certain cables. The defendants had the right of working various trans-Atlantic cables, and in March, 1912, the plaintiffs leased to them one of their cables for a term of 99 years at a rental which amounted to between £60,000 and £70,000 per annum. The plaintiffs undertook an obligation to carry out repairs. The clause under which the undertaking was given provided that they should at their own cost maintain the Direct Company's cable in proper working condition, and renew it as it became worn out or destroyed. Then it was provided that in the event of any interruption continuing for more than 12 months half of the rent should cease to be payable, and in the event of the interruption continuing for more than 18 calendar months the whole of the rent should cease to be payable until the cable was repaired and communication restored. It was further provided that in the event of such interruption it should be lawful for the Western Union Co. to give notice for the determination of the lease and to claim damages. On the interruption taking place it was notified in due course, but the cable was not repaired until after the expiration of 18 months, and the defendants accordingly gave notice to determine the lease, and the question now was whether the plaintiffs were, under the circumstances, entitled to relief. A break occurred in 1918, and it was proved that deep-sea repairs could not be executed during the winter months, which rendered it impossible to remedy breaks which had occurred in 1917-18. In October, 1917, the plaintiffs made inquiries of the owners of a repairing vessel, but they were not prepared to make an agreement so far ahead. In 1918 there was a meeting with the Admiralty for the purpose of arranging for the repairs, and the Admiralty suggested a programme by which all the cables should be put into operation before November, 1918.

His Lordship referred in detail to the negotiations which had taken place with the Government for the purpose of getting the cables repaired, the steps which had been taken by the defendant company with that object, and the difficulties experienced in getting repair ships owing to the action of submarines. Continuing, his Lordship said that the plaintiffs' first contention was that the case came within Section 2 of the Courts Emergency Powers Act, 1917, which limited the carrying out of any contract. The lease in this case was no doubt a contract of continuity within the section, and it was argued that the plaintiffs were bound to repair the Eastern break. It was not suggested that they did not make the repairs with all possible dispatch, but the circumstances were such as prevented the completion of the repairs within the 18 months. It was said that the Admiralty orders restricted the repairs, and their failure to allow the repair ship to do the work was the cause of the cable not being repaired. Defendants contended on the true construction of the clause the only breach would be if the plaintiffs did not use all dispatch in carrying out the repairs after having received notice. He did not find it necessary to determine this question, and would assume that the plaintiffs' construction of the clause was correct, and that they were under obligation to repair the Eastern break. It was said that the decision of the Admiralty was an interference with private rights, but it was not an interference for the representatives of the Admiralty to decide that another cable should be repaired before the plaintiffs' cable. That was not an interference with the private rights of property, nor could the orders of the Admiralty given for the safety of the vessels be so considered. The orders were given for the purpose of assisting plaintiffs to repair the cable, not to restrict. In his view the decision of the Admiralty at the meeting in February, 1918, could not properly be described as an interference with the navigation of the repairing ship. It was necessary for the plaintiffs to show that failure to repair was attributable to the Admiralty orders, but it could not be said that the orders were responsible for the failure to repair. The order was made for the purpose of assisting, and not restricting, repairs. He was not satisfied that the failure to repair could be properly attributable to the decision of the Admiralty. The shortage of ordinary merchant ships must be disregarded, as the ships required were cable ships, and there was no evidence that cable ships were diverted to other purposes, and he could not say that there was a shortage of cable ships or that the damage to the cables or the insufficiency of cable ships was attributable to the war. It was contended that there was a shortage of cable ships because one of the cable ships had been taken for the repairs of a German cable which the British Government had taken possession of, and it was argued that that was the result of the war, but that contention had not been established. In his opinion the plaintiffs' claim to relief under section 1 failed. Another section upon which plaintiffs relied was that which provided for a case in which a contract could not be enforced without inflicting serious hardship upon one of the parties to it; but in his opinion that also failed. Therefore the plaintiffs' application on the whole failed, and it would be dismissed with costs.

On the application of Mr. Mark Romer, K.C., a stay of execution was granted in view of appeal.

Carpenter v. Jones.

In the Lord Mayor's Court on Monday, before the Recorder, a claim was made by Mr. Charles A. Carpenter, electrical engineer, 4 and 5, Masons Avenue, Basinghall Street, E.C., against Mr. J. R. Jones, secretary of the Metropolitan Division of the National Council for Demobilised Soldiers and Sailors, 11, Great Turnstile, Holborn, for £11 5s. for electrical work done.

Mr. Potter was counsel for the plaintiff and Mr. Waldo R. Briggs for the defendant.

The plaintiff's case was that in August of last year he was employed by the landlord of the premises, 11, Great Turnstile, to do certain electrical work. While his workmen were engaged on the work the defendant requested the plaintiff's foreman to fix two heater plugs for him at places he indicated. The work was proceeded with for some time, and after a certain amount of progress had been made the defendant said he must have an estimate for the work. This was given at the price of £11 5s. The defendant then said that the figure was too high, and he could not allow the work to proceed. The plaintiff then called and saw the defendant and made an offer to take out the material that had been put into the job and so cut his loss. The defendant, however, said that as the work had proceeded so far it had better be proceeded with, and he would do what he could to get the committee to pass the account. The job was completed and the bill sent in for the amount now sued for. Although repeated applications had been made for payment, the plaintiff had been informed that the matter would receive attention, but no payment was made.

The defendant, in his evidence, said the plaintiff's workmen were employed on the premises carrying out electrical work for the landlord. He was thinking of having electric radiators fitted up in the place of coal fires, and he thought, not knowing much about electricity, that a wire could be run from the existing installation to suit his purpose. He asked for an idea of what it would cost. No order was given to do the work until he had received the estimate. He found that the work had proceeded before he was told the price and he stopped the work. Afterwards, when the price was given, he found the job would cost more than he had power to expend.

The Recorder found in favour of the plaintiff, for whom judgment was entered with costs.

Loud-Speaking Telephones.—An interesting demonstration of loud-speaking telephones took place at the North Woolwich works of the Western Electric Co., Ltd., recently at which we were privileged to be present. These telephones comprise a specially sensitive transmitter similar in size and shape to those used for ordinary telephony, a three-stage valve amplifying outfit, and a number of specially designed loud-speaking receivers. The amplification comprises three stages, the first and second consisting of one and two valves respectively are voltage amplifiers, and the third stage consisting of a number of valves (according to the number of receivers) amplifies the power. The valves used were 205 B, three-electrode, Western Electric type, and the loud-speaking receivers, which were placed in the open, were fitted with horns similar to those used on gramophones. The demonstration consisted in both male and female voices reading, a pianoforte solo, and gramophone records. It was quite successful, the claim of the makers that the articulation was perfectly clear, being amply justified.

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BUSINESS NOTES.

The Easter Holidays.—The issue of the ELECTRICAL REVIEW for April 2nd (Good Friday) will be published on Wednesday, March 31st. It will be necessary, therefore, that all matter for our editorial pages should reach us two days earlier than usual.

New copy for, and alterations to existing, displayed advertisements should be received not later than Thursday morning, March 25th. Official notices and small prepaid advertisements can be received up to 5 p.m. on Monday, March 29th.

Machine Tool Trades Association.—This Association now has 145 members. Practically the whole of the space for the Olympia 1920 Exhibition (September 4th to 25th) has been let to 200 exhibitors. The attendance is expected to be much in excess of that of 1912. The next exhibition thereafter is to be in 1923. The Association will take possession of more commodious offices at 70, Victoria Street, S.W., in April. The annual dinner was held on March 10th at the Connaught Rooms, Sir Alfred Herbert presiding.

A Palestine Inquiry.—The D.O.T. has received an inquiry from a firm in Haifa, Palestine, asking to be put in touch with manufacturers in the United Kingdom of electric pocket lamp torches and batteries of every description with the object of representing them in the Palestine market. They ask for price lists and samples; British manufacturers can obtain the name and address and information as to their financial standing upon application to the D.O.T., 35, Old Queen Street, S.W. 1.

Rotary Snap Switches.—Rotary snap switches are practically indispensable in the control of heating and cooking apparatus, owing to the relatively large currents to be controlled, and the need for various degrees of heat control, for which the ordinary tumbler type is unsuitable. The General Electric Co., Ltd., have accepted the sole agency in this country for the well-known "H. & H." Hart rotary snap switches, and other specialities produced by the Hart & Hegeman Manufacturing Co., of Hartford, Conn., U.S.A. Representative stocks will be held by the G.E.C. at their various branches throughout the country. A descriptive catalogue is in course of preparation.

London County Council Committees.—The General Purposes Committee of the L.C.C. recommends the following appointments to the Highways, and the Stores and Contracts Committees:—

Highways Committee:—Major P. Dawson, Mr. J. M. Gatti, Mr. H. A. Glanville, Lieut. H. H. Gordon, Mr. J. H. Harley, Mr. D. Hazel, Mr. G. H. Hume, Lieut.-Col. A. C. H. Kennard, Mr. S. Marsh, Lieut.-Col. E. W. Morrison-Bell, Lieut.-Commander A. C. Rawson, Mr. A. H. Scott, Mr. J. Speakman, Mr. W. J. Squires, Mr. R. G. Taylor, Mr. H. Ward, Brig.-General W. W. Warner (and one vacancy).

Stores and Contracts Committee:—Capt. A. O. Goodrich, Mr. W. Hunt, Mr. W. C. Johnson, Rev. J. C. Morris, Major I. Salmon, Mr. C. E. Taylor, and one vacancy to be appointed by the Council; also one representative to be elected by each of the Asylums and Mental Deficiency, Education, Fire Brigade, Highways, Main Drainage, and Park and Small Holdings and Allotments Committees.

Lead.—MESSRS. G. CAWSON & Co. report (March 13th):—

There has been a large quantity of Government lead available on the market this week. It has been difficult to get consumers to take it all up, and some of the metal has presumably gone into store. Further quantities will be available during the next few weeks, so that consumers are more than amply supplied. . . . Some interested parties are prognosticating a famine in lead when the Government stocks are cleared. We, however, fail to see such a contingency. It may take another six months to clear out the Government stocks, by that time the Broken Hill strike may be settled, and the American Exchange will then be in a very different stage to what it is at present. . . . Furthermore, we are now receiving soft lead from Burmah, and this will probably come forward regularly, so that in three to six months' time we may, perhaps, have a larger supply than at present. . . . The course of the market at present is more than ever dependent on the action of speculators. So long as they continue to support prices the market can no doubt be maintained, but should they withdraw their support, a serious slump in price is not by any means unlikely.

MESSRS. JAMES FORSTER & CO. report:—

The turnover for the week is approximately 10,000 tons, and consumers have bought heavily for both prompt and forward, there being experienced a specially urgent demand for immediate delivery of the best brands, some consumers in the London district having been brought to almost a standstill through delays in delivery of suitable lead, American not being good enough for certain important trades.

The reaction on March 11th may have been due to rumours of a possible early resumption of work at Broken Hill, which was mentioned in the Press yesterday, but nothing is known of anything of the kind in responsible quarters. The reaction is more likely due to declarations of the Government lead from Liverpool, and to a good line from America sold in January, now about due, and declared on the market on Thursday; but there is no evident pressure of even this on the market. . . . If the Broken Hill strike were to finish this month, we could not expect new production here till about October.

French Electrical Companies.—With the style of L'Electricité Appliquée, has been formed at 103-5, Rue St. Lazare, Paris, a company, with 350,000 fr. capital, for the carrying out of electric installations of all kinds.

Messrs. Reynes, Renaud et Cie. have been constituted a company at Paris (12, Rue Monceau), with a capital of 1,700,000 fr., for the undertaking of public and private installations, electrical, mechanical, and otherwise.

The Société Anonyme Ansot has been formed at Paris (27, Rue de Marac), with a capital of 500,000 fr., for the acquisition, installation, repair, and manufacture of all kinds of electric station plant.

There has been formed at Paris (94, Rue St. Lazare) the Société Hydro-électrique du Sud-Est, with a capital of 2,000,000 f., for the generation and distribution of electricity in the south-eastern suburbs of Paris.

L.C.C. Contracts.—The Stores and Contracts Committee recommends, owing to the large increase in the number of tenders and quotations received in consequence of the purchase of specific quantities of goods required instead of their purchase under running contracts, that it be authorised to open from April 1st, 1920, until March 31st, 1921, all tenders received for the supply of stores and maintenance works included in the order of reference to the Committee. The General Purposes Committee concurs in this proposal.

German Aluminium Prices.—According to a German paper quoted in the *Economic Review*, a price investigation office for the aluminium goods industry has been established with headquarters at Hagan, in Westphalia. The chief function of this office is to prevent the goods in question from being sold at ruinous prices abroad.

Cost of Petrol.—The Automobile Association and Motor Union is promoting a petition to the Prime Minister urging that the situation created by the increasing cost of petrol can only be relieved by the production of benzole and power alcohol in large quantities within the Empire under appropriate legislation, and calling for an International Conference on the subject. The matter is of great importance to everyone, in view of its bearing on road transport, and to the electrical industry in particular in connection with the use of small electric light and power sets, which is extending so rapidly. We therefore confidently commend the petition to our readers as worthy of their support. Forms can be obtained from the Fuels Department, Automobile Association, Fanum House, Whitcomb Street, W.C. 2.

Whitley Councils.—Delegates to the District Industrial Council (No. 7) for the East Midland area of electricity supply met at Nottingham last week, when the constitution of the body was approved and 12 representatives of employing interests and 12 representatives of Trade Unions were elected to form the council. It was agreed that the sphere of operations should be South Derbyshire, including Clay Cross, Bakewell and Buxton, but excluding Glossop. New Mills and Chapel-en-le-Frith, which will be dealt with by the Manchester District Council; South Notts from a line drawn south of Mansfield; South Lincolnshire and all of Leicestershire, Rutland and Northants, with the exception of Peterborough. Ald. E. Huntsman, chairman of the Nottingham Corporation Electricity Committee, was elected chairman for the ensuing year, and Mr. W. H. Gilkes, one of the employés' representatives, as vice-chairman. The constitution, which gives very wide powers regarding trade disputes, was adopted, the alternative provided to settle matters locally in the event of failure to arrive at mutual agreements, being the reference of points in dispute to the National Joint Industrial Council. It was agreed that members should do their best to collect information for the use of the Council relative to conditions and wages in the area covered by the Council, and the next meeting was fixed for May 6th at Leicester.

Book Notices.—"Modern Practice in the Construction and Maintenance of Rail Joints and Bonds in Electric Railways," Technologic Paper No. 62 of the U.S. Bureau of Standards (131 pp. and plates). Second edition. Washington: Government Printing Office.—A lucid and well-illustrated treatise on the efficiency and life of many types of rail joints and bonds, dealing chiefly with the latter.

"*Journal* of the Institution of Electrical Engineers," Vol. LVIII, No. 288. February, 1920. London: E. & F. N. Spon, Ltd. Price 10s. 6d. —This issue contains the following papers:—"Failures of Turbo-Generators and Suggestions for Improvements," by Mr. J. Shepherd; "High-Frequency Resistance of Wires and Coils," by Prof. G. W. O. Howe; and "Electricity in the Mining Industry," by Messrs. D. M. W. Hutchison and W. J. Wayte.

"Coal Mining and the Coal Miner." By H. F. Bulman. Pp. xii + 338; 22 illustrations. London: Methuen & Co. Price 15s. net.

"Distribution of Energy in the Spectrum of an Acetylene Flame," Scientific Paper No. 362 of the U.S. Bureau of Standards (13 pp.). Washington: Government Printing Office. Price 5 cents.

"Electricity: Its Production and Application." By R. E. Neale. Pp. viii + 136; figs. 45. London: I. Pitman & Sons. Price 2s. 6d. net.

"Modern Illuminants and Illuminating Engineering." By L. H. Gaster and J. S. Dow. Second edition. Pp. xv + 490; 213 figs. London: I. Pitman & Sons. Price 21s. net.

Trade with Australia.—Mr. Fred. S. Lee, of a firm trading under that name as an importer of electrical appliances at 38, Market Street, Sydney, Australia, has arrived here by way of Japan and America. Mr. Lee, who is representing Messrs. Dorman & Smith in Australia, wishes to hear from electrical manufacturers desirous of disposing of their products in Australia and New Zealand. His temporary office is at 59, Mark Lane, London, E.C.

Plant for Sale.—Manchester County Asylum has for disposal two Mather & Platt steam dynamo sets. St. James' and Pall Mall Electric Light Co., Ltd., have for disposal two Willans central-valve compound engines, direct-coupled to two 310-KW. Siemens dynamos. Manchester Corporation Electricity Department invites offers for six Babcock & Wilcox land-type water-tube boilers. For particulars see our advertisement pages to-day.

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Trade Announcements.—MESSRS. E. E. ANDERSON & Co., of 116, Snow Hill, Birmingham, have been appointed sole selling agents for that city by Messrs. F. L. Mitchell & Co., Ltd., of Peckham, and they are exhibiting the latter's electrical and other scientific specialities at the National Trades Exhibition, Bingley Hall, Birmingham. Messrs. Mitchell have acquired premises in McDermott Road, Peckham, S.E. 15, to deal with the increasing demand for wireless receiving sets and the usual components for experimental wireless stations.

MESSRS. WALES BROS., who are electrical engineers for Messrs. Prior, Watson & Co., builders, at 3, Surbiton Park Terrace, Kingston-on-Thames, desire to receive electrical manufacturers' catalogues, display cards, &c.

SIR ISAAC PITMAN & SONS, LTD., announce that all books formerly published by Messrs. Jas. Selwyn & Co., Ltd., of Essex Street, Strand, W.C., will in future be issued by themselves at 1, Amen Corner, E.C. Messrs. Selwyn's catalogue consisted chiefly of technical and scientific books, full particulars of which will be found in Messrs. Pitman's Spring List.

MESSRS. ALBERT LEE & Co., LTD., of London, have opened a branch at 5, Cross Street, Newcastle-on-Tyne, under the management of Mr. S. Gillitt.

Catalogues and Lists.—THE ELECTRICAL DEVELOPMENT ASSOCIATION, Hampden House, 84, Kingsway, W.C. 2.—Leaflet entitled "Eye Strain or Eye Comfort," contrasting good and bad lighting.

THE CONSOLIDATED ELECTRIC TOOL CO., LTD., Egyptian House, 170, Piccadilly, W. 1.—Electric tool catalogue, No. 10 E (45 pp.).—A list of portable and pneumatic tools, including various types of drills, grinding machines, spike drivers, &c. Profusely illustrated by photographs.

SIMPLEX CONDUITS, LTD., Garrison Lane, Birmingham. Advance list No. 704.—This is the forerunner of a more complete list, and deals with various types of conduit and accessories, including switches, joint-boxes, &c.

MESSRS. F. & A. PARKINSON, LTD., Guiseley, Leeds.—Booklet (19 pp.) illustrating and describing multi-speed A.C. motors with details of tests, comparisons with standard types and wiring diagrams.

FOSTER INSTRUMENT CO., Letchworth, Herts.—Book No. 23, "Radiation Pyrometry" (24 pp. and plates) dealing with the improved Foster fixed focus radiation pyrometer, which includes a new self-contained sighting device and ventilated receiving tube. This instrument was described in the ELECTRICAL REVIEW, of January 30th (p. 137).

CREDENDA CONDUITS, CO., LTD., Chester Street, Aston, Birmingham.—An illustrated price list of "Creda" hot-plates and grills, apparatus of both plain and artistic design.

MESSRS. F. L. MITCHELL & CO., LTD., 188, Rye Lane, Peckham, S.E., 15.—Advance list (four) of wireless apparatus including condensers, tuning coils, valves, &c., and also particulars of small gas and petrol engines, accumulators, dry cells and small electrical appliances.

MESSRS. MATTHEWS & YATES, LTD., Cyclone Works, Swinton, Manchester.—A 30-page booklet describing and illustrating humidifying, heating, cooling and ventilating plant, the main feature of which is its independence of the main drive. This is designed chiefly for textile factories, breweries, &c.

"THE COVENTRY" REPETITION CO., of 47, Victoria Street, London, S.W., has issued a folder giving particulars of its facilities for intensive production of bolts and nuts, and other small parts.

Socials and Reunions.—The subscribers to Gent & Co.'s Faraday Works, Leicester, War Fund entertained their returned men to a dinner and social evening at the Turkey Café, on Thursday, last week. The dinner was presided over by Mr. Hardy Parsons, supported by Messrs. Waddington and Skinner. The chairman welcomed the returned men on behalf of their comrades at home. Messrs. Allen and Lilley responded. After the dinner an augmented company enjoyed a very successful concert and dance.

On Friday, March 12th, at Slaters' Restaurant, Cannon Street, a whist drive and concert were held for the entertainment of the B.T.H. Co.'s staff of Mazda House. Mr. J. N. Stephens distributed the prizes and occupied the chair during the concert.

Pope's Social and Entertainment Club, which has been formed by the employés of Messrs. Pope's Electric Lamp Co., Willesden, recently held a whist drive and dance at Leopold-road school. The company numbered between 500 and 600, and there was keen competition for the whist-drive prizes presented by Mrs. Pope. The dance music was provided by the Imperial Syncopated Orchestra (conductor Mr. T. Harold Brown), and Mr. Sidney Penny officiated as M.C.

A French Amalgamation.—The shareholders in the Société Anonyme Westinghouse, at a recent extraordinary general meeting, approved a scheme of amalgamation with the Compagnie Electro-Mecanique, under which the latter will take over all the assets and rights of the former company. The purchase price will be paid in the form of the allotment to the Westinghouse company of 20,000 fully-paid shares in the Electro-Mecanique in exchange for the former company's shares, and the payment of a contract sum of 1,216,000 fr. at the end of June.

Calendars.—We have received a wall calendar, with monthly tear-off sheets, from the NATIONAL ENGINEERING SUPPLY CO., of West Bute Street, Cardiff.

THE TANGENT TOOL CO. (COSMOS), LTD., of Keynsham, Somerset, has issued a wall calendar, with a block of daily slips, for 1920.

Philips' Glow Lamp Works.—The report of the directors of the N. V. Philips' Gloeilampen Fabrieken, of Eindhoven, for 1919 first recalls the decision arrived at in December to increase the preference capital from 2,500,000 to 5,000,000 florins, and the ordinary shares from 3,500,000 to 15,000,000 florins. It was intended to create certificates for the preference shares, and every year place them at the disposal of the personnel at par as a portion of the bonus, as had hitherto taken place. A portion of the new ordinary shares would be subscribed privately by the American group with which a community of interests had been concluded. It was desirable to bring the social capital and the actual capital more in harmony with each other by the capitalisation of a portion of the undisclosed reserves formed in the course of years; the balance of the working account, therefore, contained not only the results of the financial year 1919, but also a part of the reserves in question. It was therefore proposed to distribute 100 per cent. of the dividend on the ordinary shares in certificates for ordinary shares, and 20 per cent. of the preference dividend in ordinary share certificates, whilst the balance of the dividend would be paid in cash. During the second half of 1919 the company concluded a community of interests with the International General Electric Co. and the General Electric Co., of Schenectady, U.S., which would participate in the Dutch company's capital, whilst the proceeds from this transaction would be invested in shares of the General Electric Co. In future there would be a mutual exchange of experience and patents. The company had acquired a portion of the new capital raised by the Edison Swan Electric Co., of London, and was otherwise interested in the latter's glow lamp works, so that the company would occupy a position in the English market which was protected by strong patents.

A large amount had been reserved in the balance sheet for 1918 for the depreciation of stocks. This precautionary measure seemed now to have been unnecessary, so that a portion of this amount came to the credit for 1919, whilst the market value of the stocks was considerably higher than that entered in the accounts. The sum of 1,000,000 florins reserved in 1918 for extensions still appeared in the balance sheet, because the new buildings were not completed by the end of last year, and the amounts already expended were provisionally booked among debtors. The raw materials in the stores would again last for some time. As the coal supplies became more plentiful it was possible to start the third furnace at the glass factory in May, and the fourth in August, so that it was now possible to cover the company's requirements in glass. The accounts for 1919 show that the gross profits amounted to 11,208,000 florins, as compared with 7,718,000 florins in the preceding year, and the net profits to 8,974,000 florins, as against 3,025,000 florins. It is proposed to pay a dividend at the rate of 151 per cent., this contrasting with 40 per cent. in 1918. As an interim dividend of 11 per cent. has already been distributed for 1919, the final dividend is 140 per cent., of which 40 per cent. is to be paid in cash and 100 per cent. by way of a bonus in the form of a certificate for an ordinary share. The dividend on the preference shares amounts to 35 per cent., as against 8 per cent.; and as 7 per cent. has already been paid, the final distribution is 28 per cent., of which 8 per cent. will be paid in cash and 20 per cent. in two ordinary shares of 100 florins each. A large increase has also been made in the amount allowed to the profit participating shares, payable wholly in cash.

Liverpool Lock-out Sequel.—Our correspondent writes: "This week probably marks the end of the Liverpool electricians' lock-out, and the Electrical Trades Union having given a pledge that they would use their influence to get the men to accept any decision given by the conciliator who had been asked to adjudicate on a newly introduced controversial point, the position is extremely hopeful. At the conference which took place at Liverpool between the Electrical Trades Union and the National Federated Electrical Association, Mr. Tate, general secretary of the N.F.E.A., pointed out that the quarrel was not so much between the Liverpool N.F.E.A. and the E.T.U. as between the National Council of the N.F.E.A. and the E.T.U. The position, he said, was that no local branch could make arrangements to alter conditions of labour without the consent of the sectional board, whose power, in turn, was subject to the National Council of the N.F.E.A. The Liverpool branch, therefore, were not in order in coming to an agreement with the Electrical Trades Union without first getting that agreement through the sectional board of the National Council. The employers' representatives asked whether the E.T.U. were prepared to consider amendments to the rules, and on behalf of the E.T.U. it was stated that they could discuss the rules provided it was clearly understood that such discussion was without prejudice to the general contention that the whole of the rules should come into operation. The rules were then considered seriatim, and several amendments were proposed. At this stage, however, the E.T.U. introduced a new issue, and their spokesman drew attention to the fact that the wages in the London area had been agreed on at 2s. 3d. per hour. Electrical Trades Union members now asked for the same rate of pay, and their committee would not consider the employers' amendments unless the employers' attitude on the wages question had been made clear. Mr. Tate made the suggestion that alternatively to paying 2s. 3d. per hour and no walking time, the

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whole of the rules be scrapped and they start afresh. They could not settle the matter then, as it would have to go before the National Council. At a subsequent meeting of the conference, Mr. Tate said that they were prepared to recommend that the Liverpool branch be put in the same wages position with regard to London as it was before the war. Eventually, however, the following memorandum was agreed upon: (1) That this conference recommends that the previous wages disparity between the Mersey district and the London district be proportionately maintained; (2) the union representatives claim that this should be ascertained on an hourly basis. The employers claim that it should be calculated and ascertained on the basis of normal weekly earnings; (3) for the purposes of calculating the disparity the union's representatives suggest either of two periods: (*a*) the agreed rate for the period covering August, 1914, (*b*) the revised rate arranged under the 47 hours agreement of January 29th, 1919. The employers suggest period (*a*). It was agreed to submit these matters to conciliation, and that the decision be known before the men resume work. A no victimisation clause has been carried, and so far as possible, when work is resumed, employers' representatives will start all the men they possibly can. The award of the arbitrator is not known at the time of writing."

Non-Ferrous Metals.—The following particulars are published of the stocks (exclusive of old metal and scrap) in this country of soft pig lead and refined spelter in the possession of the Minister of Munitions on March 1st, 1920: Soft pig lead, 40,435 tons; refined spelter, 7,299 tons. A proportion of the above stocks is already sold to the trade for forward delivery. Since the stock of virgin non-ferrous metals unsold under the control of the Government have now reached such proportions that they cease to be an important factor in the general stocks of such metals held in the United Kingdom, it is proposed to discontinue publication of these notices.

Labour: its Output and Reward.—Lecturing on March 9th in the Department of Industrial Administration of the Manchester College of Technology, Mr. Percy J. Pybus, C.B.E., one of the managing directors of the English Electric Co., said that increased production was a cry with which they were all familiar. They had heard it from the lips of politicians and financiers, from the Press, and from the leaders of organised labour, and though, like every other truth which attained wide popular currency, the doctrine was in some danger of being twisted and misused until it became no more than a half-truth, it was most vital.

Reviewing the objections of the trade unions to increasing output, the lecturer said that it was a doctrine which was repudiated by many trade unionists, and by almost all the responsible labour leaders, but it was impossible to contest the extent of its influence on the rank and file. It had its origin in the dread of unemployment.

The group-bonus system, Mr. Pybus continued, was radically unsound, and its adoption as a solution to our present troubles would only intensify them. The relative popularity with the engineering unions of systems such as the Priestman bonus system in itself excited suspicion. The support given by district branches of those unions was consistent neither with their declared objections to payment by results nor with the advocacy of many of their leaders of idleness as a political principle. From the point of view of the men such systems represented "money for nothing." The good worker shared the result of his exertions with his colleagues while the slacker distributed the results of his idleness over the shop. Rate-fixing was difficult, and in the last resort many of the calculations must be purely arbitrary. The employer could have no assurance that he was in fact obtaining increased output from his increased wages, and if the apparent increase was excessive he had every facility for cutting rates. The workmen could always defend themselves from the charge that the output was not increasing by saying there was a defect in the calculation of the standard.

Mr. Pybus said, however, that he was emphatically of opinion that it was possible to overcome the legitimate objections of labour to other and older methods of payment by results, on the one condition that proper machinery was provided for fixing piece-rates, and for reviewing them at the request of either party.

The first step was to make rate-fixing scientific. It called for special training and for a human manner, but the most efficient and courteous of rate-fixers sometimes made mistakes, and the machinery must provide a quick and easy method of appeal. He then briefly outlined a scheme which was successfully working in a modern factory, and said the reason for its success lay in the fact that the whole question of rate-fixing was brought into the light of day and revealed its true character as an open bargain between the workmen and the employer. A rate was fixed for a new job and offered to the man concerned. He was at liberty, if he questioned it, to go to the time study office and work through the calculations with the responsible official. If still unconvinced he could refer to a committee, which had to meet within two days of the complaint. Pending its meeting the firm's rate was given effect, and the decision of the committee, when given, was retrospective, and no figure as to the time taken on the job between the fixing of the rate and the meeting of the committee was taken as evidence before the committee. That body consisted of three representatives of the firm and three of the men, one of whom was the workman concerned, and the other two were selected by him as being on similar work. If the committee failed to agree, the firm was called upon to demonstrate in its own works that the rate was fair. It was open to the firm to use the machinery for reviewing a rate which they thought too high, but any reduction was compensated by an equivalent addition to the rate for some other job less favourable to the men.

Liquidations. — F. Husband, Ltd., electrical engineers and manufacturers, Craven House, Kingsway, W.C.—A largely attended meeting of creditors was held last week, at the Cannon Street Hotel. It was stated that the shareholders of the company had previously passed resolutions in favour of voluntary liquidation, and had appointed Mr. R. S. Farries, of 8, Laurence Pountney Hill, E.C., as liquidator.

It was stated by the liquidator that the company was formed in July, 1915, for the purpose of carrying on the business of electrical engineers. The present adverse position had been brought about by the lighting restrictions and other causes. The company had a share capital of £1,000. Shares to the extent of £500 were issued for cash, and the balance of the capital was allotted for the goodwill and certain patents which were secured. Subsequently further capital was found for the business. The idea was that the money so found should be for shares, which would be issued as soon as the necessary legal formalities were completed. Those legal formalities had, however, never been completed, and no further shares had been issued. During the year to July, 1916, a sum of £597 was put in by Mr. Husband and his friends, while in the twelve months to July, 1918, a further £330 was found for the business. Between July, 1918, and January 3rd, 1919, sums aggregating £1,330 were put into the concern. That made a total of £2,257. In the absence of any shares having been allotted those amounts appeared as advances, but it was always intended that the money should be for shares. The money had been regarded as part of the capital of the company, and those who had advanced it had no right to withdraw it.

Mr. Osborne: Was it treated as a loan to the business?

The Liquidator: No, it was treated as capital.

A Creditor: Do you treat it as capital to-day?

The Liquidator: Yes. He went on to say that all the £2,257 had been lost. The company had two overdrafts at the bank which totalled £1,697. The bank had been secured by the deposit of securities, and a claim would have to be made against the company in that respect. The assets of the company were estimated to realise £3,133, from which had to be deducted £81 for preferential claims, leaving net assets of £3,052. The latter asset was subject to the claims of the debenture holders which amounted to £2,428. The assets consisted of stock £2,500, book debts estimated to realise £250, furniture valued at £300, and cash in hand £82. The liabilities to creditors aggregated £3,346. With regard to the stock, it had been taken in detail. Some little time ago a verbal offer was made for the stock, the figure then mentioned being £2,500. He had only estimated the book debts at £250, as many customers had returned goods for which no credits appeared in the books. No value had been placed on the goodwill. Owing to the liquidation the licence of the company to manufacture and sell the "Husband" fire had terminated. As the rights in that direction had gone he did not think there could be much value in the goodwill of the company.

Mr. P. Houstoun: Who is the owner of the patents?

The Liquidator: The licence is granted to the company to manufacture and sell the fires. Under the terms of the licence immediately liquidation took place the owners had the right to terminate the licence. The gentleman who granted the licence had nothing to do with the company. He went on to say that the debenture was created in June of last year for £3,000, and carried interest at the rate of 7 per cent. per annum.

In answer to questions, the liquidator stated that by order of the Court he was appointed receiver for the debenture holders on February 20th last. His firm had also been the auditors of the company. An approximate balance sheet was prepared as at December 31st last, and that showed the company to be insolvent.

Mr. Houstoun said he understood that the company was formed under "Table A." which definitely stated that debentures in a company could not exceed the amount of the share capital.

The Liquidator replied that the company was formed under a modified form of "Table A." and there was a special clause in the articles of association which referred to the issue of debenturese.

Several creditors expressed dissatisfaction at the position disclosed, and after a short discussion it was unanimously resolved that an application should be made to the Court for the appointment of Mr. W. Osborne, of Messrs. Corfield and Cripswell, Balfour House, Finsbury Pavement, E.C., as the liquidator of the company. A committee of inspection was also nominated consisting of Mr. J. Scriven ("Z" Electrical Co.), Mr. E. Heath (Messrs. Heath, Wingfield & Co.), and a representative of the General Electric Co. Messrs. Heath Wingfield were nominated to make the necessary application to the Court.

J. Hopkinson & Co., Ltd.—Winding up voluntarily for reconstruction purposes. Liquidator: Mr C E. Hobson, of

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Huddersfield, secretary to the company, who is authorised to consent to the registration of a new company with the same name.

Ebonitis, Ltd.—Meeting of creditors, March 22nd, at 3, Crosby Square, E.C. Voluntary liquidation. Liquidator: Mr. E. C. Moore, 3, Crosby Square, E.C. 3.

Cowlishaw, Walker & Co., Ltd.—Winding up voluntarily. Liquidator: Mr. J. A. Edmondson, Woodville, Trentham Road, Stoke-on-Trent.

Cosmos Engineering Co., Ltd.—A petition for the winding up has been presented to the High Court by Alfred Herbert, Ltd., of Coventry, and will be heard in London on March 23rd.

Telephos Domestic & Street Lighting Co., Ltd.—Meeting of creditors, March 25th, at Salisbury House, London Wall, E.C. Claims must be sent to the liquidator, Mr. H. H. Foster, of 806-9, Salisbury House, E.C., by April 30th.

A.E.G. Electrical Co. of South Africa, Ltd.—First and final dividend of 20s. in the £ to non-enemy creditors, payable March 15th at Carey Street, W.C.

The Electrical Co., Ltd.—First and final dividend of 20s. in the £ to non-enemy creditors, payable March 15th at Carey Street, W.C.

Trafford Power & Light Supply (1902), Ltd.—Winding up voluntarily. Liquidator: Mr. C. Cooper, 60, Spring Gardens, Manchester.

Swedish Electrolytic Process.—It is announced from Gothenburg that the A.B. Cumberland Elektrolytiska Process, which was established in 1918, has now disposed of the company's Norwegian and Danish patents to companies in those two countries. Many installations have been carried out since the company's formation, and extensions of the works have become necessary.

Danish Cable Works.—The directors of the A.S. Den Danske Kabelfabrik, of Copenhagen, do not propose to recommend the payment for 1919 of any dividend. After making the statutory allocations to depreciation and reserve funds, the sum of 60,800 kr. remains to be carried forward to 1920.

Trade in Canada.—An agent of the Canadian General Electric Co., Ltd, who has been in this country for some months for the purchase of raw materials, draws attention to the opening for export trade offered by his company, which purchases large quantities of electrical supplies and automobile accessories. Manufacturers looking for export business should address the Manager of the Supply Department at Toronto, Ontario, Canada.

Sentence.—At the West Riding Assizes at Leeds, on Monday, George Edward Pearson, of Pearson & Sons, Ltd., electrical engineers, Farsley, was sent to prison for six months in the second division, for stealing, while bailee, an electric motor belonging to the Ministry of Munitions at the Barnbow munition works, near Leeds; and V. W. T. Bradshaw, electrical engineer, of Sunderland, who pleaded "guilty" to various indictments, received a like sentence.

Report on the Electric Lamp Industry.—At the moment of going to press, and therefore too late for publication in this issue, we have received a copy of the findings and decisions of a sub-committee appointed by the Standing Committee on Trusts, to inquire into the existence of any trust or trade combination in the electric lamp industry. The report was adopted by the Standing Committee.

Copper and Lead Prices.—Messrs. F. Smith & Co. report, March 16th:—Copper (electrolytic) bars, £120. £4 decrease; ditto sheets, no change; ditto wire rods, £135, £4 decrease; ditto H.C. wire, 1s. 4½d, ½d. decrease.

Messrs. James & Shakespeare report, March 17th:—Copper bars (best selected), sheets and rod, no change; English pig lead, £45 10s., a reduction of £7 on the week.

LIGHTING AND POWER NOTES.

Alfreton.—Electricity *v.* Gas.—Owing to the excessive cost and poor quality of the gas supplied to them, several tradespeople and other residents have arranged a conference with the Notts. and Derbyshire Power Co. to ascertain the conditions under which the company's system may be extended to the town.

Arbroath.—Power for Harbour.—The Town Council has asked the Electric Light and Power Co. to quote terms for the extension of mains to the harbour.

Ashton-under-Lyne.—Joint Electricity Authority.—The Town Council has decided to apply to the Electricity Commissioners to form a Joint Electricity Authority for the undertakings of the Ashton Corporation and the Stalybridge, Hyde, Mossley, and Dukinfield Joint Board.

Brazil.—New Stations.—The Compagnie des Mines de San Jeronymo et l'Etat de Rio Grande do Sul has prepared a scheme to construct generating stations of an aggregate capacity of between 10,000 and 30,000 H.P. to supply the City of Porto Alegre.—*L'Electricien.*

Birmingham.—Removal of Restrictions.—The restrictions placed upon consumers between the hours of 3.30 and 5.30 p.m. during the winter months have now been rescinded. It is stated that the new station cannot be put into commission until next February.

Blackpool.—Finances.—The estimated loss on the Corporation electricity works during the current year was £2,200, as compared with a loss a year ago of £2,727. Next year's revenue is estimated at £91,732, and after allowing £23,983 for interest and sinking fund charges, a surplus of £4,000 is anticipated.

Bray (Co. Wicklow).—Extensions.—The Urban Council is contemplating extensions and renewals in the electric lighting system of the town, at a cost of £7,000. The Council has asked for expert reports on the matter.

Carlisle.—New Generating Station.—The approval of the Electricity Commissioners has been obtained for the erection of a new generating station at an estimated cost of £100,000. This will not supersede, but supplement, the present station, at which a new rotary converter costing £7,000 is to be installed.

The Commissioners, in consultation with the Corporation, arrived at the following conclusions:—(1) That on account of the growing demand extensions are urgently needed; (2) That the present site is unsuitable for such extensions; (3) That there is no possibility of a bulk supply from another undertaking; (4) That the question of utilising water power from the River Eden cannot be considered at present.

Clacton.—Extensions.—The electrical engineer has advised the purchase of a new Diesel engine and generator, at an estimated cost of £9,500, to replace the present plant, which, it is stated, is worn out and expensive in running. The report and recommendations were adopted.

Continental.—Germany.—By the construction of the Rhine-Main-Danube canal, two valuable power centres will be obtained. The Main is to be canalised between Aschaffenburg and Würzburg, with 12 falls, which will produce a yearly average of 40,000 H.P. The Danube is to be canalised from Ratisbon to Passau, and a weir constructed below Vilshofen, forming a fall of nine metres, which could produce about 42,000 H.P.—*Economic Review.*

Saxony.—The Government proposes to erect an electrical power station near Borna, which is to have a capacity of 100,000 KW.

Switzerland.—The "Forces Motrices Bernoises" company is constructing a large hydro-electric station at Berne, designed to develop 64,800 H.P. It is expected that the station will be completed this year. A large dam is being built across the River Aar, at Mühleberg, in connection with the scheme.

Coventry.—Parliamentary Bill.—The Leicestershire and Warwickshire Electric Power Co. was recently refused permission by the Court of Referees to oppose the Parliamentary Bill being promoted by the Coventry Corporation. The Bill, which seeks powers to erect a new station, &c., is considered prejudicial to the company's undertaking, which, it was stated, is being augmented by the construction of an additional station for the Coventry district.

Dartmoor.—Lignite.—In order to secure a cheap form of power for the proposed copper refinery to be established in Devonshire, it was proposed, as will be remembered, to harness the water power of Dartmoor, but the outcry against this scheme has brought forward a counter-proposal to open up the lignite beds at Bovey Tracey. The Germans had already interested themselves in a similar proposition, and had spent £100,000 in preparatory work. During the war the Petroleum Research Department investigated the deposit, and subsequent work has proved the existence of a large bed of high-grade lignite.

Dorchester.—Purchase of Undertaking.—The Town Council is negotiating with the County of Dorset Electric Supply Co. for the purchase of the company's Dorchester plant.

Price Increase.—The Electric Supply Co. has intimated that it is applying for powers to increase its charges for lighting to a maximum of 10d. per unit. The Council has pointed out to the Minister of Transport that there is no justification for such an increase.

Ellesmere Port.—Power for Docks.—The Urban District Council has decided to oppose the granting of an order to the Mersey Power Co. authorising it to supply electricity to the Manchester Dry Docks and Pontoon Co.

Harrogate.—Engines from Submarines.—At a cost of £15,750, two 600-B.H.P. Diesel engines, taken from captured German U boats, have been acquired by the Corporation to replace steam engines for driving generators at the electricity works.

Kirkcaldy.—Bulk Supply.—The offer made by the Fife Electric Power Co. is considered excessive by the Council, and it is stated that the energy which the company is able to supply will not be sufficient to meet the present demands surplus to the output of the town plant. The Electricity Commissioners are being approached with a view to obtaining their opinion as to the advisability of disposing of the undertaking.

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Lincoln.—Price Increase.—The Town Council has increased the price of energy to all consumers, except where prices are fixed by agreement, by 15 per cent., as from January 1st. From the same date a rebate of 5 per cent. is to be made in respect of electricity used for domestic purposes.

Lampeter.—Electric Lighting.—The Urban District Council has given permission to Mr. Eric Richards to construct overhead electric light wires in the town.

Lanarkshire.—Loan.—The County Council has received the sanction of the Secretary for Scotland to a further loan of £2,500 in connection with the execution of capital works under the Blantyre Electric Lighting Order.

Liverpool.—House Lighting.—It has been proposed to equip the houses now being erected under the Liverpool Housing Committee scheme, with electric light. When the matter came before the Electricity Committee, it was decided to refer the matter back for further consideration with a request that the Electric Lighting Sub-Committee would furnish particulars as to estimated cost, the number of houses to be supplied, and the saving that could be effected by laying the necessary mains simultaneously with the water mains.

London.—L.C.C.—The Council having asked the Electricity Commissioners whether they proposed forthwith to take over the duty of sanctioning loans for Metropolitan Borough Councils, which, until the Electricity (Supply) Act was passed, came under the Council's jurisdiction, the Commissioners replied that they would take over this duty at once; with regard to the provision in the Act that they should act in consultation with the Council in this respect, they proposed to refer to the Council only those loans which might involve a call on the local rates for repayment, and stated that they were proposing a similar arrangement to the Government Departments referred to in the same section of the Act. The Finance Committee of the Council found that the Ministry of Health had agreed to the transfer to the Commissioners of loans formerly subject to its sanction, and recommended the Council to take the same course, on the understanding that the Council be notified of all loans by Metropolitan Borough Councils proposed to be sanctioned by the Electricity Commissioners for electricity purposes, and that cases in which plant purchased with 42-year loans still outstanding was to be superseded should come before the Council.

Loans.—The Finance Committee recommends the sanction of the Council to the borrowing by the Islington Borough Council of £4,866 for mains, transformers, house services, and meters, and the Stoke Newington Borough Council of £3,000 for mains and services.

St. Marylebone.—The Council has been advised by Sir John Snell to negotiate for a bulk supply from the Central Electric Supply Co. in lieu of making extensions at an estimated cost of £250,000. Information regarding a supply has been received from the company, but the Council is still of the opinion that extension of plant would be more advantageous, and is, therefore, urging the Commissioners to reconsider the scheme. The Council has already an agreement with the Metropolitan Electric Supply Co. whereby the latter may claim to supply all energy which the Council cannot generate.

Prices.—The Westminster Electric Supply Corporation, Ltd., has informed its consumers that the proposed increase in price of ½d. per unit for lighting as from January 1st last (notice of which was given in September, 1919) will not now be imposed, and the rates of charge will, therefore, remain the same as last year.

Street Lighting.—New street lamps for the Strand and the parish of St. Martin-in-the-Fields, proposed by the Westminster City Council, will, it is said, increase the pre-war lighting four-fold, but the cost of lighting and maintenance, it is estimated, will be less than double. The proposed new lamps will be of 1,800 c.p., the old ones being of 500 c.p., which during the war period was reduced to 100 c.p., at which standard some of the lamps remain.

Middlesbrough.—Bulk Supply.—Regarding the recent decision of the Corporation to augment the power station plant, the secretary of the Cleveland and Durham Electric Power Co. has written suggesting that a bulk supply could be given instead, which would be less expensive. The total cost of this, including rotary converters, is stated to amount to £3,000. The company has also suggested that the Corporation consider the provision of the whole of the energy required by Middlesbrough by the power company.

Presteigh.—Electricity Supply.—The Urban District Council has decided, after interviewing the engineer for the Hereford electric lighting scheme, to accept the terms for the supply of electric light and power to the town.

Walsall.—Mains Extensions.—The Town Council has sanctioned extension of mains from Bloxwich to Cannock at a cost of £30,000.

Whitehaven.—Flat-rate.—The Town Council, with a view to simplifying accounts, has substituted for the present charge for electricity of 4½d. per unit, plus 52½ per cent., a flat-rate of 7d., less 10 per cent., for domestic lighting. Owing to the expenditure involved, £1,603, the Council has decided to defer the question of extending the mains to Harras Moor.

Wolverhampton. — Extensions. — The Council has approved recommendations of the Electricity Committee, and sanction is being sought for loans of £17,648 for mains extensions, £2,750 for sub-station buildings, and £13,660 for converters and accessories.

TRAMWAY AND RAILWAY NOTES.

Australia. — Queensland. — The Brisbane tramway system is to come under Government control in September next.

Bradford.—Collision.—Two cars collided in the early morning of March 10th, on a single stretch of line on the Bingley section of the Corporation's system. One of the drivers had his leg broken and was severely bruised. The other driver was not seriously injured.

Blackpool.—Tramway Estimates. — The receipts on the Blackpool Corporation Tramways, including the recently-acquired Fleetwood section, for the coming year are estimated at £270,000, and, after allowing £42,000 for interest and sinking fund, it is expected there will be an available balance of £25,000. The current year's balance was estimated at £15,000, but it will probably be £2,000 more than this figure. During the coming year it is proposed to spend £15,000 on the new tramway depot, £50,000 on permanent-way renewals, and £12,000 on six new Pullman cars for the Fleetwood route.

Chile.—Tramcars Destroyed.—Owing to the enforcement of a municipal order prohibiting more than the legal number of passengers on the Valparaiso tramcars, and the poor service, an indignant crowd burned 21 cars and destroyed the remainder, last week.

Continental.—Italy.—The Communal Council of Trento has approved the proposal of the Giunta to construct a second hydro-electric station on the River Sarca. It is proposed to set up machinery for the generation of 10,000 kw., so as to utilise the average flow of the river, at an outlay of 6,500,000 lire. This includes 400,000 lire for the replacement of the 20,000-volt conductors by others capable of carrying 53,000 volts. Schemes are also in contemplation to utilise the "spare" flow of the river for the generation of extra power to be used at certain periods of the year. The energy, besides working the tramway network, will be used for the following lines to be constructed:—(1) Trento, Lavis, Cembra, Cavalese, Predazzo, Modena; (2) Trento, Sarche, Plone, Pinzolo, with a line linking Sarche, Arco, Riva; (3) Malè, Fucine, with a future extension, Fucine-Edolo.

Darlington.—Extensions.—The Electricity and Light Railway Committee is ascertaining the cost of extending the Corporation's electric tramway system from Greenbank Road to the N.E.R. Stooperdale Offices.

Dumbarton.—Proposed Fare Increase.—The Town Council has received a communication from the Dumbarton Burgh and County Tramways Co., intimating that, owing to the increase in expenses, it is necessary to increase fares. The matter has been submitted to the Tramways Committee for a decision.

Greenock.— Contemplated Purchase.— The Town Council, having received assurances of co-operation from neighbouring bodies, is considering the purchase of the local tramway undertaking under the terms of the company's lease which provides an option for such purchase in May, 1921.

Hutton Magna.—Time Extension.— Formal application has been made to the Minister of Transport by the Hutton Magna Light Railway Co. for an order authorising an extension of the time by one year, from May 17th, 1920, in which to purchase lands and to complete the railway.

Leeds.—Proposed Fare Increase.—The Tramways Committee is considering the advisability of raising fares to the full statutory limit owing to the increase in the cost of working. This would mean practically doubling the pre-war rates.

London. — Underground Railway Fares. — Lord Ashfield addressing a Committee of London M.P.'s upon the subject of increased fares, stated that the promoters of the Bills under discussion were prepared to accept one of two alternative schemes instead of that formulated. The first of these was to have a maximum of 1½d. per mile, or fraction of a mile, with a minimum charge of 2d.; workmen's fares to be at the rate of single fares for return journeys with a minimum charge of 3d. The other suggestion was that the companies should have the power to raise fares within the limits imposed by the present Bills, but that any such increase in excess of the existing maximum would have to receive the approval of the Minister of Transport, who, after investigation, would decide whether the increase was justifiable. These alternative suggestions were to be considered at a further meeting.

Tramway Schemes.—The London County Council Bill seeking authority for a large programme of tramway extensions was considered by the Standing Orders Committee of the House of Commons, this week. Fifteen London borough councils have refused their assent to different parts of the scheme, and the County Council asked for a suspension of the Standing Orders to enable it to override the veto and proceed with the proposals. The Standing Orders Committee, after a long discussion, came to the conclusion that the subject was of such importance that it ought not to decide on its own responsibility. It decided to refer it to the House of Commons as a whole for settlement.—*The Times.*

Fare Increase.—The L.C.C., as announced in our last issue, has decided to increase all tramway fares. The new scale is 1d. for 1·2 miles, as against the previous rate of 1d. for 1·5 miles. Workmen's fares are raised from a maximum of 5d. to 6d.

Accidents.—Two men were injured and several other passengers badly shaken in a tramcar accident at Camberwell Gate, on Monday,

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which was caused by a car fouling the points. For two hours City-bound cars were diverted at Camberwell *viâ* Kennington.

A tramcar took fire in the London Road, S.E., on Tuesday, through, it is stated, a defective electric circuit, and one of the passengers was burned on both legs and was removed to hospital.

Traffic was delayed for about 20 minutes on Thursday morning last week on the City and South London Tube, owing to a breakdown near Stockwell.

East Ham.—The Corporation has been informed by the Ministry of Transport that it is imperative that life-guards should be provided on new tramway cars.

Middlesbrough.—Tramway Municipalisation.—The question of a joint board for the control of the tramways on Tees-side, which are shortly to pass over from the Imperial Tramways Co. to the municipalities, has recently been under consideration by the Middlesbrough, Stockton and Thornaby Corporations. Stockton and Thornaby decided favourably, but Middlesbrough negatived the project.

The Tramways Committee has decided that when the Corporation takes over the Imperial Tramways Co.'s system in its area, at least one-third of the conductors shall be women.

South Africa. — Railway Electrification. — The report of Messrs. Merz & McLellan upon the possibilities and advantages of electrifying a considerable mileage of South African railways, was published in a recent number of the *Electric Railway and Tramway Journal*. The lines covered by the report are Durban-Maritzburg, Ladysmith-Glencoe, Witbank-Germiston-Randfontein, Waterval Boven-Komatipoort, Witbank-Waterval Boven, and various lines from Cape Town. The system recommended as being best applicable to prevailing conditions, is D.C. 1,500 to 3,000 volts, the distribution to be effected by means of overhead wires. The total capital cost of the suggested scheme is estimated at £5,274,135, which will bring in an annual profit of £801,900.

Todmorden.—Opposition to Bill.—The Town Council has decided to oppose the Halifax Corporation Extensions Bill, because of the Council's desire to run a motor omnibus service of its own beyond the town boundary line and in the direction of Halifax.

TELEGRAPH AND TELEPHONE NOTES.

A New Form of Wireless Aerial.—According to the *Vaderland*, says the *Board of Trade Journal*, a new form of wireless aerial has been experimented with at Scheveningen, which is the invention of a Dutchman of the name of Vlug. The wires for a length of from 100 to 150 metres are lightly buried in the ground. They are said to be highly sensitive, with the result that two wires are sufficient for direct communication with Bandoeng (Dutch East Indies), a receiver being placed between the two, which contains certain improvements of Mr. Vlug's invention. Comparison has been made between this wiring and the large antenna at Scheveningen, by which it was proved that signals were louder on being received through ordinary aerials, but that not a letter was distinguishable owing to the disturbances. These had not entirely disappeared when employing the Vlug system but had gained greatly in distinctness, so that not a letter was missed. One valve was used as a detector, and another as a low-frequency amplifier. The report goes on to say that the period of the year is especially suited to receiving the Bandoeng messages, and also that, although great difficulties are experienced owing to disturbances caused by the large European stations, the Telefunken station at Sambeek contains an apparatus by which Bandoeng will always be easily detected, but it remains open to question whether it will be practicable for ordinary operators. On the other hand, an instrument constructed by Dr. Koomans, an engineer attached to the Telegraph Service, does not present such difficulties.

Atlantic Cable Repairs.—The Western Union Telegraph Co.'s cable ship *Mina*, which was engaged in repairing the company's cables about 90 miles west of the Irish coast, put into Queenstown on March 15th for shelter. The work of repairing the cables had to be temporarily abandoned owing to the bad weather.

Canada.—The Postmaster-General gives notice that deferred (as well as ordinary) telegrams are now accepted at any Post Office for transmission to Canada by the State-owned Imperial cable (which is at present the only route available for the deferred service). The rates per word are as follows:—Eastern Provinces, 4½d.; Manitoba, 7d.; Western Provinces (excluding the more inaccessible parts of British Columbia and the Yukon), 7½d.

Denmark.—An official Commission appointed to consider the erection of a long-distance wireless station in Denmark is proceeding to America on April 4th to negotiate regarding the possibility of linking up the Danish with the United States wireless system.—*The Times.*

Germany.—Telegraphic Press rates have been resumed between France and Germany. Press telegrams being accepted at the rate of 9 centimes per word.

A wireless station has been erected at Dortmund by the German Ministry of Posts and Telegraphs. It is proposed to transmit by wireless important communications of the express service of the Foreign Trade Office.—*Economic Review.*

Guernsey.—The revenue statement and statistics for the year ended December 31st, 1919, of the States Telephone Department show that the revenue was £8,687, an increase of £436, and the working expenses £8,650, leaving a net profit for the year of £37, a decrease of £175 on the previous year. The number of lines of all descriptions increased by 148 to 2,536, and the mileage of overhead wire by 96 to 1,735 miles. The average number of connections per day increased by 97 to 5,124; per subscriber per day decreased by 1 to 2·3; and per public telephone per day increased by 4 to 5·8. The total number of calls increased by 20,082 to 1,654,923. The staff increased by 12 to 62.

India.—The Bengal Telephone Co. promises to complete the installation of new plant at Calcutta by the middle of this year. The new plant, it is said, will completely modernise the Calcutta telephone system. The present switchboards, which answered all pre-war requirements, were designed to meet an average of 4·5 calls per telephone per day, but since 1915 the calling rate in Calcutta has trebled. The daily average exceeds 60,000 calls, and approximately 7,500 are made during the busy hours. This state of things led to dissatisfaction and to complaints against the operators who, in turn, reciprocated by refusing to work without increased wages. Whatever the failings of a telephone service may be, the use of offensive language to the operators is inexcusable. It is rumoured in the local Press that so bad has the behaviour of many telephone users at Rangoon become that the girl operators are inclined to cease work rather than continue to be insulted. The Indian Press understands that research work is being undertaken by a staff from Home in order to find means of overcoming meteorological obstacles which interfere with the proper working of wireless telegraphy in India during certain seasons of the year. These difficulties are not experienced in England, but are very marked in South America as well as in India.

Spain.—The Budget Commission has approved credit for the laying of a direct cable between Bilbao and Gibraltar.

Telephone Employés' Pay.—The new rates of pay for telephonists recently agreed upon between the Post Office authorities and the Post Office Engineering Union provide for a minimum wage of 29s. in London and 27s. in the provinces for skilled unestablished workmen at 21 years of age, and of 28s. and 26s. respectively at 20 years of age. Labourers—unestablished—also receive 28s. and 26s. for London and the provinces respectively, and the rates for boys and youths in training are 20s. and 18s. at 18 and 15s. and 13s. at 16. All the above rates are plus 30 per cent. bonus, and in the case of the skilled workmen and labourers 24s. additional bonus is paid. This makes the highest wage in the scale a little under 63s., and that for a 48-hour week.

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the Electrical Review *in which the "Official Notice" appeared.)*

OPEN.

Australia.—Melbourne.—April 12th. City Council. Two 2,000-kw. rotary converters; H.T. switchgear, 6,600 v.; D.C. switchgear, 600 v. (January 30th.)

Aylesbury.—March 25th. Installation of electric light in St. John's Church. Specification, &c., from Mr. T. Moore, "Fern Lea," 36, Bierton Hill, Aylesbury.

Ayr.—March 24th. Electric light work, Newton Park School, for the Education Committee. J. & H. V. Eaglesham, architects, 24, Wellington Square.

Bacup.—March 27th. Electricity Department. Annual contracts, including cables, fuses, lamps, meters, &c. (See this issue.)

Bedford. — March 31st. Electricity Department. Twelve months' supply of electricity meters and H.T. and L.T. cables. (March 5th.)

Belgium.—April 7th. The municipal authorities of Ixelles, Brussels. Supply of a quantity of armoured cable for low-tension distribution mains. Specifications may be obtained from the Maison Communale, Ixelles, for two francs.

March 24th. The Société Nationale des Chemins de Fer Vicinaux, of 48, Rue de Montoyer, Brussels. Supply of 12,000 metres of grooved trolley wire, having a section of 64 sq. mm., 1,300 metres of round copper wire of 64 sq. mm. section; and 2,200 metres of round copper wire of 100 sq. mm. section.

Bristol.—March 22nd. Board of Guardians. Electric lighting installation at Eastville Institution. (March 5th.)

Dublin.—March 24th. Board of Guardians. Electrical fittings. Particulars from the Master, Workhouse.

Edinburgh.—March 29th. Electricity Supply Department. Condensing plant for Portobello station. Specification No. 23. (February 27th.)

March 29th. Town Council. Structural steel for the new electric generating station, Portobello. Sir A. B. W. Kennedy, 17, Victoria Street, Westminster.

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France.—The French post and telegraph authorities in Paris last week invited tenders for the supply of six lots of lead and rubber-insulated cables and 29 lots of paper-insulated cables for the telephone service.

Gellygaer.—March 21st. Urban District Council. Transformer plant, H.T. and L.T. switchgear, 11,000 v. and 500 v. overhead line material. (February 27th.)

Great Yarmouth.—April 16th. Electricity Department. One 2,000-KW. turbo-alternator, one 750-KW. rotary converter and transformer, and one 750-KW. frequency changer. (See this issue.)

Halifax.—March 23rd. Board of Guardians. Electrical fittings required, during the six months ending September 30th, 1920. Mr. A. T. Longbotham, Clerk to Board of Guardians, Union Offices, Carlton Street.

Kettering.—March 26th. Electricity Department. Concentric lead-covered feeder cable and feeder pillars. (March 12th.)

Leith.—Town Council. Materials for the year, from May 16th, including overhead, electrical and car fittings, and insulated wire, &c. Mr. J. A. Greig, Town Clerk.

Lincoln.—April 8th. Electricity Department. Pipework, and motor-generator and switchgear for St. Swithin's power station. (March 5th.)

London.—SHOREDITCH.—Electricity Supply Department. Water-tube boiler, 5,000-KW. turbo-alternator, E.H.T. and D.C. switchgear. (See this issue.)

Mountain Ash.—March 20th. Urban District Council Electricity Department. Transformer plant, H. and L.T. switchgear, three-core and four-core armoured cables and overhead line equipment. (March 5th.)

Manchester.—March 22nd. L. & Y. Railway Co. 12 months' supply of stores, including signal, telegraph and electric fittings, signal, telegraph and electric wires. Mr. Sharp, Stores Department, Osborne Street, Manchester.

Newport (Mon.).—March 27th. Tramways Department. Tramway bodies, trucks, electrical equipment. Mr. A. Nichols Moore, Borough Electrical and Tramways Engineer, Town Hall.

New Zealand.—DUNEDIN.—April 26th. City Council. (*a*) electric car bodies; (*b*) car trucks; and (*c*) car equipment. Documents may be consulted by British firms interested, at the Department of Overseas Trade (Development and Intelligence), 35, Old Queen Street, S.W. 1 (Room 49).

April 31st. Auckland Harbour Board. Electric cranes. Mr. R. B. Burnett, Secretary, Quay Street, Auckland.

Peterborough.—Electricity Department. 1,000-KW. turbo-alternator with condenser and pipe work, switchgear, 500-KW. rotary converter, superheaters, induced draught fan, two sets forced draught furnaces, foundations and builders' work, and H.T. cables. (See this issue.)

South Africa.—April 24th. Oudtshoorn Municipality. Time for receipt of tenders extended from March 24th to April 24th.

CLOSED.

Ayr.—Town Council. Electric light installations, George's Avenue Dwellings.

W. Auld & Sons £449

Bolton.—Electricity Committee :—

Steelwork required for the extensions at Back-o'-th'-Bank generating station.—John Booth & Sons, Ltd.

Barnes.—Fire Brigade and Lighting Committee. Recommended :—

H.T. and L.T. switchgear for 1,500-KW. turbo alternator and rotary converter; H.T. section, £820; L.T. section, £395; three-phase watt-hour meter on the rotary converter feeder panel, £45.—English Electric Co., Ltd.
Turbo-generators, condensers, &c., £15,848.—English Electric Co., Ltd.
Rotary converter, transformer and switchgear, £5,152.—General Electric Co., Ltd.
Soot-blowing plant, £526.—Diamond Power Speciality Co.

Croydon.—Town Council :—

Babcock & Wilcox, Ltd.—Steam pipe work, £456.
Metropolitan-Vickers Electrical Co. (per Brown, Boveri & Co.).—Turbo-alternator, £17,000; switchgear, £1,597.
Cole, Marchant & Morley.—Condensing plant, £6,556.
Metropolitan Electrical Co. Automatic air dampers, £360.
G. P. Banbury.—Cable racks, £2.2.
G. Everitt & Son.—Extensions to engine room, £4,315.

Galashiels.—Parish Council :—

Electric light installation, Council Buildings.—Robinson, Fraser & Co., £57.

Gillingham (Kent).—Town Council :—

Two 780-H.P. Diesel engines.—Banks, Warner & Co., Ltd., £11,520 each.
Two alternators.—Electric Construction Co., Ltd., £3,966 each.

Heywood.—Electricity and Tramway Committee :—

E.H.T. cables.—Macintosh Cable Co., Ltd.

Lanarkshire.—The offer of Messrs. Ferranti, Ltd., £226, for the supply of Sangamo meters in connection with the electric lighting of Cambuslang district has been accepted.

Sunderland.—Town Council. Electricity Committee. Accepted :—

B. I. & Helsby Cables, Ltd.—Insulating tape.
Ferguson, Pailin & Co.—Switchgear.

Winchester.—Town Council :—

500-KW. geared turbo-generating set, with condensing plant.—Fraser and Chalmers Engineering Works, Ltd., £10,008.

FORTHCOMING EVENTS.

Royal Institution of Great Britain.—Saturday, March 20th. At Albemarle Street, W. At 3 p.m. Lecture on "Positive Rays," by Sir J. J. Thomson, F.R.S.

Friday, March 26th. At 9 p.m. Lecture on "The Scientific Work of Lord Rayleigh," by Sir J. J. Thomson, F.R.S.

Birmingham and District Electric Club.—Saturday, March 20th. At the Grand Hotel, Birmingham. At 6.30 p.m. Annual dinner.

Institution of Civil Engineers.—Tuesday, March 23rd. At the Institution, Gt. George Street, S.W. At 5.30 p.m. Paper on "The Work Done by Railway Troops in France During 1914-1919," by Colonel D. Lyell.

Faraday Society.—Tuesday, March 23rd. At Burlington House, W. At 7.30 p.m. General discussion.

Edinburgh Electrical Society.—Wednesday, March 24th. Visit to Telephone Exchange, Rose Street.

Royal Society of Arts.—Wednesday, March 24th. At John Street, Adelphi, W.C. At 4.30 p.m. Paper on "Industrial Lighting in its Relation to Efficiency," by Mr. L. Gaster.

Institution of Electrical Engineers.—Thursday, March 25th. At the Institution of Civil Engineers, Great George Street, S.W. At 6 p.m. Discussion (*a*) on "The Electrical Equipment of Artisan Dwellings," to be introduced by Mr. L. Milne; (*b*) on the Report of the Earthing Sub-committee of the Wiring Rules Committee.

(**North-Midland Centre**).—Saturday, March 20th. At the Royal Victoria Hotel, Sheffield. At 7 p.m. Joint meeting with the Association of Mining Electrical Engineers. Paper on "Electric Winders," by Mr. D. Kerr.

Tuesday, March 23rd. At the Royal Victoria Hotel, Sheffield. At 7 p.m. Paper on "Transformers for Electric Furnaces," by Mr. J. L. Thompson.

(**North-Eastern Centre**).—Monday, March 22nd. At the Armstrong College, Newcastle-on-Tyne. At 7.15 p.m. Paper on "Production of Power from Blast Furnace Gas," by Mr. S. H. Fowles.

Tuesday, March 23rd, at the Technical High School, Darlington. At 6.30 p.m. Joint meeting with the Tees-Side Sub-Centre and the National Association of Industrial Chemists. Paper on "Notes on Electric Furnace Practice," by Mr. J. Hedley.

(**North-Western Centre.**)—Tuesday, March 23rd. At the Engineers' Club, Manchester. At 7 p.m. Paper on "The Protection of Alternating Current Distribution Systems Without the Use of Special Conductors," by Major K. Edgcumbe, R.E. (T.).

(**South-Midland Centre.**)—Wednesday, March 24th. At the University, Birmingham. At 7 p.m. Ordinary meeting.

Chemical Society.—Thursday, March 25th. At Burlington House, W. At 5 p.m. Annual general meeting. Presidential address by Sir J. J. Dobbie.

Association of Engineering and Shipbuilding Draughtsmen.—Thursday, March 25th. At Liverpool University. At 7 p.m. Lecture on "Some Experiences in Malaya," by Mr. W. S. Laverock. At the Grammar School, Chesterfield. At 7.30 p.m. Lecture on "Some Notes on Iron and Steel," by Mr. A. Chambers.

Junior Institution of Engineers.—Friday, March 26th. At 39, Victoria Street, S.W. At 7.30 p.m. Lecturette, "The Future of the Gas Industry," by Mr. W. A. Tookey.

Wireless Society of London.—Friday, March 26th. At the Institution of Civil Engineers, Gt. George Street, S.W. At 6 p.m. Paper on "Harmonics in Continuous Wave Transmission," by Capt. L. A. T. Broadwood.

NOTES.

The Batti-Wallahs' Society.—The first annual dinner since 1914 is to be held on Friday, March 26th, at the Holborn Restaurant. There will be the usual concert after the dinner. It is the only ladies' night on the programme, and every effort is to be made to ensure a distinct success.

Diseases of Rubber Trees.—An exhibition of specimens showing the diseases to which rubber trees are subject is taking place in the Botany Section of the Imperial College of Science and Technology, Prince Consort Road, South Kensington. It has been arranged by Prof. J. B. Farmer, Director of the Biological Laboratories of the College.—*The Times.*

An Electric Tamping Machine.—The Kalamazoo Railway Supply Co. has brought out a novel tamping machine for consolidating ballast under sleepers, which, according to *Engineering*, consists of a small enclosed induction motor with a tamping bar fixed to the casing in such a way as to be at the end of the casing and perpendicular to the axis of the rotor. The nose of the tool is set so as to incline under the motor, in the same vertical plane as the spindle. Fixed to the opposite end of the casing is an extension of a Z-shaped spring handle. The motor is three-phase, 60 cycles at 110 volts, running at 3,600 R.P.M. The spindle is fitted with an unbalanced weight, which sets up an oscillation on the spring handle and gives the necessary motion and kick to the tamping bar. The amplitude of the movement is stated to be ⅛ in., which can be varied to suit the ballast, by changing the tamping bar for one of a different weight. It is said that if the tamping bar is placed against a sleeper in ordinary ballast, the tool will work its way down the side and under the sleeper. The operator merely has to hold the machine upright and direct it to its work. The machine is watertight and dust-proof, and weighs 37 lb. It is arranged for working four machines from a small portable electric generating set weighing 125 lb., so that the whole outfit is quite of a portable nature. Smaller and larger sets are also supplied.

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South Wales Linking-Up Committee.—A meeting of the South Wales and Monmouthshire Linking-Up Committee, which issued an interim report upon the above subject in June, 1918, was held on the 9th inst. at the South Wales Institute of Engineers, Cardiff, Mr. Lewis W. Dixon (of Merthyr), vice-chairman and hon. secretary in the chair. A letter, dated February 13th, 1920, from Sir John Snell, chief electricity commissioner, was read, suggesting that the Committee should consider the whole matter from an engineering standpoint, with a view to improving the organisation of the supply of electricity in South Wales. It was decided on the strength of this communication to promote investigations on the lines suggested by the Chief Commissioner. Mr. W. A. Chamen was elected chairman in place of Mr. Arthur Ellis, who has acted as chairman since the Committee commenced operations in 1916. Mr. W. Burr, borough electrical engineer, Swansea, was appointed vice-chairman, and Mr. L. W. Dixon remains hon. secretary.

Appointments in Canada.—We learn from an agent of the Canadian General Electric Co. that it is very badly off in its Engineering Department for three or four skilled electrical engineers who have had considerable experience in the manufacture of electrical apparatus of all kinds. Designers of alternators, induction motors, and direct-current apparatus, together with several first-class draughtsmen in these lines, are urgently needed, and should apply to the company at Peterborough, Canada. The introduction of British engineers into this firm should prove of great advantage to trade within the Empire, as they will be familiar with the goods made here, and will know where they can be usefully employed.

The Coal Supply of London Electricity Works.—On March 10th a deputation from public electricity supply undertakings in London, at a meeting of the committee of London M.P.'s, criticised the policy of the Coal Controller's Department; Alderman Duncan Watson, Mayor of Marylebone, said that the reserve supply of coal held by many undertakings was equivalent to four days' consumption only, and that the coal supplied contained an excessive proportion of ash. Sir John Snell, who attended at the invitation of the committee, corroborated the statements, and said that the Commissioners in some cases had found it necessary to sanction loans for the installation of new boilers, in consequence of the bad quality of the coal. The Coal Controller's Department told them that shortage of transport was the cause of the trouble. The chairman said that the committee would do what it could to bring about an improvement.

Inquiry.—Makers of a small lamp marked "8 v. 8 N. K." are asked for.

Power from the Tides.—The Cabinet, it is announced on high authority, has had before it preliminary plans prepared by the experts who are inquiring into the possibilities of utilising water power in the United Kingdom for generating electrical energy, for the construction on the Severn, close to the new high-level bridge which the Great Western Railway proposes building, of a huge dam, in the centre of which would be a free space for the escape of the imprisoned tidal water, thus providing the power. The Cabinet has given instructions for further preliminary stages of the project to be undertaken. It is interesting to note in this connection that a power station is about to be erected on the Mersey to supply the Liverpool and Birkenhead area, and that a project is on foot to utilise the water power of the Dee from Llangollen downwards in the electrical development of North Wales.

Discussing the Severn proposal a leading South Wales engineer ventured the opinion that the harnessing of tidal power could only be solved by interlinking the big waterways and making use of the difference in the times of the tides. "From a private enterprise point of view," he continued, "it would be cheaper to produce electricity by means of coal, for the capital outlay would be tremendous. Such a scheme, when it comes, must be a great undertaking, and should be run on a national basis—not the estuaries of the Severn and Wye only, but every waterway that has any storage capacity. There is a big difference of tide between the Severn, Mersey, and Forth, for example, and if you could harness and link together these estuaries it would be a good thing, for it would stabilise the ebb and flow. This would require very careful calculations, and would have to be undertaken after close study of the tides and the various channels. The other means is by storage in accumulators at a terrific cost. There must be a storage capacity of practically the full output of the station, for at the turn of the tide the plant would be absolutely useless."

"Before any tidal power scheme is a financial success," said Prof. Frederick Bacon, A.M.I.E.E., Professor of Engineering at the South Wales and Monmouthshire University College, Cardiff, "you must have some economical and cheap means of storing electricity. At present the recognised method of storing energy during the time of high tide, when you can get no power, is by pumping water into a high reservoir, and the capital necessary is absolutely prohibitive unless the natural configuration of the district has special facilities to offer. If a scheme for the use of tidal power were put forward, Chepstow would be a good place to start, for a 40-foot tide is not to be found in many places; but the capital cost would be very great, and I doubt whether it could be economically worked."

Appointments Vacant.—Plumber-jointer, for the Derby Corporation Electricity Department; fitter (£5) for the Stepney Borough Council Electricity Department; meter-tester (£4) for the Darwen Corporation Electricity Works; draughtsman (temporary) (£6), for the Wimbledon Corporation Electricity Works. See our advertisement pages to-day.

Naval Telegraphists' Rating.—With a view to assisting ratings of the wireless telegraph branch, who, being due for discharge, may wish to obtain posts as civilian operators, the Admiralty has made arrangements for the Postmaster-General's certificate of proficiency to be issued to telegraphist ratings.

Scientific and Technical Books.—One part of the descriptive catalogue of the British Scientific Products Exhibition, organised by the British Science Guild last year, was devoted to selected lists of books on science and technology. The Guild has been asked to extend these lists, so as to include not only all branches of science—both biological and physical—but also the chief technical subjects. It has undertaken to do this; and a committee, of which Sir R. A. Gregory is chairman, has been appointed to prepare such a catalogue. The lists will be limited to books of British origin actually in current catalogues of the publishers, so that they can be obtained in the usual way through booksellers. School-books and elementary manuals will not be included, and the general standard will be that of college courses in scientific and technical subjects, or of works' libraries. Each list will be submitted to authorities upon the subject with which it deals, but in order to secure that no important work is omitted, the committee invites the assistance of everyone interested in its task. Such aid may be afforded by sending (to the British Science Guild, 6, John Street, Adelphi, London, W.C. 2) lists or single titles of British books of standard value or proved worth in any branch of science or industry.

Agricultural Research.—Although the Rothamstead Research Station had little faith in the electrical treatment of seed, it appears to be more favourably disposed to one part of the process—the treatment of the seed with chemical solutions before sowing, which is being investigated at Paris with good results, and in Italy. In an interview with a *Daily Chronicle* representative, Dr. Russell, of Rothamstead, said that some very sound work had been carried out by Prof. Blackman, who had demonstrated that considerable effect was produced by the electrification of the seed and the soil, and the economic value of electrification to agriculture had been made clear.

Modern Motor Control Gear.—On March 10th the London Section of the "Igranic Engineering Society" held an open meeting at its headquarters in Queen Victoria Street, which was largely attended by members and non-members. A paper on "Electric Motor Control Gear," illustrated by many interesting lantern slides, was read by Mr. John T. Mould. The author's purpose appeared to be to emphasise how greatly the usefulness of electric motor control gear had increased within the last few years. Its functions extended to the actual supplanting of manual labour, so that in many cases tasks which in the past demanded the constant attention of workmen, were automatically performed without human attention at all, and with greater regularity and accuracy than could be expected continuously from workpeople. This development he attributed to the introduction of self-acting types of control gear, many of which, suitable for both direct and alternating current, he described to the audience.

London Traffic Congestion.—The problem of relieving the serious congestion of traffic in London during the morning and evening "peak load" hours—between 7.30 and 9 in the morning and 5 and 7 o'clock in the evening—has been under the consideration of the Advisory Committee on London Traffic, of which Mr. Kennedy Jones, M.P., is chairman. The Ministry of Transport, in an official announcement, states that it is in the evening that the heaviest congestion occurs, and little or no relief can be looked for in the near future from any increase of the transport facilities during these hours. The congestion has been accentuated by the general adoption of the eight-hour day, and the Advisory Committee believes that if certain "allied" businesses could arrange for the majority of their employés to leave their work between 4 and 4.45 p.m., instead of 5 p.m., or later, appreciable benefit would result from the spreading of the present "peak load" traffic over a longer period. With regard to the possibilities of improving transport facilities, it is pointed out that there is a shortage of rolling stock. Although orders have been placed for additional stock, there is delay in delivering it, owing in a large degree to the recent prolonged moulders' strike. A general extension of electrification in the suburban zones of the main-line railways might go a long way towards solving the difficulty; and, recognising this, Sir Eric Geddes has set up a Committee to deal with the question of standardisation in connection with schemes of electrification.

British Oil.—"I am the Minister for petroleum affairs," said Sir Hamar Greenwood, in Parliament on March 8th, in explaining how he came to answer a question regarding the oil operations which the Government has been carrying out in Derbyshire and other parts of the United Kingdom. He said that while oil had so far been met with in quantity only in one well, it had been proved that deposits of oil existed, and there was every encouragement to continue the work. Further developments could not be undertaken pending legislation dealing with oil rights. Licences to bore for petroleum had been granted to two companies.

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INSTITUTION NOTES.

The Institution of Electrical Engineers.—Arrangements for the remainder of session 1919-20 :—

ORDINARY MEETINGS.

March 25th.—Discussion on : (*a*) "The Electrical Equipment of Artisan Dwellings" (with introductory paper by Mr. L. Milne). (*b*) The Report of the Earthing Sub-Committee of the Wiring Rules Committee.

April 15th.—C. V. Drysdale, D.Sc., the Eleventh Kelvin Lecture, "Modern Marine Problems."

May 20th.—Annual General Meeting.

MEETINGS OF TERRITORIAL CENTRES.

North-Eastern Centre.

March 22nd.—S. H. Fowles, "Production of Power from Blast-Furnace Gas."

April 19th.—Major T. Rich, O.B.E., "Electricity in the Western War Zone" (lecture). Annual General Meeting.

Tuesday, March 23rd, at the Technical High School, Darlington, at 6.30 p.m., joint meeting with the Tees-side Sub-Centre and the National Association of Industrial Chemists ; paper on "Notes on Electric Furnace Practice," by Mr. J. Hedley. Preceding the meeting, a visit will be paid to Darlington Forge.

North Midland Centre.

March 20th.—D. Kerr, "Electric Winders" (joint meeting with the Association of Mining Electrical Engineers).

March 23rd.—J. L. Thompson, "Transformers for Electric Furnaces."

April 20th.—Major K. Edgcumbe, R.E. (T.), "The Protection of Alternating-current Distribution Systems without the Use of Special Conductors."

May 11th.—Annual General Meeting.

North-Western Centre.

March 23rd.—Major K. Edgcumbe's paper.

April 13th.—Annual General Meeting and Smoking Concert.

April 20th.—C. V. Drysdale, D.Sc.—The Kelvin Lecture.

Scottish Centre.

April 13th.—Squadron-Leader J. Erskine-Murray, "Wireless Telegraphy" (lecture).

South Midland Centre.

April 21st.—C. V. Drysdale, D.Sc.—The Kelvin Lecture.

Western Centre.

April 5th.—Prof. F. Bacon, "Thermionic Valves" (lecture).

The February *Journal* gives the following list of the Institution's Sub-Centres :—

Parent Centre.	Sub-Centre.	Name and address of Hon. Secretary.
North-Eastern	Tees-side	R. M. Longman, Kinton's Buildings, Middlesbrough.
North Midland	Sheffield	J. D. Bailie, 65-67, Prudential Buildings, Park Row, Leeds.
North-Western	Liverpool	O. C. Waygood, 50, Manor Road, Meols, Hoylake.
" "	Preston	J. F. Simpson, Corporation Tramways, Deepdale, Preston.
Scottish ...	Aberdeen	A. Gardner, Electricity Works, Milburn Street, Aberdeen.
South Midland	East Midland	J. F. Driver, Technical College, Loughborough.

A Local Centre has been formed in Argentina. The Council has decided to publish the papers and discussions held over from previous sessions as a supplement to last year's volume (No. 57) of the *Journal*.

On Friday, the 26th inst., the WOLVERHAMPTON AND DISTRICT ENGINEERING SOCIETY will hold a meeting at the Technical School, Garrick Street, Wolverhampton, at which a lecture will be delivered on "Coal and its By-Products," by Mr. J. R. Allett. This Society has invited members of the SOUTH MIDLAND CENTRE to join it at that meeting.

INFORMAL MEETING.—On Monday last an informal meeting was held in London, when Messrs. J. W. Beauchamp, M.I.E.E., and S. M. Hills, A.M.I.E.E., opened a discussion on "Industrial Electric Heating," dealing with the numerous applications of electricity to the heat treatment of metals, enamelling ovens, dental work, the manufacture of tiles, buttons, &c., die casting, linotype metal pots, and other uses. They pointed out the facility with which electricity could be employed, and the many incidental advantages which resulted from its use, such as the reduction of waste, safety, convenience, increased output, health of employés, and economy of labour. Many of the audience took part in the discussion which followed.

An informal social evening and smoking concert is to be held on March 29th, at 7.30 p.m., at the Albert Tavern, Victoria Street, S.W. Early application should be made for tickets (2s. 6d. each), which are obtainable from Mr. Tooley, at 34, Victoria Street, S.W.

A meeting of the LIVERPOOL SUB-CENTRE was held on Monday, March 15th, when Lieut.-Col. E. O'Brien read a paper on "The Application of the Electric Locomotive to Main-Line Traction on Railways." The paper dealt with the history of the subject, general problems of design and operation, and the advantages of the electrification of main and suburban lines. A lengthy discussion followed.

Edinburgh Electrical Society.—The eighth general meeting was held on March 10th, at the Philosophical Institute. An interesting evening was spent in the discussion of emergency measures taken to deal with motor and other plant breakdowns. The question of "Joints *v.* Connectors" in wiring installations was also debated. It was intimated that the members would meet on Wednesday, March 24th, at the Telephone Exchange, Rose Street, Edinburgh, at 8 o'clock.

The Birmingham and District Electric Club.—At a meeting on March 13th, a paper was read by Mr. W. E. Warrilow, A.M.I.E.E., upon "Advertising in the Engineering Industries." The lecturer stated that engineering advertising had not yet received that serious consideration which its relation to sales would seem to justify, although there were signs of great improvement. As a rule, even the largest firms spending large sums of money did not appear to attach the same importance to spending the money wisely as they did in other departments. There was room in the business for men with an engineering training, who had a natural aptitude for publicity work. The importance and responsibility of the work should be realised, and a commensurate salary paid ; the best men would then be attracted to it. Mr. Warrilow made a special appeal to manufacturers to support their trade papers rather than issuing large numbers of circulars, "house organs," and the like ; with greater support the trade Press could give better service. The writer's statement that engineers had nothing to learn from American advertising caused some little dissent. Mr. Warrilow was accorded a hearty vote of thanks at the close of the meeting.

Wireless Society of London.—Mr. A. A. Campbell-Swinton, president of the society, delivered his annual address on March 27th, at the Royal Society of Arts. The address (which was entitled "Some Wireless Wonders") was an exceedingly interesting one, and was received with enthusiasm by the audience, which filled the lecture hall to overflowing. The address was illustrated by a series of experiments whereby the audience were shown the enormous strides which have been made in the science of wireless telegraphy since the last presidential address was delivered in 1914. A message which had been sent specially from Paris by General Ferrié, a vice-president of the Wireless Society of London, was made audible and visible on a screen to the audience, and in addition wrote itself out in Morse characters on a tape machine. This and other special messages from the Air Ministry and the wireless station of the Radio-Communication Co. at Slough, were received and made audible to the audience, not on the usual external aerial, but on a simple loop of wire standing upon the lecture table. Mr. A. A. Campbell-Swinton paid tribute to the Fleming valve, without which it would have been impossible to obtain these results.

The proposal for affiliation of provincial clubs and societies has met with most favourable response, and all the principal wireless clubs in Great Britain are now affiliated. A conference of these clubs, at the invitation of the Wireless Society of London, was held in the afternoon of the same day.

The conference was held under the presidency of Sir Charles Bright, F.R.S.E., supported by Admiral of the Fleet Sir Henry B. Jackson, G.C.B. ; Captain F. C. Loring, R.N., representing H.M. Postmaster-General ; and other vice-presidents and officers of the Society, including Mr. Frank Hope-Jones, M.I.E.E., chairman ; Major Basil Binyon, O.B.E., vice-chairman ; and Mr. Leslie McMichael, hon. secretary. Wireless clubs of the following towns and suburban districts were represented by delegates at the conference :—Burton-on-Trent, Plymouth (two clubs), Southport, Altrincham, Woolwich, Brighton, Sheffield, Manchester (two clubs), Stoke-on-Trent, Derby, Glasgow, Bristol, North Middlesex, and Peckham. Sir Charles Bright in his opening speech said that the object of the meeting was to discuss the general terms on which affiliation should take place, and whether future conferences should take place in London or in various towns from year to year. The president called upon Mr. Hope-Jones to welcome the delegates, after which the delegates were invited to express their opinions on behalf of their clubs, and to ask questions upon matters on which they desired information. Captain Loring made an official statement in which he pointed out how strongly the Post Office officials were in favour of any amalgamation, which would tend to keep amateurs within the limits of their licence. He stated on what terms the Post Office proposed to grant transmitting licences, viz. :—A licence of about 10 watts where an amateur could prove that he thoroughly understood the apparatus he was asking to make use of, that he was conversant with the Morse code and proficient, and that his transmitting station was to be used for genuine experimental work, and not merely for communications with other stations in a general way. Admiral Sir Henry Jackson, at the close of the conference, in an able speech, pointed out how much in the past wireless telegraphy had benefited by the amateur experimenter.

E.P.E.A.—The first annual dinner of the Northern Section of the Irish Division was held on February 26th at Belfast, under the chairmanship of Mr. B. Croft. After the toast of "The King," Mr. J. McMordie, in proposing "The E.P.E.A.," gave a brief *résumé* of the activities of the Association to date, and congratulated the Northern Section on its progress during the brief period since its inception.

The vice-chairman, Mr. Piggott, proposed the "Guests and Artistes." Mr. T. W. Bloxam, city electrical engineer, responded on behalf of the guests, and said that the chief aim of the E.P.E.A. was the promotion of efficiency in the generation and distribution of electrical power. Mr. J. Wyld also responded, and said that the E.P.E.A. supplied a long felt want, bringing together for mutual benefit isolated and scattered members of the technical staffs. He wished the Association every success.

During the evening an entertaining and enjoyable programme was contributed to by the following artistes :—Messrs. D. Wilson, H. McIvor, J. Wilson, R. Bolton, E. Lee, A. Holland, G. Fawcett,

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D. Anderson, and J. Hardy, the accompaniments being efficiently played by Messrs. W. J. Hanna and J. Wilson.

Before the evening terminated, Mr. Bloxam proposed a vote of thanks to the chairman.

The chairman, in reply, thanked Mr. Bloxam for his kind remarks and all present for the hearty way they had received the toast.

Royal Institution.—The following are among the lecture arrangements for after Easter:—Major G. W. C. Kaye, two lectures on "Recent Advances in X-Ray Work"; Prof. W. H. Eccles, two lectures on "The Thermionic Vacuum Tube as Detector, Amplifier, and Generator of Electrical Oscillations"; Prof. J. H. Jeans, two lectures on "Recent Revolutions in Physical Science": (1) Theory of Relativity: (2) Theory of Quanta. (The Tyndall Lectures). The Friday evening meetings will be resumed on April 16th, when Prof. J. A. McClelland will deliver a discourse on "Ions and Nuclei." Succeeding discourses will probably be given by Lord Rayleigh, Prof. J. A. Fleming, Prof. W. L. Bragg and others.

Faraday Society.—A general discussion on "Basic Slags: Their Production and Utilisation in Agricultural and other Industries" will take place on Tuesday, March 23rd, 1920, from 7.30 to 10.30 p.m., in the Rooms of the Chemical Society, Burlington House. Prof. F. G. Donnan, F.R.S., vice-president, will preside, and Dr. E. J. Russell, F.R.S., will give a general survey of the subject, after which a number of authorities will read papers on "The Demand for Basic Slag," "Its Place in the Development of Agriculture," and allied questions.

Institute of Metals.—At the annual meeting last week, the presidential address was read by Engineer Vice-Admiral Sir George Goodwin, K.C.B., dealing mainly with the propelling machinery of warships, turbine blading, the corrosion of condenser tubes, propeller blades, and bearing metals.

At the annual dinner on Friday last, amongst the guests were Capt. H. Riall-Sankey, Prof. W. H. Bragg, Dr. J. E. Petavel, Mr. W. O. Smith, Mr. Roger T. Smith, Mr. C. C. Paterson, Mr. C. H. Wordingham and Mr. G. Shaw-Scott (secretary).

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the* Electrical Review *posted as to their movements.

The salary of Mr. A. R. Dayson, general manager of the Sunderland Corporation tramways, has been advanced from £700 to £850 per annum. An amendment that the increase be only £100 was defeated by the casting vote of the Mayor.

The *Times* states that Sir James Dewar has been elected a corresponding member of the French Academy of Sciences.

Exeter T.C. has increased the salary of the tramway manager from £350 to £450 a year, by two equal instalments, the first to date from November 1st, 1919.

Mr. R. B. Mitchell has been recommended by the Committee in charge for the appointment as general manager and engineer of the Glasgow Town Council's electricity department, in succession to Mr. W. W. Lackie, who was recently appointed a Commissioner under the Ministry of Transport. Mr. Mitchell, who is 48 years of age, served his apprenticeship as an engineer with Messrs. Muir & Houston, Kinning Park, and entered the Glasgow T.C. service 22 years ago as shift engineer in charge of the Tontine and Claremont battery stations, and was for three years resident engineer at the Port Dundas station. Then he was promoted mains superintendent, and for twelve years had charge of the transmission and distribution sides of the undertaking. Three years ago he was appointed deputy chief engineer and superintendent of stations, and an important part of his work has been the supervision of the erection of Dalmarnock power station. He is a member of the I.E.E. and of the Institution of Engineers and Shipbuilders in Scotland. For twelve years he was a lecturer in the Royal Technical College.

Mr. S. S. Braid, who has just been appointed deputy chief engineer in the Glasgow Corporation tramway department, is an Edinburgh man, and he received his education at the Heriot Watt College there, and at the Royal Technical College, Glasgow. He joined the service of the Glasgow tramways in 1901, just before the electrification of the whole system, as assistant engineer, graduating to chief electrical assistant. Mr. Braid acted during the war with the Ministry of Transport in a voluntary capacity as an inspector of engineering works, and later as captain and adjutant in the 2nd Batt. Highland Light Infantry.

Rhyl Corporation has increased the salary of the electrical engineer from £275 to £310.

The Highways Committee of the L.C.C. recommends that Mr. A. G. Clarke, chief publicity assistant, Sheffield Corporation Development Committee, be appointed publicity assistant in the tramways department, at a salary of £300, rising to £400 per annum, plus temporary war allowance of 20 per cent. and a war bonus of £70 to £73 a year.

Mr. R. E. Winkfield, M.I.E.E., has just returned, after 15 years, from India, where he held the position of agent and chief engineer to the Calcutta Electric Supply Corporation, Ltd. The home board of this company has appointed him to be its general adviser. Mr. Winkfield, who is a past-chairman of the Calcutta local section of the Institution of Electrical Engineers, has now associated himself with the Robertson-Cole Co., of 5, Bishopsgate, London, E.C., and New York, which firm, in conjunction with Messrs. Graham & Co., of Calcutta and Bombay, have established a large connection with the mills and factories throughout India and the East, by acting as buying and shipping agents in the United Kingdom and America. Mr. Winkfield has had a long experience of Oriental engineering requirements. Prior to going to the East he was connected with various electric supply manufacturing and railway companies in England.

On February 28th the employés of the Walsall Corporation electric supply department (Darwall Street sub-station) presented an attaché case and some technical books to the mains engineer, Mr. J. D. Spark, who is leaving. Mr. E. W. Eynon, sub-station foreman, made the presentation. Gifts were also made to Mr. T. Southgate, who has gone to Sunderland as meter test-room foreman, and to Mr. C. Waidson, until lately a sub-station engineer.

We are informed by Messrs. Swarren, Ltd., of London, W.C., that Mr. S. A. M. Rose, the late managing director, is no longer connected with the company in any official capacity.

Obituary.—Mr. W. Munro.—The death is announced of Mr. William Munro, late electrical engineer superintendent of the Midland Railway, Belfast.

Mr. W. Rigden.—The death occurred suddenly on March 10th, whilst officiating as Worshipful Master of the Lewises Lodge of Freemasons, of Mr. William Rigden, electrical engiener of the Ellington Works, Princess Road, Ramsgate.

NEW COMPANIES REGISTERED.

West Lancashire Electrical Co., Ltd. (165,565).—Private company. Registered January 31st (delayed at Somerset House). Capital, £2,000 in £1 shares. To carry on the business of electricians, electrical, mechanical, motor, telephone and general engineers, &c. The first directors are: W. Bateson, "Newlands," Newton Drive, Blackpool; L. C. Speed, 27, Promenade, Southport; T. Healy, 57, Sussex Road, Southport. Secretary: L. C. Speed. Registered office: Princes Street, Hoghton Street, Southport.

South-Western Engineering Co., Ltd. (164,829).—Private company. Registered March 4th. Capital, £10,000 in £1 shares. To take over the business of general and electrical engineers carried on by L. G. Stone and J. Moiseiwitsch at Point Pleasant Works, Wandsworth, as the "South-Western Engineering Co." The first directors are: L. G. Stone, 71, Linden Gardens, Bayswater, W.; J. Moiseiwitsch, 21, Stanwick Road, West Kensington; E. Moiseiwitsch, 21, Stanwick Road, West Kensington; D. de Groot, 3a, Montagu Mansions, Baker Street, W. Secretary: H. Kenward. Registered office: Point Pleasant Works, Wandsworth, S.W.

Levant Iron and Machinery Co., Ltd. (164,813).—Private company. Registered March 4th. Capital, £25,000 18s. in 5,000 6 per cent. cumulative preference shares of £5 each and 18 deferred shares of 1s. each. To carry on at Constantinople and elsewhere the business of importers of and dealers in metals, agricultural implements, electrical and other machinery and implements, &c. The first directors are: W. J. Whittall, Impasse Whittall, Grande Rue Mahmondich, Galata, Constantinople. The Board of Trade authorises the company to acquire parts of the undertakings of J. W. Whittall & Co., Ltd., and George Chisnell & Co., Ltd., the books and documents of which undertakings are liable to inspection under the Trading with the Enemy Act. Registered office: 8, Serjeant's Inn, E.C.

Scottish Welding and Sheet Metal Co., Ltd. (11,007).—Private company. Registered in Edinburgh February 28th. Capital, £3,000 in £1 shares. To carry on the business of electric and oxy-acetylene gas welders, coppersmiths and engineers and merchants, &c. The first directors are: A. R. Duncan, 66, Hamilton Place, Aberdeen, merchant; J. Johnston, 49, Hamilton Place, Aberdeen, solicitor; R. D. Moncur, Duncairn, Great Western Road, Aberdeen, merchant; C. A. McArthur, Great Western Road, Aberdeen, brassfounder. Secretary: J. Johnston. Registered office: 129, Union Street, Aberdeen.

Colonial and Foreign Glass Industries, Ltd. (164,843).—Registered March 5th. Capital, £750,000 in £1 shares. To carry on the business of manufacturers, merchants, importers and exporters of glass, including glass, electric lamp bulbs, tubing rod, bulbs for miners' lamps, wireless telegraphy and lamps of all kinds, glassware for scientific, medical, optical and industrial purposes, &c. The first directors are: C. C. Hatry, 56, Upper Brook Street, W.; P. J. Mitchell, 37, Avenue Road, N.W.; T. B. Kitson, 72, Albion Street, Leeds; L. Owry, Holwood House, Walton-on-Thames. Minimum cash subscription, £7. Registered office: 6, Austin Friars, E.C.

Fred Rothwell, Ltd. (164,918).—Private company. Registered March 6th. Capital, £3,000 in £1 shares. To carry on the business of electricians, mechanical engineers, workers of electricity, motive power, light and heat, switchgear makers, &c. The first directors are: F. Rothwell, 52, Cronkeyshaw Road, Rochdale, electrical engineer; E. Grimshaw, Ashtead, Fairhaven, Lytham, flock manufacturer. Solicitor: J. A. Hudson, The Butts, Rochdale.

Union Electric Welding Co., Ltd. (164,940).—Private company. Registered March 6th. Capital, £15,000 in £1 shares. To carry on the business of electric, blow-pipe and other forms of welding and soldering, shipbuilding and repairing, &c. The first directors are: H. H. Fletcher, 8, Crescent Road, Brighton, shipbuilder; G. W. Roger, "Iona," 44, Dartmouth Row, Blackheath, naval architect; J. M. Wilkinson, 10, St. Austell Road, Blackheath, secretary; E. H. Jones, Duxbury, Kew Road, Richmond, engineer; W. A. Hunter, Charlton Lodge, London Road, Thornton Heath, merchant; J. Coldwell, M.I.C.E., M.I.E.E., Nanfans Grange, Great Missenden, Bucks. Solicitor: W. E. Mortimer, 18, Austin Friars, E.C.

Tees-side Electric and Plumbers' Stores, Ltd. (164,903).—Private company. Registered March 5th. Capital, £2,000 in £1 shares. To carry on the business of manufacturers, importers and exporters of and wholesale dealers in electrical plant, plumbers' and glaziers' merchants, general electrical engineers, &c. The first directors are: E. Phillips, 1, Church Street, West Hartlepool; F. Thompson, 6, Clifton Avenue, West Hartlepool; Henrietta Hayman, 63, Church Street, West Hartlepool; R. Winspear, 13, Commercial Street, Middleton, Hartlepool. Registered office: 76, Reed Street, West Hartlepool.

Associated Electric Welders, Ltd. (164,990).—Private company. Registered March 9th. Capital, £10,000 in £1 shares. To carry on the business of electric welders, motor, mechanical and general engineers, founders, shipsmiths, &c. The first directors are: H. E. Bye, 114, Guildford Street, Grimsby; R. H. Charlton, Royal Dock, Shipyard, Grimsby; H. Dring, Finsbury House, Abbey Drive West, Grimsby; J. Davison, 130, Leysby Avenue, Grimsby; D. Good, The Lines, Woolsby Road, Grimsby; A. H. Gidley, Elmdens, Woolsby Road, Grimsby; H. R. Hookey, 11, Somersby Street, Grimsby; G. H. Unwin, 82, Rainton Avenue, Grimsby. Registered office: 29a, Victoria Street, Grimsby.

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B. E. Manufacturing Co., Ltd. (164,872).—Private company. Registered March 5th. Capital, £10,000 in 9,950 ordinary shares of £1 each and 1,000 deferred shares of 1s. each. To enter into any contracts as manufacturers for and on behalf of the B.E. Company (of London and Birmingham), Ltd., for the appointment of the last named company as sole selling agents for the products of this company, to carry on business as designers, manufacturers, exporters and importers of and dealers in electrical apparatus, advertisement signs, burglar alarms, glass, porcelain and rubber goods, &c. The subscribers (each with one ordinary share) are: C. D. Falcke, 57, Upper Thames Street, E.C. (managing director of B. E. Co. of London and Birmingham, Ltd.); C. White, 57, Upper Thames Street, E.C., electrical engineer. Managing director: C. D. Falcke. Secretary: C. White. Registered office: Hendon House, 57, Upper Thames Street, E.C.

Engineering and Lighting Equipment Co., Ltd. (165,048).—Private company. Registered March 10th. Capital, £15,000 in £1 shares. To take over the business of electrical and mechanical engineers and manufacturers carried on at the Sphere Works, St. Albans, by Bird & Wells, and lately acquired by them from Engineering and Arc Lamps, Ltd. The subscribers (each with one share) are: W. Bird, 61, Evershot Road, N.4, electrical engineer; G. J. Wells, 524, The Broadway, Crouch End, N.8, electrical engineer. Permanent directors: W. Bird, G. J. Wells and S. A. Marples. Registered office: Sphere Works, St. Albans.

Arthur Duckham & Co. (1920), Ltd. (164,834).—Private company. Registered March 5th. Capital, £50,000 in £1 shares. To take over the business of Arthur Duckham & Co., Ltd., to carry on the business of consulting, gas, mechanical, electrical, water supply and chemical engineers, heating specialists, gas makers, wharfingers, shippers, &c., and to adopt agreements (1) with the said old company; (2) with Woodall, Duckham & Jones (1920), Ltd.; and (3) with the Woodall Duckham Vertical Retort and Oven Construction Co., Ltd., Arthur Duckham & Co., Ltd., Gibbons (Dudley), Ltd., Newton Chambers & Co., Ltd., Thomas Vale & Sons, Ltd., Sir William J. Jones, Woodall Duckham Vertical Retort and Oven Construction Co. (1920), Ltd., and Woodall Duckham & Jones, Ltd. The subscribers (each with one share) are: E. M. Bonus, 11, Stafford Mansions, Buckingham Gate, S.W., solicitor; Phyllis Joshua, 89c, King Henry's Road, N.W.3, private secretary. The first directors are: Sir Arthur M. Duckham, K.C.B., Sir William J. Jones, K.B.E., and Lieut.-Col. H. W. Woodall, C.I.E., each of whom shall acquire 10,000 shares within 90 days from date of incorporation, and thereafter shall be permanent, subject to holding such shares. Solicitor: E. M. Bonus. Registered office: Thanet House, 231-2, Strand, W.C.

Fintona Electric Light Co., Ltd. (4,918).—Private company. Registered in Dublin March 1st. Capital, £4,000 in £1 shares. To carry on the business indicated by the title. The subscribers (each with 100 shares) are: F. Bradley, Fintona, M.D.; H. F. Jones, Fintona, provision merchant; J. F. Buchanan, Fintona, hardware merchant; M. J. McCarroll, Fintona, publican; F. J. McAtee, Fintona, auctioneer; G. Stewart, Fintona, draper; S. Stewart, Fintona, provision merchant; T. Tubman, Fintona, provision merchant; S. M. McCrea, Fintona, drapery merchant. The first directors are: Dr. F. Bradley, J. Baxter, S. M. McCrea, H. F. Jones and J. F. Buchanan. Solicitors: Dickie and Carson, Omagh.

Sewell Electric Co., Ltd. (165,085).—Private company. Registered March 10th. Capital, £2,000 in £1 shares. To carry on the business of electricians, mechanical engineers, &c. The first directors are: C. Lord, 12, Kelso Road, Leeds, salesman; J. Wilkinson, 12, Kelso Road, Leeds, salesman. Qualification, 100 shares. Registered office: 12, Kelso Road, Leeds.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Switchgear & Cowans, Ltd.—Particulars of £18,000 debentures authorised February 13th, 1920, the amount of the present issue being £50, the company's property, present and future, including uncalled. No trustees. Property changed.

Mann, Egerton & Co., Ltd.—Satisfaction in full on February 23rd, 1920, (*a*) of debenture dated October 3rd, 1912, securing not more than £10,000, and (*b*) of mortgage dated December 2nd, 1912, securing £3,000.

National Telewriter Co., Ltd.—Issue on March 1st, 1920, of £530 debentures, part of a series already registered.

Dubilier Condenser Co., Ltd.—Debenture for £20,000, dated February 17th, 1920, charged on certain leasehold property. Holders: L.C.W. and Parr's Bank.

Allen, West & Co., Ltd. (108,870).—Capital, £150,000 in £1 shares. Return dated December 29th, 1919. 112,940 shares taken up and fully paid in cash. Mortgages and charges, £100,000.

Rangoon Electric Tramway and Supply Co., Ltd.—Satisfaction to the extent of £8,323 on February 18th, 1920, of debenture stock, dated February 1st, 1906, December 22nd, 1908, and November 5th, 1913, securing £250,000.

CITY NOTES.

Telegraph Construction and Maintenance Co., Ltd.

The Earl of Selborne, K.G., presided at the annual meeting on March 11th. He said that in the balance sheet the debentures disappeared, and the shares were doubled. The debts owing by the company and reserves for necessary contingencies were up a good deal. The reserve fund was down by the amount taken out of it last year in connection with the capital. The profit and loss was slightly higher than the previous year. Turning to the other side of the account, their property was up £200,000, which was due to the inflated value of all the material which they had to use in the business. The amounts owing to the company were roughly £50,000 more, and the cash at bankers and in hand, including deposit on account of contracts, was up over £200,000. The dividend this year on the double capital was 10 per cent., as against 20 per cent. last year. When he proposed the rearrangement of the capital last year he was very careful to tell them that in his opinion it would not mean that they would be able to pay a higher dividend. They proposed to put £20,000 to the reserve fund again, and add another £10,000 to the pension fund. This year, for the first time since 1873, the shareholders found themselves in absolute possession of the property of the company without any first charge or mortgage before them. That satisfactory state of affairs was brought about by the paying off of the 140,000 outstanding 4 per cent. debentures on January 1st, 1919. During the year an issue of fully-paid shares amounting to £448,200 was made to the shareholders by appropriating £55,000 from the reserve fund, and by taking £39,200 from reserves for contingencies which were no longer required. That had been done in order to bring the share capital of the company more into accord with the capital employed in the business. The amount of capital required for carrying on such a manufacturing business as theirs in these days was quite double what it was before the war; much more money had to be provided every week for wages, and also in the monthly accounts for the purchase of materials. They were fortunate in being able to use their reserves to provide that money, but they must husband their resources in view of the future. Last year their output was not so great as it had been in many years before the war, but yet they paid away three times as much in wages as in any year before the war. Their cash at bankers and in hand no doubt appeared to be large, but that item was greatly increased at the end of last year by some large payments by instalments on account of contracts which had just been made, and upon which work had not then been commenced. Those funds, therefore, were not cash in the ordinary sense of the word, but must be considered also as a liability. Their turnover during the year was large, and their profits had been above the average of the past five years, but the enhanced price of materials compelled them to lock up a much larger sum of money than in past years. Their factories continued to be full of work, and they were constantly pressing upon the limits of possible supplies of materials, particularly copper and steel. They were exporting a fair proportion of their trade to America, which should help to promote a return to a normal rate of exchange between the two countries. Throughout the war and since, submarine cables had played a very important part. It was not possible to conjecture how the war could have been carried on without cable communication. It fell to England's lot to maintain that great system, and even to lay many new cables during the war, and the company had had its share in that perilous work. In consequence of the suspension of general renewals during the past five years, there was to-day a world shortage of cable, with a great necessity for increased production. There was no cable working to-day that was not carrying a greater traffic than it ever carried before, and as the cable systems were working efficiently, and telegraph communication had increased enormously, all the more lines were required. At this time it was necessary for them to try and fill all their customers' requirements, so that they might not have to look elsewhere, and in doing that they hoped for the loyal help of their staff and workers. The fact was there was a general demand for higher wages, and an improved standard of living, and labour was also asking for shorter hours. Those good things could only be maintained by all doing their best and taking trouble to increase production. There were two things which everyone in the country ardently desired—a reduction in the cost of living and no unemployment. He was convinced that both those things could only be achieved by increased production. The report was adopted.

Metropolitan Electric Supply C., Ltd.

The annual meeting held on 9th inst. presided over by Mr. A. W. Tait, who said that the gross revenue was 18 per cent. better, and the revenue from sale of current 19 per cent. better, than in 1918. Units sold decreased by 6 per cent. Increased revenue was largely due to extension of the lighting load during the last quarter of 1919 and partly to increased charges. The decrease in units sold was due to munition work load in the Western area coming to an end; the change over to peace time industry took some time to accomplish. There was also a cessation of night work, and a practically universal adoption of the 48-hour week. Towards the end of the year they again commenced to register growing increases in load over the corresponding period of 1918. One satisfactory feature had been the number of new consumers connected during the year, representing 2,867 KW. The demand for electricity for all purposes was broadening out considerably, and their chief difficulty at present was to cope with the new business which was offering, particularly in the industrial area in the West. The new consumers in London alone, however, were nearly five times more numerous than in 1918. Since the close of the year the units generated had shown a satisfactory increase, and there was every indication at present that this should continue. This expansion naturally entailed additional capital expenditure on plant and mains. The costs of generation and distribution showed an increase of approximately £29,000, £14,000 of which was accounted for by the increased cost of coal. The increase in wages and salaries accounted for approximately £9,700 of the increase in costs. The wages for the current year would be still further increased by a sum representing an additional war allowance of 5s. per week, which was granted in January last. Substantial increases in the war allowances had also been granted to the staff to meet the increased cost of living. Within the past few days they had received intimation that the trades unions in the Joint Industrial Council Divisional Area No. 10, being their area, had applied for a further advance of 10s. per week. He hoped it would not be very long before they could call a halt to the constant cycle of increasing costs and inflated prices. This, however, could only be brought about by the

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strictest economy all round, and by everybody saving. With regard to coal, the increase of 25 per cent. in railway freights represented the equivalent of about 1s. 10d. per ton. The difficulty of maintaining supplies during the last few months has been greater than at any period during the war. There had been labour troubles at certain collieries, then came the railway strike in September last, and the worst trouble of all was probably the shortage of trucks, which still continued. The new 4,000-KW. turbine installed at Willesden station was just about to be put on load, and they had placed contracts for a further increase in the boiler capacity at that station and certain plant at the sub-stations. The item of capital expenditure would show a substantial increase over the next few years if they were to provide adequately for the demand, which would involve not only further generating plant, but also a large increase in mains and distributors. They were at present installing further plant in the Uxbridge power station, to provide for the growth of load in that district, and had laid high-tension mains from that station to the Ironbridge sub-station of the Metropolitan Co. to supply part of the demand in that area. It was intended in due course to continue the high-tension main to connect up with the Willesden power station, so that the requirements of that part of the western area might be fed from either station. The expenditure to which they were committed in the Uxbridge area would probably involve a further £150,000. The increase in load in the Metropolitan area, not only in London and Paddington, but also in the western area, would shortly necessitate installing further plant in the Willesden station and the laying of additional feeders—particularly in the western area. Expansion could not go on indefinitely without the expenditure of further capital. The whole question of capital expenditure was receiving constant attention, and would be carried out step by step following the lines of a plan of general development of the district which had already been agreed. The progress which had been made since the close of the year so far supported the opinion that they would be able to continue the rate of dividend now recommended, and next year he hoped to submit as satisfactory a state of affairs as to-day. Later the speaker referred to the Electricity Supply Act, and to the association among the leading London companies. This was a considerable step in the right direction, and he hoped it might go through to its logical conclusion, which would not only mean the unification of supply within the London area, but also the unification of the interests of the companies and authorities at present giving supply within that area.

Charing Cross, West End and City Electricity Supply Co., Ltd.

Mr. W. F. Fladgate, presiding at the annual meeting on March 11th, said that the chief outstanding feature of the year had been the increase in the units sold and the consequent increase in the gross revenue. In the City area they had reached the highest record ever touched, the output being nearly two million units more than in 1911, the previous record year. In the West End area the output was the highest of any preceding year except 1913, and had the sale of current for public lighting been normal the output for even that year would have been exceeded. In 1918 and last year they did some of the repairs which during the war it was practically impossible to do. They also ordered new plant to enable them to get over their difficulties. Unfortunately endeavours in that direction met with no great success; orders long since given, through various causes, more particularly the moulders' strike, had not been filled. For instance, a large turbine which should have been in position in November last, so as to meet the winter load, he feared, would not be delivered until June next. Costs had again risen, the main cause being the cost of labour and the price of coal. The full effect of the official awards increasing the cost of labour had now been felt. Increases sanctioned made the war bonus payable to all employés no less than 33s. 6d. per week, and a further award, increasing the wages of some of the engineers, was made in February last. With regard to the delivery of coal, they—and all other electrical lighting companies—felt that they had not been treated fairly by the authorities. They had been practically obliged to take whatever was delivered at the price which was fixed, and in many cases what had been delivered was little more than rubbish. They sincerely hoped that some arrangement would be made in the near future to rectify this. In 1914 their coal bill did not amount to £40,000; in 1918 it was £108,000, and last year no less than £157,000. As against that, however, receipts had largely increased; those in the West End by some £70,000, and in the City by nearly £100,000, showing good progress under adverse circumstances. Their maximum price in the City was fixed after the maximum price which was fixed for the competing company, and while that company was allowed to go up to a maximum considerably exceeding theirs, they had been prevented by the authorities from increasing their maximum beyond the very moderate one which existed, and one which did not in any way correspond with the increased expenditure involved in producing energy. The amount spent upon repairs and maintenance is again very large—in the City upwards of £50,000, and in the West End some £25,000. Notwithstanding these adverse circumstances, they found themselves in the position of showing a more satisfactory result so far as the interests of shareholders were concerned. During last year their consulting engineer and engineer-in-chief had been carefully considering the state of the station at Bow. Much had been spent upon repairs, but a considerable amount of capital expenditure would be required in order to enable the company to meet the calls upon its resources. They did not, however, feel any doubt as to the prudence of the alterations and additions which they were making, nor did they think they would have any difficulty in arranging for the capital expenditure that would be required. They were giving the very greatest attention to an endeavour to decrease the cost of coal. They hoped in the latter half of this year improvements will have been made which will have very satisfactory effects. No alteration has been made in the price charged to customers during the year. They looked forward to being able to maintain the prosperity of the company in the future. The chairman briefly referred to the Electricity Supply Bill, and to the appointment of the Commissioners.

City of London Electric Lighting Co., Ltd.

The report for the year 1919 shows that the additions, extensions, and replacements under capital account have cost £38,466; the amount written off is £36,590 for the year, leaving the net expenditure at £1,999,772. Including £23,050 to be carried to reserve, that fund now amounts to £336,615. The total revenue for the year was £526,872, including £5,756 interest on investments and discounts, &c. Generating and distributing costs £213,394, repairs and maintenance £21,327, street lighting expenses £8,672; rent, rates, taxes, management expenses, &c., £97,730, leaving £185,748, plus £20,019 brought forward. Interest on loans and debenture stock £23,863; contributions to provident and benevolent funds £5,682; written off cost of investments £10,000; to reserve £62,130. Preference dividend 6 per cent., less tax, ordinary dividend 10 per cent., and a bonus of 6s. per share on account of reduction of dividends for 1914 and 1915, less tax. Carried forward to 1920 £23,050. The directors regard this result as very satisfactory. They have been able to give substantial benefits by the reduction of charges to consumers dating from September last. The gross revenue from all sources given above compares with £389,859 in 1918; and the net revenue of £185,748 compares with £149,267 in 1918. Average price obtained per unit sold 3.81d., against 3.27d. in 1918. Units generated 38,744,187 and sold 31,256,348 in 1919; units generated 31,731,491, and sold 26,656,655 in 1918. Maximum supply demanded: 1919, 25,410 KW.; 1918, 18,900 KW. Units sold for power 12,092,541; heating 5,070,399; together 56.76 per cent. of the total private sale. The provision of adequate coal supplies has caused considerable anxiety; supply was maintained without interruption, notwithstanding very irregular deliveries, and the sadly inferior qualities obtained. The board has devised an employés' saving deposit scheme. Referring to the Electricity Supply Act, the report says that the intentions of the Government to revive the controversy of last session by reintroducing certain clauses must inevitably hinder extensions which are urgently needed, and cause delay when speedy construction is essentially necessary. In the City of London the position is urgent, and while the directors would have preferred to await disclosure of the Government's intentions, they have felt compelled to take immediate action in the public interest. In the belief that the Government cannot seriously desire to prevent the provision of an ample supply of electricity, and will not penalise those who endeavour to meet the growing demands of the community, the directors arranged, before the passing of the Act, for the erection of three large power units at the Bankside station, together with the necessary converting sub-stations. This plant will be available for the supply of electricity in bulk to adjacent electricity supply undertakings, as well as for the company's own needs. The capital expenditure involved is large, but the step is absolutely necessary, unless the additional supplies required by existing and new consumers are to be refused. Authority is asked for to increase the capital to £2,000,000 by the creation of £800,000 shares. It is proposed to divide each of the existing preference and ordinary shares of £10 each into ten £1 shares.

British Aluminium Co., Ltd.

At an extraordinary general meeting of the shareholders, held on Monday, Mr. A. W. Tait, who presided, said the meeting had been called to pass resolutions giving effect to the recommendations made by the directors to increase the capital to £1,500,000, and to capitalise a sum of £400,414, being part of the reserve account, and to apply that sum in paying up in full at par 400,414 ordinary shares, distributing the same to the holders of the existing ordinary shares at the rate of two fully-paid ordinary shares in respect of every three ordinary shares now held. If the resolutions were passed that day, they would be submitted for confirmation to a meeting to be held on the 30th inst., when further resolutions necessary in connection with the carrying out of the scheme would also be submitted. It was decided to make the recommendation now, before the submission of the accounts for the year ending December 31st, 1919, but it was understood that the annual general meeting was to be held on the same day as the confirmatory meeting. The reserves of the company at the present time were the debenture redemption account of approximately £150,000, the general reserve account £470,000, and depreciation reserve £400,000. The appropriation of the £400,414 which was recommended would come out of the general reserve

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account, leaving a balance of approximately £70,000, subject to what might be added in respect of the year 1919. The directors felt that in making that recommendation they were amply justified in view of the inherent strength of the company's position, and they were only reinstating part of the capital which was written off at the time of the reconstruction ten years ago, which amounted to approximately £520,000. The reinstatement was being made out of the reserves that had been built up by the company since reconstruction, and it was gratifying alike to the directors as well as to the shareholders that they had been able to do so within such a comparatively short space of time. While he need not anticipate the report and accounts, he might say that what he forecasted at the last annual meeting that the accounts for 1919 would not be so good as those for the previous year, was the case. That was due to the fact that, owing to the cessation of hostilities and the accumulation of stocks of materials in the hands of the Government and of manufacturers, there had been a considerable diminution in the demand, which continued for at least the first half of the year. Since that time, as those stocks became absorbed and the industry had got back to its general peacetime manufacture, the situation had improved, and to-day the demand was good, although in common with other manufacturers they were experiencing an upward trend in costs, due to the increase in prices of materials and labour. The scheme of distribution was a simple one, in so far as the existing shareholders would receive two new ordinary shares fully paid for each three ordinary shares which they now held, and in respect of fractions, the shares representing those fractions would be allotted to trustees who would in due course sell the shares and distribute the proceeds in cash to the parties entitled thereto. The new shares would rank for dividend as from January 1st, 1920, and therefore they would not participate in the dividend which would be paid in respect of the year 1919. The resolutions were carried unanimously.

Newcastle-upon-Tyne Electric Supply Co., Ltd.

The connections at the end of 1919 were 316,737 H.P., an increase of 7,686 H.P. The profit for the year was £248,194, against £342,394 for 1918. There is put to reserve for plant renewals and improvements £30,000. Including £41,428 brought forward the total available profit is £259,622. Interest on debenture stocks, loans, &c., £77,393; nothing is put to reserve for "special depreciation and contingencies other than the equalisation of dividends," as against £60,000 last year. After paying the preference dividend and a total of 8 per cent. per annum on the ordinary shares, £9,598 is to be carried forward. Expenditure on plant renewals and improvements was £30,009. The very unsettled conditions in trade have had a serious effect upon the revenue of the year, but signs of improvement have shown themselves since the commencement of the current year. The additional capital expenditure of the year was £555,811, representing further extensions at Carville and Dunston power stations, and of the company's distribution system generally, particularly in the northern area, where some important collieries are in course of being connected to the company's system. Negotiations with the N.E.R. regarding a supply of power for the electrification of its main line between Newcastle and York are still proceeding. A housing scheme has been put in hand for the accommodation of the company's employés engaged at the new Tees power station; 73 houses are in course of construction in the neighbourhood of Billingham. The share capital was increased in November and the whole of the £1,500,000 seven per cent. cumulative preference shares have been allotted.

Newcastle and District Electric Lighting Co., Ltd.

The annual meeting was held in Newcastle on the 12th inst., Lieut.-Col. Frank R. Simpson, T.D., who presided, said that £19,000 had been spent on capital account —buildings, £1,627; plant, £9,100; mains, &c., £8,273; this would add to the earning power of the company. £16,000 had been provided out of the year's profits for depreciation, which brought the amount written off for depreciation to £89,500. The provision of a certain sum each year for the redemption of the second debentures and for the leasehold redemption fund, which now amounted to £21,378, was equivalent to making a further provision for depreciation. Wages, salaries, rent, rates, coal, &c., stood at £58,650, a decrease of £7,333, but on the other hand, the total receipts showed a decrease of £7,959, which was due to the stoppage of the manufacture of war materials and the inevitable disorganisation of the factories during reconstruction. However, there had been a marked recovery in the demand for power, and at the present time, there was a large number of inquiries from all quarters. In consequence of the increased cost of labour and materials, the directors had reluctantly further increased the price of energy to consumers, though the reduction of 10s. per ton in the price of domestic coal would enable the company to allow a rebate of the accounts of domestic consumers, commencing from the present quarter. They had lodged a petition against the Newcastle-on-Tyne Corporation Bill which contained clauses conferring upon the Corporation powers to supply electrical energy to consumers near their tramways, which would affect the rights of the company. A Joint Industrial Council for the electric supply industry had been formed, composed of representatives of the employers and trade unions, the business of which was to consider rates of wages, working hours, and all matters affecting the industry. It was expected that the Council would keep the employers and men closely in touch with one another, and would, it was hoped, eliminate friction.

County of London Electric Supply Co., Ltd.

At the annual meeting on March 15th, Sir Ernest V. Hiley, K.B.E., who presided, referred to the fact that the company had made satisfactory progress in every direction in spite of the difficult times through which it had passed during the year. They were creating for the first time a general reserve account, and placing thereto a sum of £45,000 out of revenue. An increased dividend of 1 per cent. was to be paid on the ordinary shares, making 8 per cent. Receipts from sale of current and meter rentals showed an increase of 29 per cent., and gross receipts an increase of 27 per cent. The total working costs increased by £86,261, so that about 70 per cent. of their increased revenue had been swallowed up in increased costs. Owing to the rapid growth of the business, the capital expenditure for the current year must necessarily be heavy, as they were increasing the capacity of their Wandsworth station to enable them to deal with the greatly increased demand. The commercial and general progress was in every way satisfactory. The gross revenue showed an increase of £124,305. The applications for new business showed an increase of 8,532 KW., and the sale of units had increased by 2,161,409, while the demand on the company's stations was 7,100 KW. over last year, and the number of consumers had increased during the year by nearly 3,000. Their bulk supply business also showed considerable expansion. The time had now come when they must proceed with the long-delayed programme of development at Barking which had been held up during the war. In conclusion, referring to the Electricity (Supply) Act, the chairman said that the Bill had been radically amended in the House of Lords, the compulsory powers being struck out and certain disabilities and restrictions under which the industry was hampered removed, while many useful provisions which should materially assist the industry had been inserted. The powers of the new Act will be exercised by the Electricity Commissioners appointed under its provisions. Upon these Commissioners devolved the responsibility for delimiting areas throughout the country, and it was probable that London and the surrounding district would be treated as one area. Undertakers were to be invited to submit schemes in each area, and it was common knowledge that several schemes were in course of preparation. It was inevitable that considerable time must elapse before any complete scheme could become effective, and probably the more comprehensive the scheme, the longer it would take to complete. In the meantime, the electrical load of London was growing rapidly, and their own company was faced with the need of large developments. They therefore proposed to proceed with the erection of the Barking power station, designed and equipped on the most up-to-date lines. This station would suffice to meet the requirements of their own area, and it would be so designed as to be capable of rapid expansion to meet in a supplementary manner increased requirements for bulk supplies which other areas might desire to receive. It would thus be their policy to assist in any way in their power all reasonable attempts—whether by companies or local authorities—to solve the common problem of securing an ample cheap and efficient electrical supply for the Metropolitan area. It was possible that the Government might introduce into Parliament this session a Bill containing some of the clauses rejected last year, and the board would take all steps to protect shareholders' interests. The progress in the company's business shown since the close of the year was even more marked. There was an increase of 23 per cent. in the KW. of new business, and an increase of 22 per cent. in the units sent out. Apart from these figures, which were themselves a satisfactory indication of the progress and vitality of the company's business, the company had now reached a stage in its history when an increased margin of profit on the capital invested might be anticipated.

Clarke, Chapman & Co., Ltd.—Final dividend on ordinary shares 1s. 6d. per share, making 2s. 6d. for the year. To reserve £20,000; to depreciation £10,798; carried forward, subject to balance of excess profits duty for 1918 and 1919, £74,973.

Durham County Electrical Power Distribution Co., Ltd.—Profit for the year £80,575. Available credit balance £72,403. Dividend of 18 per cent. for the year on ordinary shares (£72,000), carrying forward £403. Outlay on capital account for the year £8,384.

Victoria Falls & Transvaal Power Co.—Net earnings, including those of the Rand Mines Power Supply Co., for quarter ended December 31st, 1919, £207,421, before providing for taxation.

The Beauly Electric Supply Co.—Five per cent. dividend on ordinary shares. A new generating set has been installed.

Yorkshire Electric Power Co.—Letters of allotment for the new issue of debenture stock and ordinary shares were posted last week.

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Llanelly & District Electric Lighting & Traction Co., Ltd.—Presiding at the annual meeting, Mr. A. R. Holland said that the business of 1919 had been satisfactory. Expenses had been higher, but the demand for power had very materially increased, particularly during the last few months. The power plant had been added to and cable extensions were proceeding. The plant could not be in service before the end of last year as they had hoped, owing to delays in the delivery of material. When the new consumers under contract had been connected up the output of the station would be practically doubled, and negotiations were in hand for further large contracts. The district, a most important manufacturing centre, was rapidly developing, and the prospects of the company for electric supply were most promising. They would have to issue some new capital very shortly. They were paying 7 per cent. dividend, against 5 per cent. for 1918.

Bruce Peebles & Co., Ltd.—The report for 1919 states that the works were fully employed during the year; an extension has been made to the new shop for engineering work. The results are considered satisfactory, and the prospects for the current year are encouraging. The profit, including interest on investments, &c., and after deducting administration expenses, the amount required for debenture service, and provision for excess profits duty, was £47,179, plus £3,574 brought forward. Of this, £8,000 has been put to depreciation reserve and £20,000 to general reserve. The preference dividend of 7½ per cent. per annum (less income tax) is paid, and a further dividend of 2½ per cent., making 10 per cent. for the year; also 7½ per cent., less tax, on the ordinary shares, leaving £5,462 to be carried forward. Meeting, Edinburgh, March 19th.

Brompton & Kensington Electricity Supply Co., Ltd.—Revenue credit balance for 1919 £29,362, plus £2,276 brought forward, and other receipts, making a total of £32,948. There is written off cost of investments £181, and put to reserve fund £8,000; preference dividend 7 per cent.; dividend for the year on the ordinary shares 12 per cent.; directors' additional remuneration £1,000; to be carried forward £1,230. Equivalent of 35 watt lamps connected increased by 30,470 to 433,152; customers connected increased from 7,013 to 7,389; gross receipts £74,045, against £58,759; expenditure £44,683, against £40,272; net receipts £29,362, against £18,487. Average price obtained per unit 4.61d., against 4.13d. in 1918.

British Insulated & Helsby Cables, Ltd.—Profit for 1919, after providing for estimated excess profits liability, £328,689, plus £99,292 brought forward. From this have to be deducted directors' and debenture trustees' fees and works committee's remuneration, £7,165; interest on first debenture stock, £22,500; interest on second debenture stock £10,000; preference dividend, £30,000; depreciation on buildings, plant, machinery, &c., £50,000; to reserve, £50,000; to first mortgage debenture stock redemption account, £5,000; ordinary dividend total 12½ per cent. for the year, and a bonus of 2½ per cent.; carried forward, £103,316. Both the Prescot and the Helsby factories were kept busy to their full capacity during 1919.

Rangoon Electric Tramway & Supply Co., Ltd.—At an extraordinary general meeting held in London on March 8th it was resolved to transfer the control of the company from the London board to a new board of directors in Rangoon. In the course of an address at the meeting, Sir F. W. R. Fryer said that as the whole of the profits were earned in Burma, they were in sympathy with the proposal, as they appreciated the hardship of the shareholders residing in Burma and India being called upon to pay English income tax on the profits in addition to the Indian income tax. There was urgent need for the extension both of the tramways system and the electric supply. A large and considerable service of extensions was necessary, and was now long overdue.

Greenwood & Batley, Ltd.—According to the "Times," meetings are being held to approve of the sub-division of the £10 shares, both preference and ordinary, into £1 shares; to capitalise such reserves as will permit of a distribution of additional shares amongst holders of ordinary shares in the proportion of one fully-paid £1 ordinary share for each £1 of ordinary capital at present paid up, and to increase the authorised capital from £400,000 to £600,000 by the creation of 200,000 new shares of £1 each.

Davis & Timmins, Ltd.—The net profit for 1919, including £37,006 brought forward, after allowing for depreciation and commission to manager and excess profits tax on account of 1918, is £71,661. To general reserve account £2,000; to income tax account £7,572. Balance dividend at the rate of 10 per cent. per annum on the ordinary shares for the last half-year, making 8 per cent. per annum for the year (free of tax); a bonus of 17 per cent. out of profits (free of tax); carried forward, subject to special taxation £46,739.

Barcelona Traction, Light & Power Co.—The net revenue for 1918 available for interest on the bonds payable in cash and for construction expenditure was $2,516,920, against $2,354,964 in 1917. The interest payable in cash on the bonds for 1918 amounted to $1,109,422—*Times*.

Western Telegraph Co., Ltd.—Interim dividend of 5s. per share, free of income tax, for the year ending June 30th, 1920.

Para Electric Railways & Lighting Co., Ltd.—Mr. Follett Holt presided at the meeting held in London on 12th inst. He said that considering the low prices ruling for rubber it was very satisfactory to see that commercial activity at Para continued to grow, as shown by an increase of 6 per cent. in their passenger traffic, and an increase of 6½ per cent. in the number of consumers of current. One of the directors had recently visited Para, and he reported the tramway and lighting undertakings in an excellent state of repair. The gross receipts continued to show expansion for the current year, but owing to labour, fuel, and other increases, any gain might be more than set off by increased expenditure. On the other hand, there might be a material advantage from the very much improved value of the milreis for remitting purposes. Last year the average value was 14d.; at the present time they were receiving 18d. The collection of wild rubber and its exports from the Amazon did not show signs of disappearance, notwithstanding the growth of the plantation rubber industry in other parts of the world. Shipments in 1917-18 were 27,430 tons, and for 1918-1919 33,150 tons.

Stock Exchange Notices.—The Committee has specially allowed dealings in the undermentioned securities under Temporary Regulation 4 (3):—

Eastern Extension, Australasia & China Telegraph Co., Ltd.—100,000 shares of £10 each, £1 paid, Nos. 300,001 to 400,000.

Eastern Telegraph Co., Ltd.—1,000,000 ordinary shares of £1 each, 2s. paid, Nos. 1 to 1,000,000.

Globe Telegraph & Trust Co., Ltd.—60,376 ordinary shares of £10 each, £1 paid, Nos. 181,128 to 241,503.

Underground Electric Railways Co. of London, Ltd.—£700,000 6 per cent. 3-year notes, 1920-23.

Western Telegraph Co., Ltd.—103,965 shares of £10 each, £1 paid, Nos. 207,931 to 311,895.

Yorkshire Electric Power Co.—£230,000 5½ per cent. redeemable debenture stock (issued at 88 per cent., of which £15 has been paid up); and 40,000 ordinary shares of £10 each, £2 paid, Nos. 42,577 to 82,576, after issue of allotment letters.

Application has been made to the committee to appoint a special settling day in:—

Mann Egerton & Co., Ltd.—68,357 preference shares of £1 each, fully paid, Nos. 1 to 68,357.

Bournemouth & Poole Electricity Supply Co., Ltd.—Mr. J. A. Hosker, presiding at the annual meeting, said that the results were a considerable improvement over last year. Receipts from sale of current and meter rentals had increased by 16 per cent. The total working costs increased by £10,844. The cost of fuel burnt had increased 10 per cent. The balance was £20,640, compared with £15,528 in the previous year. With regard to the general business of the company, applications representing 1,695 KW. had been secured, as compared with 425 KW. last year. The trading department continued to be very successful, the net profit having reached £3,393, as against £1,331. The number of men employed by the trading department had trebled owing to growing demands for electric wiring. These figures were a good indication of the progress and potentialities of the company. Since the close of the year there had been an increase of 24 per cent. in the units generated and 158 per cent. in the KW. applied for. They were considering the best means of raising funds for the necessary capital expenditure to meet the growing business.

Constantinople Telephone Co.—The financial Press states that a meeting of the holders of 6 per cent. obligation bonds will be held in London on March 24th, to consider a scheme of arrangement providing for the funding of the arrears of interest and the debts due to contractors and others for the supply of materials and for work done. The scheme of arrangement provides for the issue of a certificate for £20 and the payment in cash of £1 on each obligation representing the arrears of interest up to and including the coupon due July 1st, 1919, of £30, less tax of £9. The certificates are to be paid off in June, 1934, and in the meantime to bear interest at the rate of 6 per cent. per annum, payable half-yearly on January 1st and July 1st. The due date of the obligations to be extended from June, 1929, to June, 1934. The right of conversion of obligations into shares to be extended from June, 1917, to June, 1923. On the approval of the scheme the coupon due January 1st last to be paid in cash.

Isle of Thanet Electric Tramways & Lighting Co., Ltd.—For the year ended September last the balance at credit of revenue account is £28,054. £1,372 to reserve; £5,691 to permanent way reserve; £6,543 to rolling-stock reserve; £494 to cost of motor vehicles, and £3,954 carried forward. It is hoped to resume payment of a dividend on preference shares for year ending September 30th, 1921.

British Electric Transformer Co., Ltd.—Mr. A. F. Berry presided at an extraordinary general meeting held at the works at Hayes, when new articles of association were adopted. The chairman said that matters were moving very rapidly in the development of the company, and the new articles were necessary to enable the directors to speed up.

W. T. Henley's Telegraph Works Co., Ltd.—Final dividend on the ordinary shares of 2s. 6d. per share, less income tax, making, with the interim dividend of 6d. per share paid in September, 1919, 3s. per share for the year.

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New Issues.—Four telegraph companies have been offering shares to existing holders this week. The Western Telegraph Co. has been offering 103,965 shares of £10 each; the Eastern Telegraph Co., Ltd., 1,000,000 shares of £1 each; the Eastern Extension, &c., Co., 100,000 shares of £10 each; and the Globe Telegraph & Trust Co., Ltd., 60,376 ordinary shares of £10 each.

Manila Electric Railroad & Lighting Corporation.—Dividend of 1½ per cent. for the quarter ending March, on the common capital stock.

Alley & Maclellan, Ltd.—Dividend on ordinary shares 6 per cent. per annum for 1919. To depreciation £14,577; to reserve £20,000; carried forward £7,315.

Ibbotson Bros. & Co., Ltd.—Interim dividend at the rate of 5 per cent. per annum, free of tax.

Liverpool District Lighting Co., Ltd.—Dividend 5 per cent. per annum, less tax, for 1919.

STOCKS AND SHARES.

Tuesday Evening.

Stock Exchange markets are in no pleasant mood. What to make of the German Revolution provides a puzzle. The vast outpourings of new issues that want to make financial hay in pre-Budget days are absorbing money at a pace which threatens the maintenance of the 6 per cent. Bank Rate. Political developments at home and abroad are anything but consolatory to holders of securities. All these considerations are subsidiary to the apprehensions of capital levy that centre round the Budget. Stock Exchange business is quiet. Sellers preponderate in all save a few favoured markets. Everyone cries he has no money. Plenty of stock, doubtless, but little liquid cash. The which, faced by a 7 per cent. Bank Rate in the probably close future, is not a position making for buoyancy, bullishness or confidence.

The Eastern Telegraph, Western, Eastern Extension and Globe Telegraph companies have duly distributed allotments of their new shares to fortunate allottees. A word, apologetic and diffident, may be of some slight service to holders of the stocks, warning those holders not to consign their papers to the wastepaper basket. Odd as it may sound to the informed, quite a lot of investors do throw away such rights, especially when they see that they are asked to subscribe more money, as, for example, in these cable cases. If the allottee does not wish to take up the proportion, it can be sold. The premium on the new Eastern Telegraph shares is 6s. to 8s.; on the other three it ranges from 75s. to 80s. per share. Where possible, the new shares should be taken up. In due time they will rank with the senior issues and provide a fine investment paying handsomely on the money. Some people are selling their old in order to provide cash for the new, and because of this, Eastern ordinary is down this week 12 points, Western shares are 25s. lower and Eastern Extensions 10s. The shrinkage has lowered the prices to much the same levels as they occupied before the recent announcement of the 10 per cent. dividends and the issue of new stock at par, but the quotations are now ex rights, of course. Nevertheless, at the present quotations, the yields are again tempting, on the assumption that the 10 per cent. dividend will be maintained in the future. And of that there seems to be little doubt.

American exchange is jumping about in extraordinary fashion, producing rises and falls in dollar securities that vary from 5 to 10 points in a day without a ha'p'orth of stock changing hands. The Anglo-American Telegraph issues (sterling) continue to fall; the deferred is down to 18½, showing a good yield on money invested at that price. Marconis slid back from 4¼ to 3 15-16 in the general disturbance that has shaken up all the markets. Canadians fell back to 12s. 3d. American Marconis are "out of it"; dealings remain perforce in suspense until the conversion into Radio shares is complete and the new certificates arrive on this side. Gas and Electric Light of Baltimore rose 7 to 130 on the declaration of a final dividend, making 8 per cent.

Callenders weakened to 8¼. Henley's eased off to 2⅜. The final dividend of 2s. 6d. on the latter makes 3s. per share, 15 per cent. for the year. Metropolitan-Vickers preference went back sharply to 2⅛, and other Construction shares are somewhat heavy. Siemens drooped a few pence to 29s. 6d., and Electric Constructions are 1s. down at 24s. British Insulated picked up to 2⅛. General Electric new ordinary advanced to 6s. 6d. premium, these being the shares distributed in right at 28s. Upon the allotment of the new public issue, the price of all the new ordinary shares fell back to 5s. premium, while the latest preference are quoted at 1s. 6d. discount. The existing ordinary at 36s. 3d. are easier on the week. Automatic Telephones remained about 19s. Probably the holders who have not signified willingness to exchange into the new International Company may be able, if they so desire, to do this for a few days longer.

City of London Electric ordinary are 2s. 6d. up on the issue of a very satisfactory report. The market looks for bonus additions to the dividend until the war-years' ravages have been entirely wiped out. London Electrics are again ¼ up. South Londons keep hard at 2⅜, and a buyer of 20 shares has found his order unfilled, for lack of sellers, though he has been trying to get this handful during the past two or three weeks. Newcastle Electric preference hardened to 21s. 3d., but the dulness this week brought in a few hundred shares offered at a guinea. The recently-offered Lancashire Power Construction 6 per cent. preference, tax free up to 6s. in the pound, can be bought at 20s. or a shade less, and the partly paid shares stand about sixpence discount. Shropshire and Staffordshire Electric Power 6 per cent. preference shares were done early this week at 13s. 11½d., suggesting a "Bargain Counter" price at a drapery store.

The County of London meeting produced a very hopeful speech from the chairman, and is worth reading in extenso by anyone interested in the lighting industry as a whole. It has had no effect, so far, upon share values in the Stock Exchange market.

Home Railways remain heavy and the public apathetic to what attractions the stocks may possess. Metropolitan Consolidated has weakened to 21, Underground Incomes to 71, and Districts to 17¼. British Columbia Electrics are again lower, and Brazilian Tractions are down 1½ on French selling. About Mexicans there is nothing hopeful to record. The Indian shares remain firm. Bombay preference are up to 19, and the ordinary has risen to 155. Engineering issues are fairly hard. The Rubber list weakened with the price of the product, now a shade below half-a-crown per lb. In armaments, only languid interest is shown—indeed, that same sentence can be truthfully applied to a good many of the recently-popular industrial sections round the Stock Exchange markets.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1918.	Dividend 1919.	Price March 16, 1920.	Rise or fall.	Yield p.c.
Home Electricity Companies.					
Brompton Ordinary	8	12	63	—	£8 16 10
Charing Cross Ordinary	4	7	8½	—	2 0 8
do. do. do 4½ Pref.	4½	4½	2⅜	—	8 8 8
Chelsea	3	4	3½	—	6 8 1
City of London	8	10	14½	+ ⅛	7 1 7
do. do. 6 per cent. Pref.	6	6	9⅜	—	6 4 8
County of London	7	8	9⅜	—	8 2 2
do do. 6 per cent. Pref.	6	6	9	—	6 13 4
Kensington Ordinary	6	7	5½	—	6 13 4
London Electric	Nil	2½	1⅜	+1/8	5 2 6
do. do. 6 per cent. Pref.	6	6	8½	—	8 11 6
Metropolitan	5	6	33xd	—	8 0 0
do. 4½ per cent. Pref.	4½	4½	2¼	—	7 16 6
St. James' and Pall Mall	10	12	6⅜	—	8 16 10
South London	5	6	2⅜	—	7 12 8
South Metropolitan Pref.	7	7	19/6	—	7 3 7
Westminster Ordinary	8	10	5¼	—	8 10 6
Telegraphs and Telephones.					
Anglo-Am. Tel. Pref.	6	6	87½	—1	6 17 1
do. Def.	33/6	1½	18½	— ½	8 2 2
Chile Telephone	8	6	6½	—	*4 13 2
Cuba Sub. Ord.	7	7	10⅝	—	*6 18 4
Eastern Extension	8	10	15⅜	— ¼	*6 7 0
Eastern Tel. Ord.	8	10	153	—12	*6 10 9
Globe Tel. and T. Ord.	8	10	15½xd	— ½	*6 9 0
do. do. Pref.	6	6	8⅜xd	—	6 4 8
Great Northern Tel.	22	—	24	—	9 8 4
Indo-European	18	—	48½	—	6 18 4
Marconi	25	—	3¹⁵⁄₁₆	— ¼	6 7 7
Oriental Telephone Ord.	10	—	2⅛	—	4 16 0
United R. Plate Tel.	8	—	8	—	*5 0 8
West India and Panama	1/8	—	1⅛	—	5 19 0
Western Telegraph	8	10	15¾	—1¼	*6 7 0
Home Rails.					
Central London Ord. Assented	4	4	47½	—	8 8 6
Metropolitan	1	1½	21	—1	5 19 1
do. District	Nil	Nil	17⅛	— ⅛	Nil
Underground Electric Ordinary	Nil	Nil	2⅜	— ¼	Nil
do. do. "A"	Nil	Nil	6/6	—	Nil
do. do. Income	5	4	71	—1	5 12 8
Foreign Trams.					
Anglo-Arg. Trams. First Pref.	Nil	Nil	3⅜	—	—
do. do. 2nd Pref.	—	—	3¼	—	—
do. do. 5 Deb.	5	5	63½	—	7 15 0
Brazil Tractions	—	—	53⅛	—1⅛	—
Bombay Electric Pref.	6	6	19	+ ¼	3 8 0
British Columbia Elec. Rly. Pfce.	5	5	61½	—	8 2 8
do. do. Preferrred	2½	5	51½	—1	9 14 2
do. do. Deferred	Nil	3	41½	—2	7 4 7
do. do. Deb.	4½	4½	60½	—	7 0 6
Mexico Trams 5 per cent. Bonds	Nil	Nil	88½	—	Nil
do. 6 per cent. Bonds	Nil	Nil	29½	—	Nil
Mexican Light Common	Nil	Nil	17½	—	Nil
do. Pref.	Nil	Nil	30½	—	Nil
do. 1st Bonds	Nil	Nil	51½	—	—
Manufacturing Companies.					
Babcock & Wilcox	15	—	3½	—	*4 5 9
British Aluminium Ord.	10	10	2¹⁵⁄₁₆	— ⅛	4 17 0
British Insulated Ord.	12½	15	2¼	+ ⅛	7 1 2
Callenders	25	—	8⅞	— ¼	7 0 10
,, 6½ Pref.	6½	6½	4⅜	—	6 16 10
Castner Kellner	20	—	4	—	—
Crompton Ord.	10	—	22/-	—	9 1 10
Edison-Swan, "A"	10	—	1½	—	8 0 0
do. do. 5 per cent. Deb.	5	5	79½	—	6 5 9
Electric Construction	10	—	24/-	- 1/-	8 6 8
Gen. Elec. Pref.	6½	6½	18/6	—	7 0 6
do. Ord.	10	—	1¹⁵⁄₁₆	— ⅛	*5 10 4
Henley	25	15	2⅜	— ⅛	6 6 4
do. 4½ Pref.	4½	4½	3⅜	—	6 4 2
India-Rubber	10	—	16	—	*6 5 0
Met.-Vickers Pref.	—	8	2⅞	— 1/16	5 11 4
Siemens Ord.	10	10	29/6	— 6d.	*6 15 7
Telegraph Con.	20	20	28	—	*4 5 0

* Dividends paid free of Income Tax.

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IMPERIAL WIRELESS COMMUNICATIONS.

The following abstract gives the leading features of the proposal for a network of wireless communications to serve the needs of the whole British Empire which we briefly abstracted last week, and which has been submitted by Messrs. Marconi's Wireless Telegraph Co., Ltd., to the sub-committee appointed to investigate this question.

The principles which it is suggested should govern the drawing-up of an Empire-wide scheme of wireless communications are as follows:—

1. That such trunk routes and branch routes be provided, as will enable England to obtain wireless communication with any part of the Empire.

2. That any part of the Empire be capable of communicating with any ship suitably equipped with modern wireless receivers, in whatever sea she be; roughly speaking between latitude 60 N. and 50 S.

3. That no submarine cable be relied upon to form part of this network of communications.

4. That the use of land telegraph lines be, as far as possible, avoided; and that these lines be restricted to the passage of messages between the public and the nearest wireless station.

5. That, where alternative routes are available, such as between England and South Africa, *via* the East Coast, or West Coast, both routes be provided.

6. That, on the trunk routes, automatic transmission and reception at a speed of not less than one hundred words per minute be provided; and that separate transmitting and receiving stations be erected, in order that the service may be duplexed, *i.e.*, available for simultaneous transmission and reception.

7. That as much foreign traffic as possible be attracted to the network, in order that the system be at least self supporting as a commercial enterprise; it being understood that preferential treatment could be accorded to British traffic. Such an arrangement would clearly be politically and strategically advantageous to the Empire.

In order to construct the wireless network in accordance with the principles above enumerated, it is proposed that the final aims should be as follows:—

1. That main trunk stations be erected for communication over long distances. (It may not be necessary to erect all the main trunk stations immediately.)

2. That no trunk station be required to communicate with more than one corresponding station; and that, in consequence, each country be provided with a separate trunk station for each route to which it forms a terminal.

3. That, in a country which forms the terminal of more than one route, the various trunk transmitting stations be erected as close together as avoidance of mutual induction will allow; and that, consequently, there be only one trunk transmitting area in any country.

4. That, in conjunction with the trunk transmitting area, smaller transmitting stations be erected, to serve as main feeder transmitting stations; and that they be situated within one main feeder transmitting area.

5. That all trunk receiving stations and main feeder receiving stations be situated close together within a main receiving area.

6. That the main trunk transmitting area, main feeder transmitting area, and main receiving area, be operated by means of underground cables from a central control office.

7. That the central control office be situated in a convenient telegraph centre of the country (*e.g.*, London, in the case of England); and that, in order to reduce to a minimum the length of underground cables, the transmitting and receiving areas be situated as near thereto as is consistent with efficient duplexing, cost of land, &c.

8. That each main feeder station be designed to communicate with one or more corresponding local feeder stations; and that each local feeder station comprise two transmitting stations and two receiving stations all operated from one building, one pair for communication with the main feeder station and the other pair for communication with the various coastal and other small local stations in the neighbourhood of the local feeder station.

9. That trunk and feeder stations employ continuous, or "undamped," waves for the transmission of signals.

10. That, also, small local stations employ continuous waves.

11. That, if found desirable in the future, arrangements be made to link up the proposed point-to-point network of "fixed" stations with any existing system of "mobile" stations which may be in use to maintain communication with units at sea or in the air.

12. That, if desirable, arrangements be made at any of the stations to devote a reasonable time in each 24 hours to sending messages at hand speed to ships (where the wave length is suitable), to the sending out of scientific and ordinary time signals, and to similar services; it being understood, however, that main trunk stations should not be expected to send to ships not specially fitted to receive the long waves which these stations must employ. As the earning power per minute of such stations working at automatic speed would be considerable; and as, therefore, it would be commercially most undesirable to use them except for their normal services, so far as possible, such subsidiary services should be performed by the main or local feeder stations.

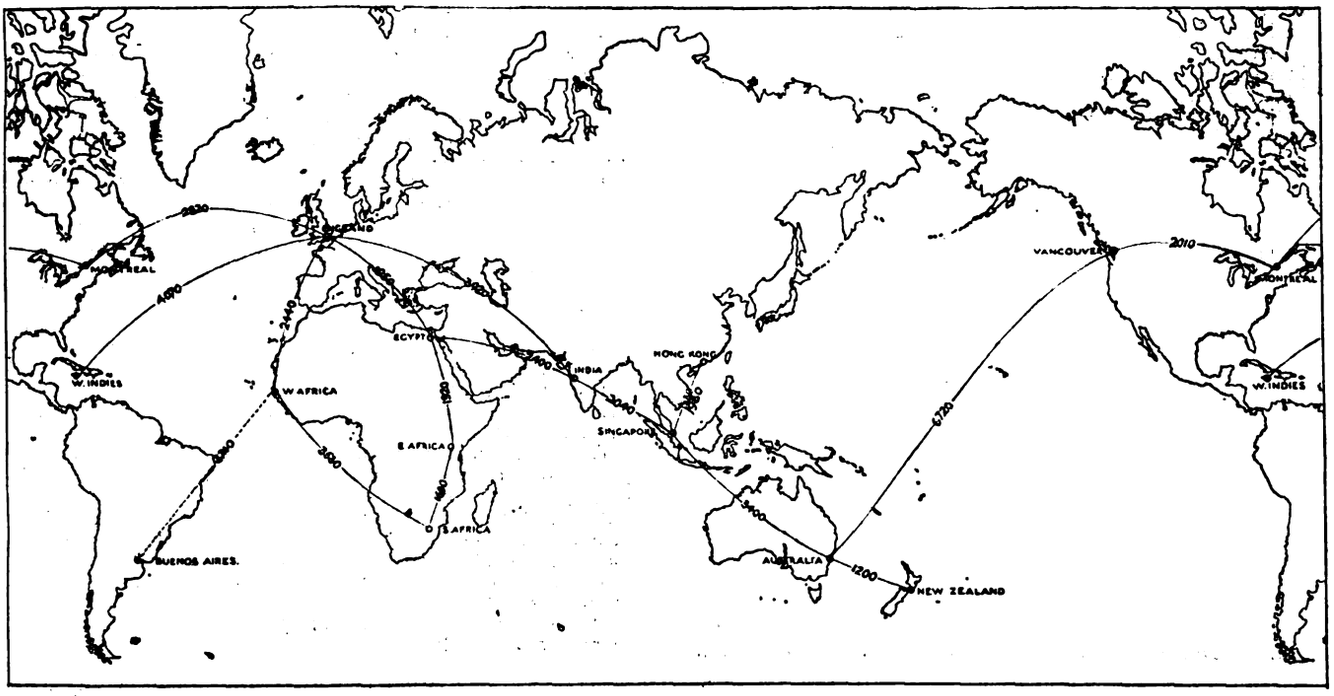

Fig. 1.—Proposed Main Trunk Wireless Communication Routes.
The numbers represent great-circle distances in nautical miles

The transmitters installed at the trunk and feeder stations should employ a continuous, or "undamped," wave system. The extensive employment of continuous waves has, until recently, been restricted, owing to lack of suitable methods of generating them. We have been limited to the *timed spark* and the *arc*. Neither of these systems can be recommended, in view of the rival claims of the *high-frequency alternator* and of the *valve*.

To obtain a given aerial current in any aerial, the ratio of power put into a valve to that put into an arc on a "dash" is approximately as two is to five. The valve avoids the necessity of an elaborate water-cooling system, and is steadier and more reliable in operation than is the arc. As, during signalling, the load of the valve is interrupted, and that of the arc is continuous, the overall energy taken during a given period of transmission by the valve, as compared with that taken by the arc, is much less than that represented by the ratio of two to five. Apparatus is already being assembled capable of dealing efficiently with an output of 100 kilowatts. The corresponding aerial power is confidently expected to be

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75 kilowatts, and the design of the set is such that it can readily be adapted to three or four times this power. Recent research with a view to the reduction of the total effective aerial resistance, without loss of radiation, leads to the expectation of an aerial current of upwards of 300 amperes.

It is important, in order that interference between stations may be avoided, that special regard be given to the elimination of harmonics. This is another consideration which operates against the employment of the arc as a transmitter. The problem of eliminating the higher order of harmonics produced by the valve transmitter, when working at the higher efficiencies (over 50 per cent.), has been successfully attacked by the company's engineers.

Separate aerial systems are essential for the several receiving stations on one site. The newest methods of reception invented and perfected by Mr. Franklin show such enormous improvement over previous methods as regards selectivity and avoidance of atmospheric disturbance, that it is unnecessary to consider a service which does not make use of this invention.

The Franklin aerial is a development of the now well-known Marconi-Bellini-Tosi direction finder, which played so important a part in various spheres of military activity during the war. The direction finder enables reception, with maximum intensity, within very close limits, of signals emanating from any two opposite directions. Signals from other directions are negligible, or can easily be rendered so. The direction finder has, however, the drawback—if such it can be called—that the mathematical *sense* of the signals cannot be determined without recourse to cross bearings. This peculiarity of the direction finder is avoided in the Franklin aerial, which is based on a suitable combination of direction finder aerials. Signals can be received, within very close limits, from any one direction, and from no other. It follows that a receiving station can be located between, and in line with, two transmitting stations, and receive signals from one, while rejecting signals from the other. This is a point of extreme significance, and marks a new era in selectivity.

Owing to the ability of the Franklin receiving system to

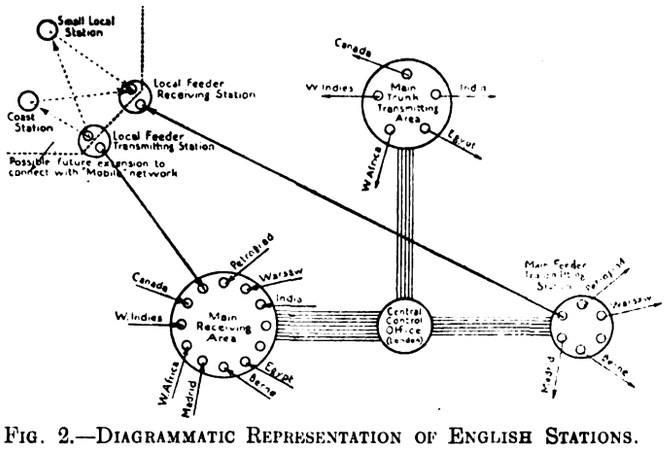

Fig. 2.—Diagrammatic Representation of English Stations.

reject signals arriving from practically any direction other than that from which it is desired to receive, any number of receiving stations may be located on one site. No balancing aerials are required.

Even so, the erection of a large number of receiving stations on one site would entail the acquisition of a site of vast proportions, were it not for a most important property of Franklin's invention, which enables the various receiving systems to cross one another; this being due to the absence of long horizontal aerial wires. Small frame aerials are employed, and frames pertaining to different lines of communication may be erected as close together as 600 ft., even where long waves, differing but little from each other, are being received.

Results show that, where the Franklin type of aerial is employed, a very great reduction in atmospheric disturbance is obtained, compared with previous experience—a reduction amounting, in certain observed instances, to as much as 90 per cent. So great is the importance of the Franklin aerial that the scheme of wireless communications outlined in this proposal depends fundamentally upon its adoption.

An enormous amount of unnecessary work is avoided by the adoption of a central control office. No staff of telegraphists is necessary either at the transmitting or receiving stations, other than that required for the care of the plant and instruments. Reception from the land lines, and retransmission by wireless, at the transmission stations, and reception by wireless, and retransmission on the land lines, at the receiving stations, is entirely eliminated.

In addition, the exchange of service messages between the operating staffs at the various transmitting and receiving stations is avoided, as all the operating staff is located under one roof. The land lines connecting the various stations are, therefore, kept free from a quantity of unremunerative traffic. The ease of control, and consequent saving of time, are too apparent to need further comment.

The operation of transmitting plant from a distance has been proved to be perfectly reliable in practice. As regards the relaying of received wireless signals through underground cables to a central control office, recent experiments, carried out over some 130 miles of ordinary Post Office land line in poor condition, show that this is an undertaking which can safely be relied upon to give satisfactory results.

The following routes and branches are proposed:—

Route 1.—England to India, and thence to Singapore, Australia, and New Zealand, with a branch from Singapore to Hong Kong.

Route 2.—England to Egypt, and thence to East Africa and South Africa.

Route 2a.—England to Egypt, and thence to India, Singaport, &c.

Route 3.—England to West Africa, and thence to South Africa, with a branch from West Africa to South America.

Route 4.—England to the West Indies.

Route 5.—England to Montreal, and thence to Vancouver.

Route 6.—Australia to Vancouver (only night service to begin with).

The above will necessitate the following main trunk stations:—

In England, five; Egypt, three; India, three; East Africa, Montreal, Vancouver, and South Africa, two each; West Indies, one; West Africa, two (and one auxiliary trunk station for South America); Singapore, two (and one auxiliary trunk station for Hong Kong); Australia, two (connection to New Zealand by main feeder station).

The number of main feeder stations provided in each country will depend upon the number of local feeder stations required, and may, from time to time, be increased without in any way affecting the scheme of trunk stations.

The purely internal communications of each State or Colony would be catered for by a network of small intercommunicating stations, adapted to meet the requirements of the country, provision being made for efficient connection with the main network.

The foregoing proposal allows for 26 main trunk stations. In order, however, to give a rough idea of the magnitude of the scheme, and also to establish a basis for the calculation of personnel to be provided for, the following figures are tentatively submitted: 30 main trunk stations, 50 main feeder stations, 100 local feeder stations, and 200 small local stations.

Tables are given showing the personnel required for running the full network of stations, aggregating 17,170. It has been assumed for the sake of simplicity that there will be ten countries, each containing three main trunk stations, five main feeder stations, ten local feeder stations, and twenty small local stations.

The total number of men required is very large, but the proportion of wireless operators is small on account of the large proportion of work done by automatic means.

A considerable staff would be required in the office of the general manager of the network, but no attempt has been made to include such staff in the estimate of personnel.

A system of stations for communication with ships and aircraft is not under review in this proposal.

The status and number of personnel required for the scheme are as follows:—

Territorial managers, 10; superintending engineers, 20; engineers, 1st class, 30; engineers, 370; assistant engineers, 1,840; superintending operators, 20; chief operators, 650; wireless operators, 1,200; operators, 7,200; accountants, 20; clerks, 490; technical assistants, 720; artisans, 1,290; labourers, 810; boys, 2,500; total, 17,170.

The terms upon which the foregoing proposal is submitted are as follows:—

1. The company offers entirely at its own cost to construct, maintain, and operate, a complete and efficient network of Imperial wireless communications, in accordance with the proposal.

2. The company will pay yearly into the Treasury of each Government, in whose territory one or more stations may be situated, a sum equal to 25 per cent. of the net profits earned by the said station or stations.

3. On the expiration of a period of 30 years, dating from the inauguration of any wireless service comprised in the network, the stations conducting such service will become, if so desired, the property of the Government or Governments concerned, free of any payment.

4. The company guarantees to complete the trunk stations within a period of three years from the date on which permission to commence work is given.

5. The Government or Governments concerned will have the right to take over the stations at any time by paying for them the value at which they stand in the company's books, plus any sum which may have been expended on the creation of the services, and by paying to the company 10 per cent. of the gross receipts for the remainder of a period of 30 years dating from the inauguration of the services.

6. The Government will have the right to take over the control of the stations during any period of war or national emergency.

7. This offer is subject to the following conditions:—

(*a*) That the Government or Governments concerned shall issue all requisite licenses for a period of 30 years, shall grant every facility for the acquisition of sites (by compulsory pur-

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chase if necessary), and shall carry out, as a repayment service, the work of building, laying, and maintaining all the underground and overhead telegraph and telephone lines required.

(*b*) That the stations, when erected, shall not be diverted from the duties for which they were constructed, except in the event of national emergency.

(*c*) That the company shall reserve the right to extend the system to foreign countries to any extent and on any terms that may be commercially advantageous, provided that Imperial traffic shall invariably have preference over foreign traffic.

(*d*) That the Government or Governments concerned shall secure the allocation of suitable international wave lengths to the stations comprised in the network, and shall see that stations belonging to other companies shall not be allowed to use unscientific apparatus or granted wave lengths which would interfere with the working of the Imperial network; and that, except in the event of national emergency, the stations comprised in the network shall not be compelled to communicate with other stations which would interfere with the Imperial services. The company asks for no monopoly; it is prepared to stand on its own merits. The offer is, however, conditional upon adequate protection on these lines being given to the service.

THE LYMN BY-PRODUCT PRODUCER GAS PLANT.

By W. H. PATCHELL, M.I.E.E.

(*Abstract of Paper read before the* Institution of Electrical Engineers.)

The plant to be described arose out of an investigation as to what was the best form of prime mover for the Hoffmann Manufacturing Co., Ltd., to adopt in the next extension of its works. The investigation was made in 1915. The plant selected was on the "Lymn" system which, although much like the better-known "Mond" system, differs from it in important constructional and operating details. It was arranged to put down the plant in 30-ton units. The first unit was ordered in July, 1916, but, due to constructional delays, it was not put into operation until August, 1917. A sudden increase in the business necessitated the ordering of the second unit shortly before the first was put to work. The complete 60-ton plant has now been in operation since March, 1919, but has not yet been worked up to its full capacity.

Description of Plant.—In a by-product recovery producer it is necessary to prevent the destruction of the ammonia, and this result is obtained by introducing a large quantity of steam with the air into the producer. The provision of so much steam is a serious item in the cost of production, so that as much steam as possible is obtained by utilising the sensible heat of the gases. The method adopted is to cool the gases by contact with water, and to heat up and saturate the air with the hot water so obtained. The process is continuous, the water coming successively into contact with the gas and the air.

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Steam was required for other purposes outside the gas plant, and a superheater was included as part of the boiler plant. When using the superheated steam for the gas plant it was found that the air was not saturated to the extent indicated by the thermometer. In order to obtain steadier operating conditions the pipe arrangement was changed and saturated steam was used for the gas plant in place of superheated.

The introduction of such highly saturated air into the producer would result in cooling the fuel bed below a good working temperature, and to prevent this a regenerator is provided wherein the temperature of the air and steam mixture is increased to about 220 deg. C. before it enters the producers, the necessary heat being obtained from the sensible heat of the hot gases leaving the producer.

The ammonia having been formed passes off with the gases which, after preliminary cleaning and cooling, are brought into contact with sulphate of ammonia liquor containing a slight excess of acid, the excess acid combining with the ammonia in the gas to form sulphate. The process is continuous.

Fig. 1 is a diagrammatic view of a plant on the "Lymn" system. The whole of the vessels on this system are worked under static conditions, all the washing being done by the movement of the gas and water, unassisted by mechanical means as in the case of most other gas washers.

The air, supplied by Samuelson blowers, enters the lower part of No. 3 washer, called the air saturator, the upper part of which is divided off by a diaphragm, the only connection between the two being through a water seal. The water, made hot by contact with the gas in the upper part of the vessel, passes through this seal into the air saturator and there meets the air from the blowers. The additional steam which is necessary for a recovery plant is blown into the air main between the air saturator and the regenerator. The warm saturated air is then passed through the regenerator which stands next to the gas producer.

The regenerator, sometimes called a superheater, consists of a nest of concentric cylinders so arranged that the hot gases from the producer and the saturated air pass in counter current. Owing to the large amount of steam which is blown into the gas producer with the air, the working temperature is comparatively low. The gases leave the producer at the top, and pass into the regenerator above mentioned, where their sensible heat is given up in part to the air and steam. The hot gas leaving the regenerator is then passed through a dust trap before it enters the vertical dust washer No. 1, in which the remaining dust is removed as sludge by the washing water. From the top of the dust washer the gases pass down to the bottom of No. 2 washer. In their upward flow through this washer they are brought into intimate

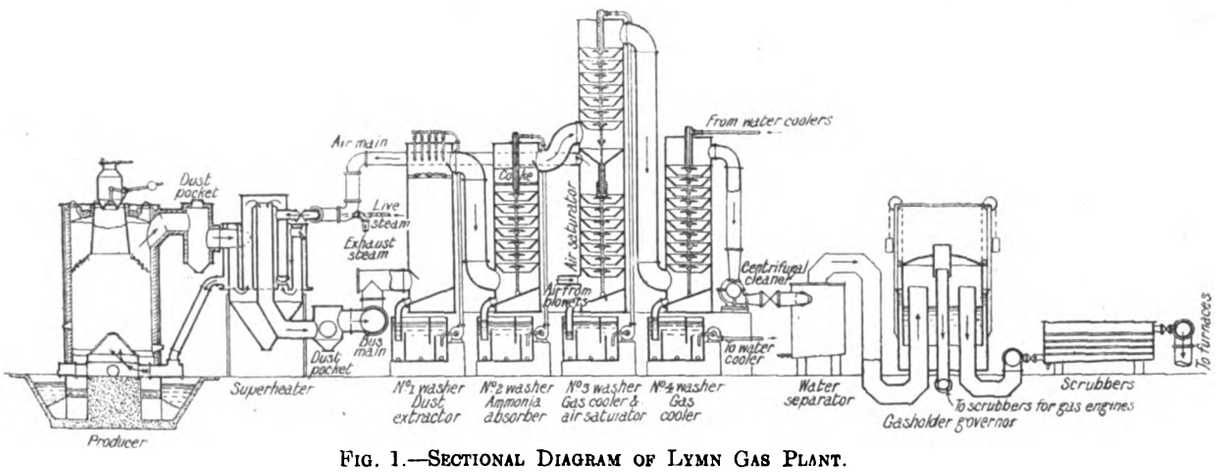

Fig. 1.—Sectional Diagram of Lymn Gas Plant.

contact with a solution of sulphate of ammonia containing a slight excess of sulphuric acid which absorbs the ammonia from the gas. After the ammonia has been absorbed in No. 2 washer the gas passes through the upper part of No. 3 washer, thence down to the bottom of, and up through, No. 4 washer.

The design of the Lymn washers differs from other types in that they are free from obstructions in the shape of packing boards or tiles, and from moving parts. The apparatus consists of several vertical cylindrical chambers, No. 1 of which is simply fitted with water jets at the top which fill the vessel with spray through which the gas passes in an upward direction and is thereby washed. Nos. 2, 3, and 4 contain a series of truncated cones. Axially placed in the centre of the apparatus a vertical shaft carries a number of fixed disks opposed to these cones. The water entering at the top is distributed on the topmost disk from which it flows in a film or sheet on to the surrounding cone, thence it falls on the next disk, and so on to the bottom of the washer. The gas passes upwards, counter-currentwise, through the sheets of falling water. By this means the gas and the washing liquids are brought into intimate contact, with a minimum expenditure of energy.

The liquor from each of the various washers falls into its respective tank, from which it is drawn by a centrifugal pump

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and circulated again through the washer, except in the case of No. 4 washer, the hot water from which is cooled before being recirculated.

In view of the difficulty in obtaining pure lead, and its cost at the time the plant was installed, it was decided to depart from the usual practice and not line the ammonia absorber with lead.

The gas, after leaving the final cooler No. 4, is passed through two Jenkins centrifugal gas cleaners. These consist of 25-in. diameter centrifugal fans with impellers of a somewhat crude shape; each of them is capable of handling continuously 4,500 cu. ft. of gas per minute against a pressure of 5 in. of water when running at 1,450 R.P.M.

The amount of power taken is 10 to 12 B.H.P. for each fan with water injection. Approximately 500 gallons per hour of cold water is injected into each fan, depending on the class

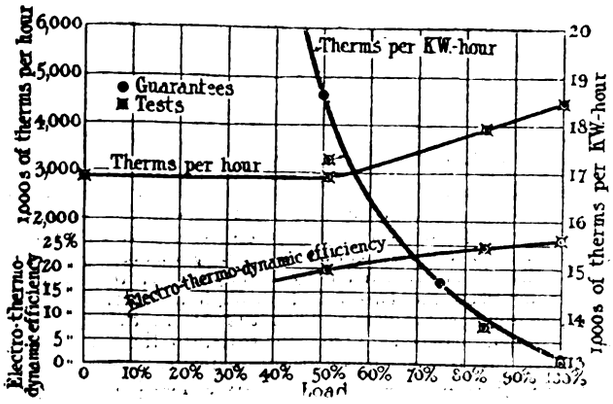

Fig. 2.—Heat Consumption Curves.

of coal in use and the atmospheric conditions. The tar and water drain away from the outlet pipes of the fans to a settling tank from which the tar is skimmed off.

The gas, after leaving the fans, passes through a water separator of the cyclone type before it goes into the gasholder governor, which is so arranged that, in the event of the gas failing, the supply to the gas engines is cut off before that to the furnaces. This prevents any suction caused by the engine coming on the furnaces, which might lead to an explosion should the gas come on again suddenly.

Gas intended for use in the engines is then passed through sawdust scrubbers to extract the last traces of tar.

Concentrated liquor produced in the ammonia absorber is by-passed to stock tanks. From these it is drawn into a vacuum evaporating pan made by Messrs. Fullerton, Hodgart and Barclay. The vacuum is obtained by a Ledward and Beckett ejector.

Sulphate of ammonia crystals from the evaporator are dried in a hydro-extractor, made by Messrs. Watson & Laidlaw,

as received, and the bunker is covered with a roof for protection from the weather. When it is necessary to draw from the storage bunker, the coal is run through valves at the bottom of the bunker into the trucks and thence tipped into the foot of the elevator.

The ashes and clinker from the producer lutes are drawn out by long shovels and rakes on to the ground round the producers, which is slightly graded to allow the water to drain back into the lutes. The ashes are then loaded into 5-cwt. trucks running on a narrow-gauge line, pushed by hand a short distance to an incline, up which they are hauled by a small electric winch and tipped into railway trucks or carts.

Gas Engines.—Messrs. Hoffmann decided that power units of about 500 B.H.P. would be the most suitable size. The type of engine selected was the multi-cylinder horizontal "Otto," manufactured by the Premier Gas Engine Co., Ltd.

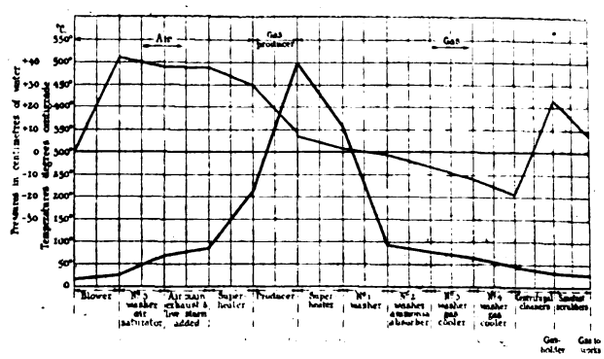

Fig. 3.—Lymn Gas Plant: Air and Gas Temperatures and Pressures.

The floor space occupied is greater than that taken up by a vertical engine, but this sacrifice is set off by the greater accessibility of the horizontal type. Another point of difference between the vertical and the horizontal type of gas engine is the speed. In the "Premier" engine the speed adopted is 190 R.P.M., which results in much sweeter working and a quieter engine room. This four-cylinder four-crank engine is naturally somewhat heavier than a six- or eight-cylinder high-speed engine, and, to obtain the necessary cyclic regularity for parallel running, a heavy flywheel is used. A spring-type governor is provided which controls a throttle valve on the gas supply to the engine. The air supply is not controlled by the governor, but means are provided for adjusting the amount of air when tuning up; under running conditions it is found that gas governing alone is quite sufficient.

Each gas engine is fitted with an exhaust boiler supplied by Messrs. Ruston & Hornsby, Ltd. Water heaters were added to the boilers connected to the later engines. In order

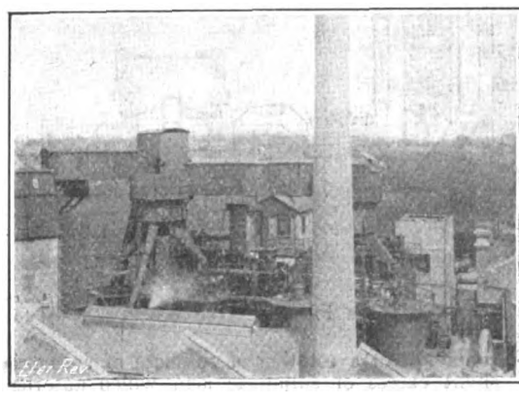

Fig. 4.—Coal Conveyors and Producers.

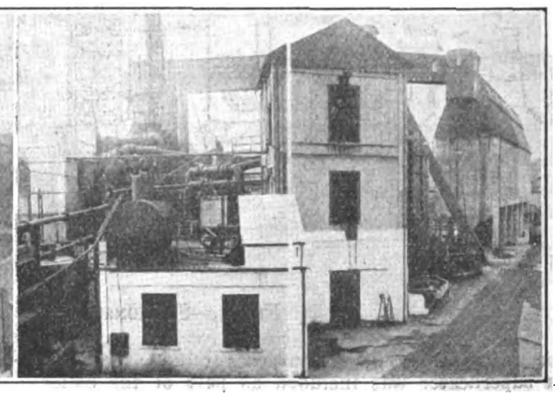

Fig. 5.—Blower House, Sulphate House, and Coal Bunker.

consisting of the usual revolving perforated copper basket suspended inside a mild steel casing lined with chemical sheet lead.

The sulphuric acid is delivered in tank wagons and discharged by an air lift into a steel tank on the top of the pump room, from which it runs by gravity through lead pipes to No. 2 washer (ammonia absorber) tanks.

Coal Store.—Coal is delivered by railway trucks to the boot of a Gibbons Bros. bucket-type elevator, which delivers it on to a band conveyor supplying the 30-ton pockets over the producers, or to a second band conveyor which carries it into the ferro-concrete storage bunker, constructed by Stuart's Granolithic Co., which holds 1,200 tons, and consists of six 200-ton pockets raised on columns sufficiently high to allow 5-cwt. trucks to run underneath. The band conveyor feeds a push-plate conveyor which delivers the coal into any of the 200-ton pockets as required. Coal is stored practically

to keep down the temperature of the engine-room and to save heat, the exhaust pipes between the engines and the boilers were lagged. Under these conditions the pipes got red hot and were unsafe, so that the lagging had to be removed and the economy due to it on the heat balance sacrificed for other considerations.

Messrs. Hoffmann's works, at the time that the extensions took place, were driven by direct current at 110 volts, and, although it was recognised in the first extension that a higher voltage would be more suitable, it was decided that the first two dynamos should be 110-volt D.C. machines, so as to avoid installing new motors and cables and the nuisance of changing the existing plant. When the second instalment of plant was put in hand a pressure of 220 volts was used, as the power was intended for new shops, for which new motors, cables, &c., had to be ordered in any case.

All the dynamos were supplied by Messrs. Crompton & Co.,

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Ltd., and are open type, direct current, shunt wound interpole, 360-KW. machines, running at 190 R.P.M. They are provided with a "Hoffmann" roller outer bearing supported in a cast-iron pedestal on a "U" bedplate, and the armature shaft is bolted direct on to the engine flywheel. This neat and compact arrangement has run very well.

In addition to the steam required for the gas plant, a large amount is required for heating and domestic purposes in the works, more especially in the winter. This is provided in part by the exhaust boilers fitted to the 500-B.H.P. gas engines. To meet the remaining call for steam two Lancashire boilers were provided, one with the first 30-ton unit and the other with the second. The Lancashire boilers, 9 ft. diameter by 30 ft. long, were made by Messrs. H. & T. Danks (Netherton), Ltd., and are fitted with Hodgkinson's mechanical stokers, a Green economiser, a Sugden superheater, and feed regulators.

One of Paterson's "B" type cold-process water-softening plants is installed for dealing with the whole of the water required for steaming purposes, as the water available was not suitable. By the use of lime in this plant the hardness of the water is reduced to 3 degrees "Clark" approximately, and the boilers are kept free from scale.

Capital Costs.—Owing to the war the cost of the plant was much above pre-war rates.

The first installation consisted of a Lymn gas plant capable of gasifying 30 tons of coal per 24 hours, sulphate of ammonia evaporating plant, two 500-B.H.P. Premier-Crompton generating sets, Lancashire boiler, superheater, economiser, chimney, pumps, pipes, feed pumps, 600-ton coal-storage bunker and coal-handling plant, &c. The second plant was a repetition of the first, except that four 500-B.H.P. Premier-Crompton sets were provided, and the gas and electric supply had to be carried considerable distances. The total capital cost per KW. of the first plant installed in 1916 and of the second installed in 1917 was respectively £40.96 and £50.

troughs and tanks to be heated, and various incidentals about the plant.

A charge of approximately 25 tons of coal for steam required for the producer and gas plant only, for every 100 tons of coal gasified, is a heavy item in working costs and one that must always seriously affect the use of by-product producer plants. Messrs. Hoffmann recognised that their conditions would be favourable for adopting this type of plant, coupled with an installation of exhaust boilers. By using these boilers and burning tar 75 per cent. of the 25 per cent. of the coal required for the gas plant is provided, and the actual coal required for gas plant steam is reduced to 6.25 per cent. of the coal gasified.

Figures for six months' operation of one 30-ton gas plant supplying gas for two engines and furnaces may be analysed as follows to show how the efficiency would appear if all the gas were used for power. The result is summarised in Table I.

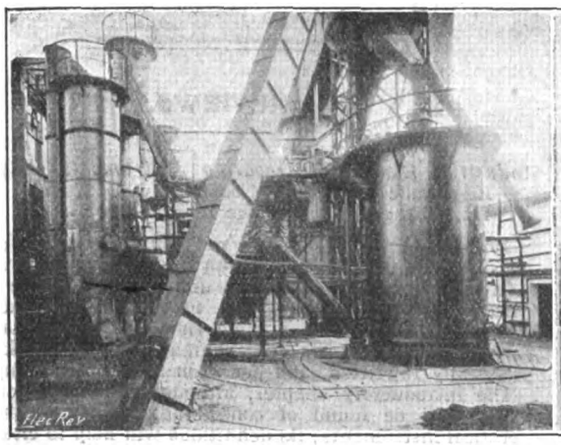

FIG. 6.—WASHERS, COAL ELEVATOR, AND PRODUCERS.

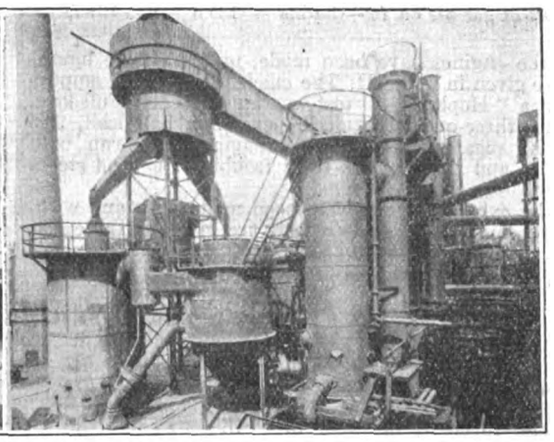

FIG. 7.—PRODUCERS, SUPERHEATERS, AND WASHERS.

TABLE I.—POWER PLANT COAL CONSUMPTION.

Coal gasified in producers—Total	1,390 tons.
Per KW.-hour	1·7 lb.
Coal, if 25 per cent. is required to provide steam	347·5 tons.
Coal gasified plus coal for steam-making—Total	1,737·5 tons.
Per KW.-hour	2·12 lb.
Amount of coal saved—By exhaust boilers ...	379·75 tons.
By tar burnt	114·7 tons.
Total	494·45 tons.
Surplus steam used for manufacturing purposes	146·95 tons.
Actual coal to be debited to power plant—Total	1,243·05 tons.
Per KW.-hour	1·51 lb.
Load factor, gas engines	73·6 %
Overall electro-thermal efficiency	19·9 %

During this period the total coal gasified was 3,235 tons, giving an average load of about 75 per cent. during operating hours of the plant. Of the total amount of gas made 42.7 per

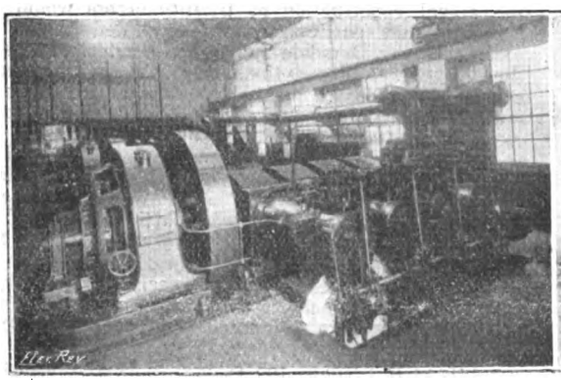

FIG. 8.—GAS ENGINES AND GENERATORS.

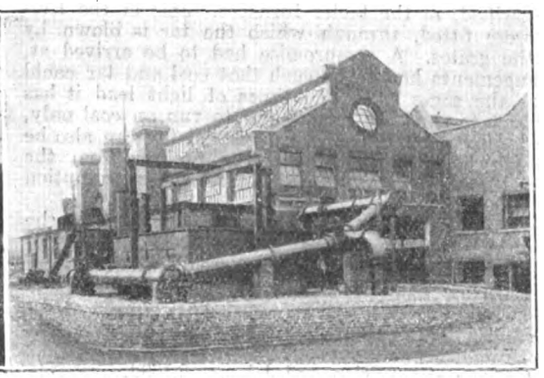

FIG. 9.—POWER HOUSE AND SCRUBBERS.

Operating Results.—Owing to war conditions the supply of coal was very uncertain. The ashes withdrawn from the producers during 1918 averaged a carbon content of 11.8 per cent., which represents 3.23 per cent. of the therms in the coal. The results given in this paper were obtained without special arrangements and under normal conditions, and can be taken as typical commercial results. No effort has been made to obtain special test figures which are not realised under ordinary working conditions.

The amount of steam required for gas plant is considerable, mainly for use in the producers and for evaporating the sulphate liquor. In addition to these uses there are tar cent. was used for the engines and 57.3 per cent. for the furnaces. For this purpose the whole of the steam raised by the exhaust boilers is credited to the gas engines, and the tar is allocated in proportion to the gas used by the engines and the furnaces respectively.

More steam is raised by the exhaust boilers than is required to make gas for the engines. In other words, exhaust boilers in connection with gas engines at a gas works would provide all the steam required for the producers, working under by-product recovery conditions, necessary to provide the gas for the engines when working on a good load factor.

Fig. 2 gives curves of the heat consumption guaranteed, the

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results of tests of the same, and the thermal efficiency of the 500-B.H.P. 340-KW. Premier-Crompton sets.

Results over a period of three months show that the variations in the calorific value and the composition of the gas made are very slight considering the different qualities of coal used.

TABLE II.—Tests of Gas Engines and Generators.

	Engine set No. 12.	Engine set No. 11.
Load factor, per cent.	102	84
Load—KW....	350	289
Generator—Gas per KW.-hour, cu. ft. ...	93·57	102
Heat per KW.-hour, therms	13,062	13,759
Load—B.H.P.	510	420
Gas engine—Gas per B.H.P.-hour, cu. ft.	64·24	69·5
Heat per B.H.P.-hour, therms	8,968	9,368
Calorific value of gas per cu. ft.—therms	139·6	134·79

Tests of the engines have been made, representative figures of which are given in Table II. The efficiency of the Crompton dynamos on a "Hopkinson" test was found to be: Full load, 92 per cent.; three-quarter load, 91 per cent.; half load, 90.5 per cent. As regards operating, the engines have run with the regularity and the freedom from trouble of a good steam engine.

Tests of the exhaust boilers have been made with and without the water heaters. Specimen tests are given in Table III.

TABLE III.—Tests of Exhaust Boilers.

	Engine set No. 9.	Engine set No. 11.
Load, B.H.P.	471	420
Heating surface—In boiler, sq. ft.	524	523
In water heater, sq. ft.	None	57·5
Total per B.H.P., sq. ft.	1·05	1·16
Steam pressure—lb. per sq. in.	53·7	44
Evaporation per B.H.P.-hour—Actual in lb. ...	1·91	2·15
From and at 212° F. in lb.	2·16	2·5
Temperature of exhaust gases—Entering boiler	560° C.	477° C.
Leaving boiler	291° C.	198° C.
Leaving heater	—	180° C.
Load factor, per cent.	94	84

The amount of sulphate recovered depends on the amount of nitrogen in the coal; actually some 90 lb. per ton of coal is recovered—an efficiency of about 65 per cent. The sulphate is of a good light grey colour, and averages over 25 per cent. NH_3.

A more critical figure for the ammonia absorber efficiency shows the amount of ammonia per cubic metre of gas when entering the absorber to be 2.73 grammes and when leaving 0.116 gramme, an efficiency of 95.75 per cent., the actual ammonia not recovered being equal to only 4.25 per cent.

The amount of tar produced in the process varies with the class of coal used; 5 to 7 per cent. of the weight of the coal is a normal figure for dry tar. The tar as made contains anything up to 40 per cent. of water. Producer tar is of a different quality and is not usually acceptable to distillers of gas tar. Where the quantity of tar to be handled is sufficiently great to pay for distillation, it may be economically dealt with in this way, but if the quantities to be handled are not sufficient to pay for such care and attention the result will be disappointing. Full consideration of the matter led to the use of the tar recovered, which amounts to about 150 lb. per ton of coal gasified, in the boiler furnaces. Jets of the Kermode type were fitted, through which the tar is blown by steam over the grates. A compromise had to be arrived at, and the arrangements had to be such that coal and tar could be burned at the same time. At times of light load it has been found best to shut the tar off and to run on coal only, keeping the tar for such times as a good coal fire can also be maintained, which not only protects the firebars from the blast action of the tar jet, but also facilitates the consumption of smoke.

The power-plant running costs per unit taken from the actual cost sheets for six months in 1918, including 10 per cent. on the capital outlay, and including credit for the sale of sulphate of ammonia and debiting cost of sulphuric acid with the average prices per ton respectively of coal, £1 8s. 11d.; sulphuric acid, £4 13s., sulphate of ammonia, £17 2s.; were as follows: Units from switchboard, 1,834,375; fuel, 0.166d.; lubrication, 0.058d.; supervision and labour, 0.159d.; repairs, 0.13d.; charges on capital, 10 per cent., 0.207d.; total, 0.72d.; load factor, 73.6 per cent.

Since the system of forced lubrication was altered the consumption of oil for lubrication on the gas engines has been reduced by 46 per cent. The costs include the value of the electricity used in running the gas plant and auxiliaries which, during six months, amounted to approximately 8.5 per cent. of the units generated. As, however, only about 42 per cent. of the gas made was used for the gas engines the actual amount of power required for auxiliaries represents only 3.6 per cent. of the electricity that would be generated if all the gas were used for that purpose. The cost of the fuel if the above debit had not been made would be 0.160d. per unit, a difference of 0.006d. or 3.6 per cent.

Fig. 3 shows the air and gas temperatures and pressures at important points from the blower through the producers to the gas leaving the works. As far as possible the gas pressures, both positive and negative, are kept low. The greatest variation is before and after the centrifugal blowers. This cannot be avoided if the gas is to be delivered at a reasonable pressure to the works. The disadvantage of keeping the pressures always above atmosphere is the increased pressure at the producer and washers which leads to loss of gas due to leakage, also some discomfort for the men working the plant.

After all that has been heard recently concerning the efficiency of electric power stations it is interesting to compare the figures with those of Messrs. Hoffmann's plant which, for the six months' period quoted above (Table I), consumed 1.51 lb. of coal per unit and showed a thermal efficiency of 19.9 per cent. on the units delivered to the feeders.

[Figs. 4 to 9 are reproductions of lantern slides, for the use of which we are indebted to the author's courtesy.—Eds. Elec. Rev.]

REVIEWS.

Industrial Electrical Measuring Instruments. By Kenelm Edgcumbe. London: Constable & Co., Ltd. Pp. xvi+414, 260 figs. 1918. Price 16s. net.

Major Edgcumbe deserves our thanks for having revised his excellent book on measuring instruments at a time when it must have been extremely difficult to find the necessary leisure, and his apologies for having allowed the book to remain out of print for some time are unnecessary. The revision, moreover, has been thorough, for the book has been practically rewritten, and has been brought quite up to date.

The introductory chapter, although it occupies only a few pages, will be found of considerable utility to the user of electrical instruments; its definitions will help to clear up some frequent confusions of terms, and the summary of the various sources of error, distinguishing those inherent in the instrument from those due to external causes, and the distinction drawn between sensibility and accuracy are clear and to the point. The chapter on constructional details opens with a description of cases and scales, incidentally calling attention to the inaccuracy of edgewise instruments due to parallax errors, a disadvantage the degree of which is frequently overlooked. Among other details in this section are a reminder that ammeters can be scaled with concentric lines to read directly in watts over a range of voltages, and a receipt for radium paint, culled from the *Proceedings* of the Physical Society. Useful data with regard to the construction and design of control springs and pivots follow, and a discussion of the most suitable degree of damping. The considerations to be borne in mind in the design of ammeter shunts are explained, and several pages are devoted to the design of magnets and the calculation of windings. To the instrument maker this portion of the book, dealing with constructional details, will be more of service in "fixing his ideas" than in giving actual new points in design, especially as the illustrations are diagrammatic and not scale drawings; but the instrument user will obtain precisely the information which will be of most service to him.

A short résumé of methods of resistance measurement leads up to brief descriptions of the various commercial forms of ohmmeter, and the principles upon which potentiometers are based are next clearly indicated. A few more details as to the actual construction of potentiometers would have been welcome, and particularly of the "deflectional" potentiometer and the Drysdale A.C. potentiometer. These pages and the very short descriptions of standard cells and galvanometers are evidently regarded by the author more or less as a digression from his main subject, and he returns to a more complete treatment of the problems involved in the design and construction of moving iron and moving coil ammeters and voltmeters. In the course of this, two popular fallacies are corrected: An "open" scale merely enables a more exact reading to be taken at the particular part of the range, but does *not* increase the intrinsic accuracy of the instrument, and similarly the very long-scale instrument (originally introduced by Davies and more recently revived by Record), although it has the merit of convenience for many purposes, may even result in decreased accuracy owing to increased travel of the moving system for a given change in torque. The author is perhaps too severe, however, in characterising the advantage of a long scale as "sentimental rather than actual."

The chapters on induction instruments, power measurement, and instrument transformers have been enlarged in the present edition, and bring together a mass of information that has hitherto only existed in a very scattered form. They are among the most useful portions of the book. Electrostatic voltmeters, frequency meters, phase indicators, and synchronisers all receive their full share of treatment; there is a good chapter on pyrometers, as in the first edition, and recording instruments have, of course, always been a subject of special interest to the author. He has, however, felt compelled to call these "graphic instruments" or "graphers," because the Americans will insist on calling integrating meters recording wattmeters.

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In spite of the length of this review, it has been impossible to deal with all the contents of Major Edgcumbe's excellent book. It should be in every electrical engineer's library, and it is safe to say that, once there, it will be one of the volumes most frequently referred to. The arrangement of the matter, with only section headings and no chapter headings, is rather bewildering at first; but, on closer acquaintance, it possesses a peculiar fascination, resulting in a longer incursion into the book upon each occasion it is referred to than would have been the case if the usual stereotyped method of capitulation had been adopted.

Efficient Boiler Management. With notes on the operation of reheating furnaces. By Charles F. Wade, A.M.I.E.E. Pp. xxiii+266 and 143 figs. London: Longmans, Green and Co., 1919. Price 12s. 6d. net.

At a time when economy of coal is of such great importance, a book with the above title enters the field of technical literature with a strong disposition in its favour. Yet, if one were to be asked exactly what information he would expect from such a book, his answer would probably be somewhat wide of the mark in describing the principal contents of the present volume. The book in question is mainly a collection of brief descriptions of almost every kind of apparatus and equipment connected with the boiler room, and there is much less directly useful information bearing upon the art of getting the best operating results from steam boilers than one might reasonably anticipate from the title.

There are indeed about 27 pages at the end of the book which are devoted to matters more directly pertaining to the organisation and management of boiler plant, but even here the author confines himself very largely to generalities. He gives no hint, for example, as to how much coal a fireman may reasonably be expected to handle per shift, or how many men of various trades and occupations are necessary for the operation and maintenance of any given boiler plant. He mentions the possibility of a bonus system apparently with approval, but his discussion of the subject could not be in the least degree helpful to anyone desirous of establishing such a scheme; in fact it would rather tend to dissuade him from the attempt. However, considering the book as we find it and not as we might have expected or hoped it to be from the title, it forms by no means a bad guide as to what kinds of apparatus are in general use in a modern boiler plant. There are certainly some serious omissions, and at times one might question the author's choice of the apparatus he has selected for description, although it is hardly to be expected that all engineers should see eye to eye in what they consider the best examples of modern practice.

The book opens with a chapter on coal and calorimetry. Although the properties of fuels are only briefly sketched, it is somewhat surprising to see the analyses of peat and lignite both given without any indication of the percentage of water which these fuels contain. Lignites, for example, even when to the eye they look like really good coal, contain anything from 20 to 30 per cent. of water, which is a serious matter for those who have either to pay for them or to burn them efficiently. Peat, of course, is worse. Again in the chapter on calorimetry, the author appears entirely to neglect to mention the necessary corrections for moisture, or for the effect of the volatile hydro-carbons, and he treats the "higher" calorific value as if it were a true measure of the heating value of the coal as fired. There are many other features in the book which are also open to criticism, on the ground that they would be misleading to engineers who might look to the work for guidance in selecting equipment. For example, writing of feed-water meters, the author says, "Where measurement on the suction is not possible or convenient the Venturi meter should be adopted." In the first place, there are plenty of reliable positive water meters such as the Kennedy, or Kent's "Uniform," which work perfectly on the pressure side of the feed pumps, and in the second place, when the pumps are of the recip- type, a Venturi is certainly not advisable. The very serious inaccuracy inherent in a Venturi meter when measuring a pulsating flow is not even hinted at by the author, although the error may be over 20 per cent., or far more than enough to condemn the type for the conditions referred to. Again, in dealing with water softening plant, the book tells us that "The Permutit filter . . . has a very valuable feature which should not be lost sight of. As the water, after treatment . . . is perfectly pure, the boilers do not need to be blown down." An equally emphatic statement to the same effect also appears on another page. This idea, of course, is entirely wrong. The action of the zeolites is merely to replace the lime salts in the water by sodium salts, which are highly soluble. The water, after treatment, is anything but pure, being in fact more highly charged with salts than it is after the usual lime and soda process. Blowing down, therefore, is more necessary than less. As simple tests for feed-water, the author mentions the use of phenolphthalein and methyl orange as indicators of alkalinity, but we fear that any uninitiated person attempting to use these reagents as a guide to the operation of his softener would find his description of their functions hopelessly inadequate. In fact, we find no information at all as to the proper management of a water softener, and even the fundamental criterion of the hardness of water, namely, the soap test, does not seem to be referred to.

The impossibility of getting the most economical results from a boiler plant, unless it is equipped with proper measuring apparatus, so that its daily performance may be known, is quite properly emphasised. This point is fundamental to efficient control of the conditions of operation, for without means of measurement the operator is working in the dark as to his results. Yet we cannot find anything in the present book relating to methods of keeping a check upon the quantity of fuel burnt. A reader would not know that such things as automatic coal scales, or other devices for the same purpose, even existed; in fact, in the model log sheet put forward as an example of what daily records should be kept, the "estimated coal consumption" is all that is recorded, although on the same sheet the engineer in charge is expected to vouch for the specific heat and average moisture of the steam and other useless *minutiæ*. Consistently with his expressed desire for exact measurements, the author advocates the use of steam meters, and in this also we agree with him. He selects for illustration, however, two instruments only, one merely a flow indicator and the other a graphic recorder. The most useful type of all, namely, the integrating meter, is not alluded to, though one would have expected some reference to the highly accurate mercury-free designs of Messrs. Kent.

What the book needs, in order to be a really useful volume, is a thorough revision, which would correct such errors as we have pointed out, and give a better balance to the apparatus described. Much of the descriptive matter suggests the condensation of catalogue information rather than the outcome of the author's own experience. Again, in other sections we continually look in vain for practical information on points of everyday interest. What, for example, is the relationship between the evaporative efficiencies of a boiler at full, half, and quarter load? At what reduction of load does it pay to bank some of the boilers? How frequently, and to what extent, is blowing down necessary? How is one to know whether lime and soda are being supplied to the softener in proper quantities and proportions? How long should water require for treatment in a softener? What percentage of combustible matter in the ashes is the lowest practical limit? What percentage of CO_2 should be aimed at? In view of the fact that several CO_2 recorders, not to mention the Orsat apparatus, are described in the book, one can hardly take the author seriously when he states that "In order to find out definitely whether the air supply is sufficient it is first necessary to ascertain the pounds of coal burnt on the grate per hour," and when he goes on to describe the method of measuring the air supply by means of an anemometer, and comparing the results with the amount deduced theoretically from the chemical composition of the coal, one is lost in wonder.

The book is well indexed and printed, but the great majority of the illustrations are only too familiar to those conversant with engineering catalogues. With all its errors and imperfections, however, we welcome the book as an endeavour to promote greater efficiency in the really important end of a power plant.

Germany's Export Price Policy.—A letter written by a German-Swiss to a Hamburg firm is made the text of an article in the *Hamburgische Boersen Halle*. The article was considered of sufficient interest to be published separately as a broad sheet. The letter stated that it was impossible to do business with German firms so long as they adhere to their curious "Zuschlagklausel" (a clause added to all delivery contracts stating that the manufacturer reserves to himself the right of adding to the sale price, on the date of invoice, such additional sums as may result from increases in the price of raw materials, wages, &c.). The article affirms that no buyer can be expected to purchase at an uncertain price, and warns manufacturers against a continuation of this policy, advocating instead an original extra charge high enough to cover the risk of price fluctuations over a sufficient period. The consequence of the present policy is that the German business man is becoming discredited not only in Finland, but also in Scandinavia and other neutral countries. Another impediment to trade with Germany lies in the fact that German business men now demand payment for their goods in the currency of the country to which the goods are to be sent, showing that they have lost confidence in their own currency which is depreciated to such an extent that it tends to disappear altogether from foreign markets. His Majesty's Commercial Commissioner at Berlin, in reporting to the Department of Overseas Trade the foregoing, remarks that: "There is no doubt that the German export merchant is being heavily penalised by the manufacturers' prevailing methods of conducting business." Considerable irritation exists among the merchanting fraternity caused by the system in use for the granting of export permits, and some light is thrown on the difficulties under which the merchant works, in a communication issued by the Spanish Ambassador at Berlin, and published in the Spanish Press, containing a warning against the conclusion of contracts with German houses, or their representatives in Spain, unless the export permit for the goods concerned is shown together with the offer.

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NEW PATENTS APPLIED FOR, 1920.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. Sefton-Jones, O'Dell and Stephens, Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

5,173. "Transmitters for electrical recorders." J. S. Wilson (A. B. Buckley). February 20th.

5,178. "Switch and means for locking same for ignition circuit of internal-combustion engines, &c." W. Hawlett. February 20th.

5,190. "Electric immersion heaters." C. G. Nobbs and W. W. Nobbs. February 20th.

5,192. "Sherardising drums." S. O. Cowper-Coles. February 20th.

5,208. "Electric door-opening device." F. Gerbsch and H. Knispel. February 20th.

5,216. "Magnetically-operated apparatus and method of applying same." C. O. Bastian and C. E. Hunter. February 20th.

5,233. "Electric circuit-controllers." R. Amberton. February 20th.

5,244. "Methods of synchronising several variable-speed electric motors." J. Bethenod. February 21st.

5,258. "Flexible insulators for electric wires, cables, &c." E. D. M. Scrivener and Taylor, Tunnicliff & Co. February 21st.

5,270. "Sparking plugs." J. E. Barrows. February 21st.

5,271. "Sparking plugs." W. E. C. Meeke. February 21st.

5,297. "High-tension electric cables." P. Dunsheath, C. Grover and W. T. Henley's Telegraph Works Co. February 21st.

5,298 "Electric fuse-carriers." W. T. Henley's Telegraph Works Co. and W. H. Nichols. February 21st.

5,301. "Dynamo-electric machines." C. A. Vandervell & Co. and A. H. Midgley. February 21st.

5,310. "Dynamo-electric machines." E. J. Harman and E. Le Bas. February 21st.

6,117. "Electric trackless tramcars, &c." G. A. Bishop and R. A Chadwick. March 1st.

6,142. "Contact-breakers for magneto-electric, &c., machines." H. Smith. March 1st.

6,150. "Electric switches." W. J. Line and J. H. Tucker & Co. March 1st.

6,180. "Electric heaters, fires, &c." C. G. Nobbs and M. J. Railing. March 1st.

6,195. "Sparking plugs." E. Pethoud. March 1st. (Switzerland, October 6th, 1919.)

6,196. "Electric frequency indicating and measuring instruments." British Thomson-Houston Co. and R. C. Clinker. March 1st.

6,198. "Automatic selective telephone system." R. C. M. Hastings. March 1st.

6,199. "Automatic selective telephony." R. C. M. Hastings. March 1st.

6,221. "Dynamo-electric machines." A. B. Field and The Metropolitan-Vickers Electrical Co. March 1st.

6,222. "Dry batteries." Burgess Battery Co. March 1st. (United States, March 13th, 1919.)

6,228. "Controllers for electric circuits." Igranic Electric Co. (Cutler Hammer Manufacturing Co.). March 1st.

6,229. "Electro-magnetic brakes." Igranic Electric Co. (Cutler Hammer Manufacturing Co.). March 1st.

6,249. "Electric cables." E. A. Bayles and The British Insulated & Helsby Cables, Ltd. March 2nd.

6,250. "Ironclad electric switches and switch fuses." R. T. Norton. March 2nd.

6,257. "Fittings for holding incandescent electric lamps." W. H. Bayley, J. T. Taylor and G. A. Taylor. March 2nd.

6,267. "Electrolytic cells." E. A. Le Sueur. March 2nd.

6,272. "Dynamo-electric generators and motors." E. Small and W. S. Smith. March 2nd.

6,303. "Mode of cementing electric conductors with non-conductors." A. F. E. Bultemann. March 2nd.

6,318. "Call-signals arrangement for field telephones, &c." Siemens & Halske Akt. Ges. March 2nd. (Germany, March 4th, 1916.)

6,344. "Dynamo-electric machines." E. Ferat. March 2nd. (France, February 6th, 1918.)

6,345. "Dynamo-electric machines." E. Ferat. March 2nd (France, October 15th, 1919.)

6,346. "Magnetos." E. Ferat March 2nd (France, January 14th, 1918.)

6,347. "Magnetos." E. Ferat. March 2nd. (France, February 18th, 1918.)

6,359. "Circuit-continuing devices." H. A. Douglas. March 2nd.

6,369. "Incandescent lamps." F. A. Feldkamp. March 2nd.

6,400. "Renewal of incandescent electric lamps." J. J. Russell. March 2nd.

6,403. "Electro-magnetic controlled lock system." W. G. Grieve and F. H. C. Offord. March 3rd.

6,414. "Sparking plugs." A. Ogden. March 3rd.

6,419. "Device for testing sparking plugs." H. Fell and E. H. Mitchell. March 3rd.

6,449. "Sparking plugs." J. E. Barrows. March 3rd.

6,480. "Interlocking device for electric switches." E. J. Brothers. March 3rd.

6,492. "Electrical instruments." E. W. Hill and G. F. Shotter. March 3rd.

6,504. "Brush holders for electric dynamos and motors, &c." A. Armstrong. March 3rd.

6,542 "Battery-charging systems." Automatic Telephone Manufacturing Co. March 3rd. (United States, June 11th, 1919.)

6,543. "Code-signalling systems." Automatic Telephone Manufacturing Co. March 3rd. (United States, June 30th, 1919.)

6,554. "Ignition systems for internal-combustion engines." S. L. Groom and C. G. Pullin. March 3rd.

6,569 "Magneto brackets and attachments for motor cars, tractors, &c." B. Shaw. March 4th.

6,587. "Electrical clinometer." J. S. G. Thomas. March 4th

6,591. "Telephone systems." Automatic Telephone Manufacturing Co and J. Savin. March 4th.

6,639. "Regulating dynamo-electric machines." British Thomson-Houston Co and N. Shuttleworth. March 4th.

6,646. "Electrical measuring instruments." W. Clark and Clark's Neo-Electric Devices, Ltd. March 4th.

6,654. "Galvanic batteries." G. Oldham, J. Oldham, O. Oldham and Oldham & Son. March 4th.

6,656. "Automatic or semi-automatic telephone systems." British L.M. Ericsson Manufacturing Co. and D. C. Crowe. March 4th.

6,658. "Wireless telegraphy." A. G. T. Cusins, A. C. Fuller and P. M. H. Lemon. March 4th.

6,661. "Sparking plugs." B. Hopps and A. M. Lodge. March 4th.

6,667. "Air-cooling arrangement for electric generator set driven by internal-combustion engine." R. Bosch Akt. Ges. March 4th. (Germany, August 9th, 1915.)

6,678. "Electric control of tipping-gear upon vehicles." E. H. Dine, P. P. Smith and F. R. Stocks. March 4th.

6,693. "Metal contacts for electrical apparatus." M. S. Conner and S. Lyttlemore. March 5th.

6,739. "Electric radiator." C. H. Verity. March 5th.

6,751. "Case for battery of ear phone." W. H. Briggs, G. Gill and Gill, Briggs & Gill. March 5th.

6,762. "Flow meters." British Thomson-Houston Co. (General Electric Co., U.S.A.). March 5th.

6,773. "Electric condensers." L. Segal. March 5th. (France, July 6th, 1919.)

6,780. "Electro-thermal absorber generator for separation processes." F. C. Sutton. March 5th.

6,800. "Sparking plugs." V. Bonde. March 5th. (France, December 20th, 1917.)

6,824. "Distribution with alternating electric currents." A. M. Taylor. March 6th.

6,832. "Electrical signalling apparatus." F. W. Baynes and Mechanical Supplies, Ltd. March 6th.

6,851. "Process for sherardising." S. O. Cowper-Coles. March 6th.

6,855. "Automatic telephone systems." Automatic Telephone Manufacturing Co., W. R. Carter and R. Mercer. March 6th.

6,856. "Arrangements for detecting and utilising vibratory movements." Automatic Telephone Manufacturing Co. and S. R. Smith. March 6th.

6,874. "Control valves." British Thomson-Houston Co. March 6th.

6,900. "Reception of signals by wireless telegraphy." E. C. Atkinson. March 6th.

6,907. "Apparatus for electrically-driven submarines." Siemens-Schuckertwerke. March 6th. (Germany, December 5th, 1914.)

6,914. "Electric condensers." L. Segal. March 6th. (France August 14th, 1919.)

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1918.

13,080. Distribution of electrical energy. W. T. Henley's Telegraph Works Co. and C. Grover. August 12th, 1918. (138,377.)

17,120. Automatic alarm devices for use with vacuum tube relays. M. Latour. October 4th, 1917. (138,383.)

18,046. Telegraphy. T. B. Dixon. November 1st, 1917. (120,899.)

1919.

1,343. Protective gear for alternating electric current generators. British Thomson-Houston Co. and R. M. Wilson. January 18th, 1919. (138,675.)

1,731. Electrolytic cells. H. W. Matheson. January 23rd, 1919. (138,406.)

3,537. Apparatus for indicating the amount of electric current passing through a network box link and the like. A. F. M. Gatrill. February 13th, 1919. (138,430.)

3,725. Magneto-electric lighting sets for cycles and the like. L. Rosengart. December 21st, 1919. (136,848.)

3,888. Automatic indicator of failing electric current. F. Hope-Jones and Synchronome Co. February 17th, 1919. (138,708.)

3,977. Electric cut-outs for circuit breakers. W. H. Illingworth. February 18th, 1919. (138,439.)

4,196. Method and means for connecting span wires and fittings for the suspension of conductor or trolley wires in overhead wire systems of electric traction. Brecknell, Munro & Rogers and A. M. Willis. February 20th, 1919. (138,441.)

4,811. Fittings for electric and other lamps. W. Harrison and E. H. R. W. Eyre. February 26th, 1919. (138,447.)

4,887. Automatic electric control apparatus. S. H. Adams. February 27th, 1919. (138,721.)

4,970. Production of tone currents for telephone circuits. Siemens Bros. & Co. and W. H. Grinsted. February 27th, 1919. (138,723.)

5,494. Electric adaptors for lighting and other purposes. Benjamin Electric, Ltd., and G. Campbell. March 5th, 1919 (138,728.)

5,706. Electric storage cells. C. J. V. Fery. April 30th, 1917. (124,211.)

6,001. Transmission gear and bracket for the magnetos of motor vehicles. T. R. R. Chilcott. March 11th, 1919. (138,460.)

6,838. Electric power steering-gear for ships or other vessels. I. Reid. March 19th, 1919. (138,744.)

6,951. Methods of and apparatus for producing vacua. Western Electric Co. March 20th, 1919. (138,745.)

7,781. Electrically-driven rotary pumps. Drysdale & Co., J. W. W. Drysdale and J. Young. March 28th, 1919. (138,753.)

8,213. Electrical time switches. E. Schattner. April 1st, 1919. (138,756.)

8,551. Drain devices for electric storage batteries. P. D. Ivey and A. J. Salisbury. April 4th, 1919. (138,488.)

10,066. Electric storage battery cells. P. D. Ivey and A. J. Salisbury. April 22nd, 1919. (138,773.)

13,362. Telephone systems. W. J. Mellersh-Jackson. (International Callephone Corporation.) May 27th, 1919. (138,350.)

14,761. Electric insulators. H. Lutz. June 11th, 1919. (138,539.)

16,635. Electric indicating-devices to be used on taxi-cabs and the like. H. Richardson and E. H. Palmer. July 3rd, 1919. (138,807.)

16,600. Telephone exchanges. Siemens Bros. & Co. and T. Pettigrew. July 2nd, 1919. (138,544.)

17,211. Electric incandescent lamps. Siemens & Halske Akt. Ges. December 29th, 1916. (112,264.)

17,528. Subaqueous sound diaphragm mechanism. W. J. Mellersh-Jackson (Submarine Signal Co.) July 12th, 1919. (138,550.)

19,182 Shades or reflectors for electric lamps. T. Phillips and J. W. Lea. August 2nd, 1919. (138,558.)

19,250. Electric fusible cut-outs. L. Stewart and A. N. Penman. August 5th, 1919. (138,559.)

19,493. Magneto-electric pocket lamp. M. A. Pattay and E. Juquemot. August 7th, 1918. (130,996.)

21,053. Sparking plugs. B. D. Bellamy and Suburban Motors, Ltd. August 27th, 1919. (138,825.)

21,358. Galvanometers and like measuring instruments. L. Johnson. August 29th, 1919. (138,826.)

23,978. Contact breakers for high-tension magnetos. A. Anzani. October 9th, 1918. (133,678.)

25,430. Regulators for dynamo-electric machines. A. Courtiade. July 18th, 1916. (133,967.)

25,948. Electric excess current indicators. E. Schattner. April 1st, 1919. (Divided application on 138,756.) (138,835.)

26,699. Electric valve amplifiers. Siemens & Halske Akt. Ges. May 22nd, 1918. (134,832.)

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THE

ELECTRICAL REVIEW.

VOL. LXXXVI. MARCH 26, 1920. No. 2,209.

ELECTRICAL REVIEW.

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THE ELECTRIC LAMP REPORT.

THE Report to the Standing Committee on Trusts regarding the manufacture of electric lamps, of which we commence a reprint in this issue, is a remarkable document, and contains much information of great interest to the electrical industry. Although the members of the Sub-Committee which carried out the inquiry are practically unknown in electrical circles, they appear to have acquired a thorough grasp of the subject, and while the Report is not free from mistakes, it is on the whole a very able, impartial, and judicial pronouncement.

The word "Trust" in the sense of a commercial alliance has somewhat unsavoury associations, and is often used by the Press—especially that section of it which has a Socialistic complexion—as a term of reproach or abuse. "Call a dog by a bad name—and hang him." Its evil reputation comes from the other side of the Atlantic, where Trusts of undoubtedly shady character have flourished in the past, battening on the vitals of the public, so that at last even the United States Government has been compelled to bring them under State control; but not all Trusts are malevolent and harmful to the public welfare, and we should not allow our minds to be swayed or our judgment distorted by the suggestion conveyed in the name of the Committee.

Let us then examine the Report and the conclusions of the Sub-Committee with an open and unprejudiced mind. First, it is interesting to note that the word "trust" is not used, the alternative expression in the terms of reference "trade combination" being employed. The power imputed to this body as regards 90 to 95 per cent. of the lamp industry will not be disputed; neither will it be denied that the operations of the Association have maintained prices to the public at a higher level than would have resulted from unrestrained competition. It is alleged that the trading discounts granted to distributors are unduly high, and that the prices of the lamps could be reduced by one-third while leaving the makers and dealers a satisfactory profit. The charge is made that lamps bought in Holland, which could have been sold here at 8s. each with a substantial profit, were sold to the public at 12s. 6d., the lamp trade thus netting £280,000 in excess of a reasonable profit. The three licensor firms are charged with imposing upon other firms in the combination an undesirable restriction upon output, and the observance of patents which have been quashed in the Courts. The Sub-Committee sees a risk of the British lamp industry being subordinated to American or international control, and calls for the institution of national control in the hands of a Department of State. Thus the Report ranges from criticism to indictment, from statements of fact to proposals for legislation.

In pre-war times we often lamented the fact that the prices obtained for electrical manufactures in this country were inadequate to provide that reasonable margin for

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research and development, without which it was impossible for the industry to keep pace with the progress of its more fortunate competitors in foreign countries. We cannot, therefore—nor do we wish to do so—reproach the manufacturers for adopting the only means at their disposal for attaining this end, provided, of course, that the margin *is* a reasonable one. Further, we have consistently supported the claims of traders to recognition by the manufacturing firms in the shape of trade discounts which are withheld from the general public; and we have maintained the unquestionable right of the inventor and patentee to the just reward of his labour and ingenuity. All these points are involved in the question of price maintenance, and all of them, we believe, will command the approval of our readers. But the question is raised whether, in this case, the various margins of profit are in due proportion, and of reasonable dimensions.

In the space at our disposal we cannot discuss the matter at length; briefly, we hold that, while the manufacturers certainly erred on the safe side in pre-war days, and might well have reduced their selling price to the trade, the fact that that price to-day remains almost the same, although the value of money has fallen to less than half the pre-war standard, indicates that, relatively to other commodities, the price of lamps to the trade has fallen to a value which is no longer unreasonably inflated. It should be borne in mind that patent rights are of limited duration, and are liable at any moment to become valueless owing to the introduction of improved methods. How much the associated firms have spent on research in this connection, we do not know, but it is within our knowledge that the equipment of the largest factory in this country was scrapped repeatedly in pre-war years, and the British patent rights were acquired at a heavy cost. So much for the manufacturers' position; the case of the distributors is on a different footing altogether. They run no great risk of patents being quashed or superseded, they incur no outlay for patent rights or for research, they have no plant to become obsolete—they are purely middlemen, and the bigger they are, under the Association system, the bigger are their profits and the easier their functions. While we adhere to the doctrine of trade discounts, we feel that in the lamp trade the rates of discount have been inordinately and quite unnecessarily high. We see no reason why a dealer in a large way should be in a position to pocket from 1s. 2d. to 1s. 6d. per lamp—more than the net cost of manufacture! In the case of bicycles, typewriters, &c., it is notorious that similar conditions have obtained, but the circumstances have been very different, and we believe, with the Sub-Committee, that the price to the public should have been greatly lowered, together with the trade discounts.

The statement that the importers and distributors of Dutch half-watt lamps during the war made a profit of £280,000 in excess of a reasonable value is generally regarded as the most serious and damaging item in the Report. These lamps could not be made in this country at the time, and therefore were imported under licence of the Board of Trade. The Sub-Committee has assumed that the difference between the list price of the most popular size of half-watt lamps and the price at which it could have been put on the market (12s. 6d., less 8s.) represents the "excess profit" per lamp that actually accrued to the trade, but we understand that the vast majority of these lamps —80 to 90 per cent.—were supplied to Government departments and controlled firms at a price in the neighbourhood of 8s., and that not 5 per cent. of them were sold at 12s. 6d., so that the sum named is at least £250,000 in excess of the true profit. The reason for listing the lamps at a high figure is admitted in the Report—namely, that the British lamp makers, who intended to manufacture the lamps themselves as soon as circumstances permitted, could not be expected to encourage the sale of the imported article to the public. As a matter of fact, they obtained the machinery for making argon gas from the Dutch firm at a heavy cost and under onerous conditions, after protracted negotiations, and commenced the manufacture as soon as possible, at the same time lowering the list price of the lamps.

The reproach that the three licensing firms imposed restrictions upon the output of the firms that they admitted to the Association must be considered in the light of the fact that they were under no obligation to issue licences at all, provided that they themselves were able to cope with the demand for vacuum lamps. The alternative course would have resulted in putting the seven British companies out of business altogether, a consequence which could only be regarded as highly undesirable. By enabling these companies to continue in operation, with the benefit of the information derived from research, and to increase their output at a moderate pace, whilst paying royalties which could not be called excessive, the Association unquestionably acted in the interests of British industry. But the second item in this charge—that the Association took advantage of its position to compel the licensees to treat invalid patents as though they continued in force—bears a different aspect. Besides its injurious effect upon a British firm of tungsten wire makers, it constituted a wholly unwarranted extension of a monopoly which was no longer justified by letters patent, and established a principle which might be extended without limit—namely, that any material that the Association chose to specify must be purchased from a member of the Association, at, of course, any price that the member chose to name. This is a proceeding which we regard as reprehensible and contrary to the interests of British industry.

The last paragraph of the Report is the only one that embodies a definite recommendation—namely, that trade combinations should be brought under the control of a Department of State. Viewing the question broadly, as affecting all such combinations in all industries, we are disposed to agree with the Committee. As we have said above, not all "Trusts" are maleficent; but some undoubtedly are, and we believe that the establishment of some such controlling authority, while it would relieve the public mind and guard against abuses, would at the same time protect the beneficent type of Trust from unfounded charges.

In the present instance, while the inquiry was certainly justified by its results, and has brought to light the existence of practices which, in our opinion, ought to be discontinued, we do not feel that anything in the nature of a scandal has been revealed. The Report in various places commends the action of the Association; it points out that the price of lamps was prevented from rising as well as from falling, and it commends the Association for removing the restrictions on output of the licensees during the war. In many places it suggests undesirable things that the Association might do if it chose, whilst admitting that it did not so choose. It points out that the licensees' output for export was not restricted. It commends the Association for undertaking to supply bulbs and caps to all lamp makers without discrimination. It points out that without some combination the British lamp-making industry could not have held its own against foreign competition, and agrees that profits should be adequate to provide for research and experiment. In fact, the Report is far from being so condemnatory as the extracts selected by the daily Press would lead one to believe. We understand that one of the largest British works was about to be doubled in capacity when the war broke out, and that the extension is only now delayed by the dilatory methods of the building trades; when the new factory comes into operation, prices will be lowered. But for the fact that, before the gas-filled lamp was invented, the use of United States patents had been secured to this country by the formation of the Association, we should have been at the mercy of American manufacturers in respect of the half-watt lamp. New Westlake machines have been bought at an enormous price from the United States, and are now at work in the North, rendering this country independent of imported lamp bulbs. In two years, we are informed, prices will be reduced 40 per cent. owing to increased output; cheap lamps are essential to the development of the electric lighting industry, and the prospect of a material reduction in price will be generally welcomed.

We have no doubt that the Association will give careful consideration to the contents of the Report, and we hope that the undesirable methods to which we have drawn attention will be especially scrutinised, with a view to their modification or abolition.

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ELECTRIC POWER AT THE WORKS OF THE VAUXHALL MOTORS, LTD.

At the invitation of Messrs. Vauxhall Motors, Ltd., we recently paid a visit to the company's works at Luton to see the electrical equipment, which is described below. This concern is an offshoot of the Vauxhall Ironworks Co., of Wandsworth Road, London, which built the first Vauxhall car in 1903; two years later the company moved to Luton, and in 1907 Vauxhall Motors, Ltd., was formed as a separate company, to devote itself entirely to the manufacture of motor-cars. In the following year the Vauxhall car was the only one which passed through the 2,000-mile International Reliability Trial of the R.A.C. without losing a single point, and without replenishing water or lubricating oil, thus at once establishing its reputation as one of the finest cars of the time. Aided by exhaustive research at a heavy cost, the company rapidly improved its engines and chassis, and in 1910 a 20-H.P. Vauxhall car attained a speed above 100 M.P.H.—a record for that rating, which was followed by many other striking feats, including the winning of 80 first prizes and highest awards in 1913, a greater achievement than that of any other car. Then came the war, and the company's whole output was supplied to the Government, consisting entirely of 25-H.P. cars for staff use.

Important extensions became necessary, and the works were reorganised on the most modern lines, involving the use of electricity in a variety of applications—lighting, power, telephony, time service, and the heating of the offices—and we have no hesitation in describing the factory as a model of its kind, laid out and equipped on scientific lines and maintained in the highest degree of efficiency.

The workshops are of one storey, and are built with woodlined saw-tooth roofs for north lighting; they are provided with heating pipes overhead, a system which has proved thoroughly satisfactory. Owing to the adoption of the individual drive, the new machine shop, with which we are mainly concerned, is of light construction and moderate height, with comparatively few columns to carry the roof. "General" lighting has been carried out with semi-indirect fittings suspended from the roof, on a scale which renders the use of auxiliary lamps superfluous. Grinding and wood-working machines are provided with powerful exhaust fan draught to carry off dust and shavings. Perfect cleanliness and order are enforced in all departments—the floors are immaculately clean and tidy, stands are provided for workmen's hats and coats, and a large well-lighted mess-room adjoins the workshops.

To maintain the highest quality of the company's products, and to minimise waste of labour, an exceptionally complete system of inspection is in force. Every class of raw material is tested on delivery by chemical analysis and mechanical tests, well-equipped laboratories being provided for this purpose. Special attention is given to the heat treatment of steel, for which purpose electrical furnaces are admirably suited, and are therefore employed. The microscope plays a prominent part in these tests. After each

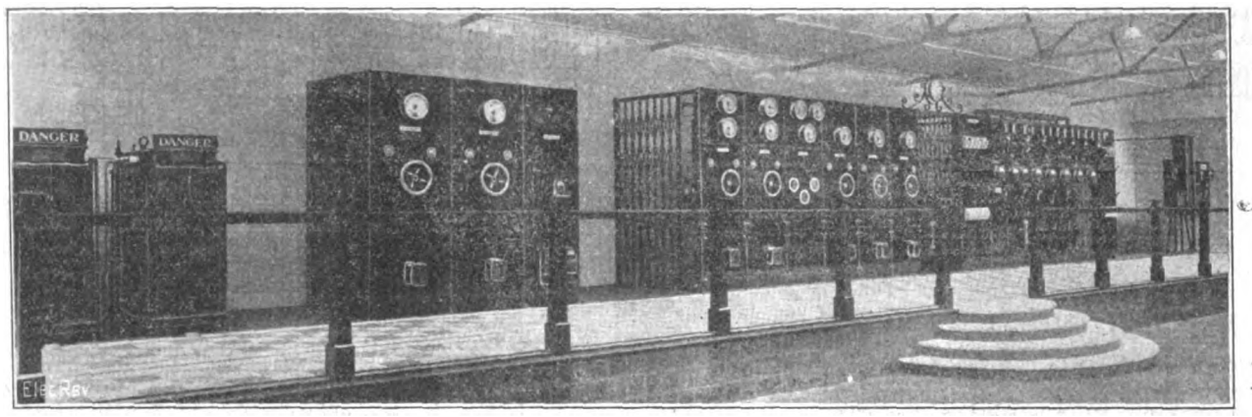

Fig. 1.—Transformers, Main Switchboard, and Time Control Board.

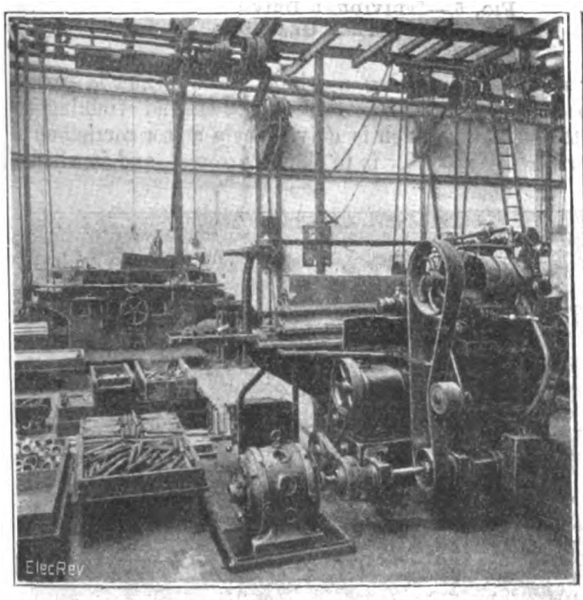

Fig. 2.—Grinders Driven Direct and by Belt.

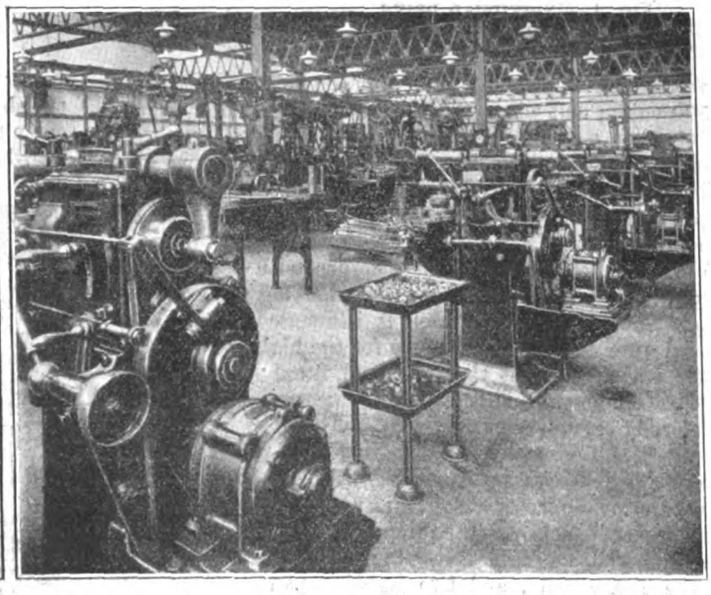

Fig. 3.—Milling Machines Driven by Geared Motors.

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machinery operation, each part passes through the viewing room before re-issue for the following operation, thus ensuring that hidden faults shall be detected at the earliest possible stage. The Newall system of limit gauges is in use, to obtain interchangeability, and jigs are used not only for the metal parts of the car, but also for the wooden parts of the car-body. By such means the greatest economy of time and labour is secured.

Like the Austin Motor works, whose power plant we recently described, the Vauxhall works were originally

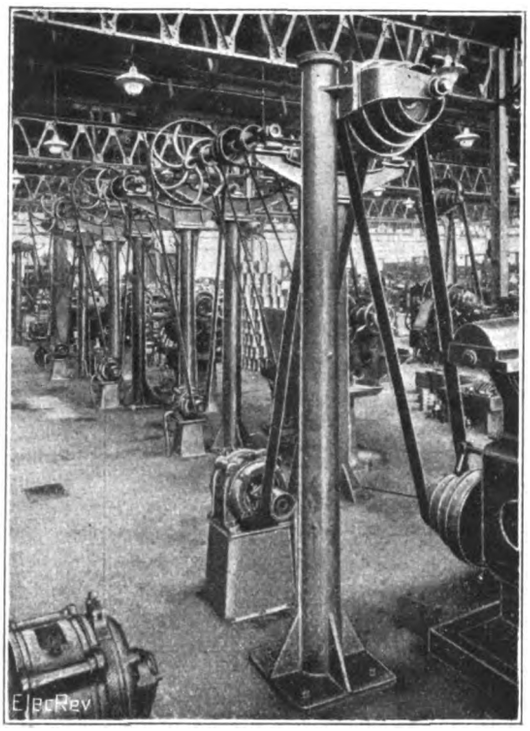

Fig. 4.—Individual drive with Countershafts.

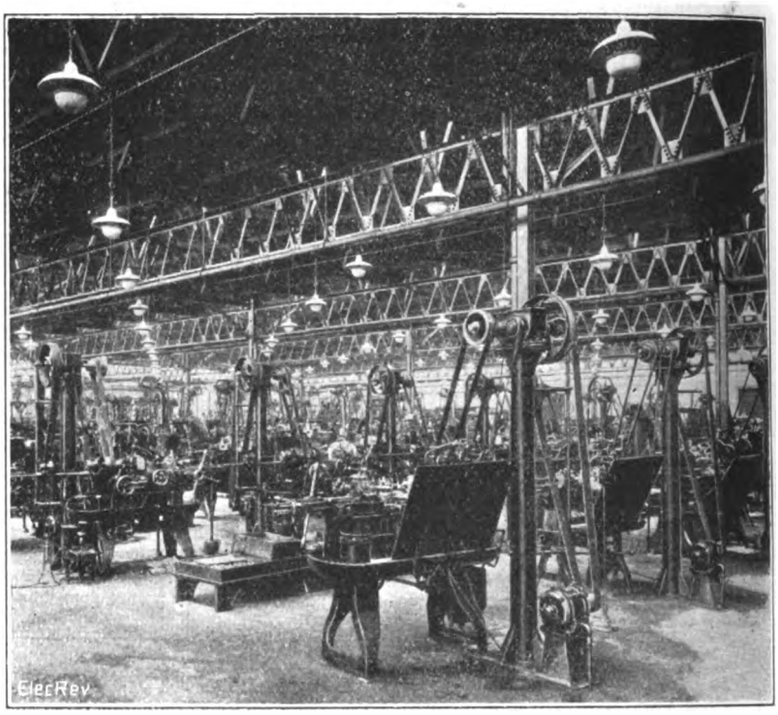

Fig. 5.—Individual Drive with Change-Speed Gear Fox.

driven by direct current, supplied by the Luton Corporation at 500 volts; but when the works were extended on the outbreak of war, the new shops were equipped for three-phase current, and at the same time the principle of individual motor drive was adopted. The sawmills, repair shops, and offices, are still supplied with direct current. The A.C. supply being given at 6,600 volts, transformers of 125 K.V.A. each were put in, together with a handsome switchboard, mounted on a dais overlooking the assembly shop. The switchboard, which is illustrated in fig. 1, is divided into three sections: one for the high-pressure side of the transformers at the left hand, fitted with oil-break switches, ammeters, and three supply meters; one with two transformer secondary panels, each equipped with a switch, voltmeter, and ammeter, a summation panel provided with ammeter (which can be connected with any phase), watt-meter, and power-factor meter, and an earth indicator, and three feeder panels each equipped with a switch and ammeter: and a section consisting of seven circuit panels for the D.C. supply, and two lighting panels. The A.C. switches are all fitted with time-element overload relays, and are mechanically operated by means of hand-wheels. The A.C. power supply is given at 440 volts, and the A.C. lighting circuits are fed through transformers at 250 volts. The transformers are oil-cooled, and were made by the Brush Electrical Engineering Co., Ltd., while the A.C. switchboard was supplied by Messrs. Johnson & Phillips, Ltd., and the D.C. board by Messrs. Bertram Thomas.

An additional transformer, of 250 K.V.A., is on order, and with the corresponding switchgear will fill up the whole space available. The D C. load, which includes a very heavy lighting load, amounts to 100-150 KW. The circuit-breakers on the main switchboard which control the office lighting are operated by push-buttons in the general office. The earth indicator consists of three lamps—red, green and yellow—connected between the three phases and earth, and is always in circuit; an earth on one phase causes the corresponding lamp to go out, whilst the other two brighten.

The assembly shop was originally used as a machine shop, and was built to carry shafting and a crane; the adoption of individual drive enabled a lighter construction to be used, with a lower roof, thus saving on capital cost. The belt-driven machines had to be adapted for individual drive, and the various methods adopted for this purpose are exceptionally interesting.

Fig. 2 is noteworthy, as showing contrasted the old and newer methods of driving a grinder; the former is seen in the background, with an elaborate overhead framing to carry the shafting, which is driven by a motor carried on a wall-bracket; the latter is in the foreground, and it will be

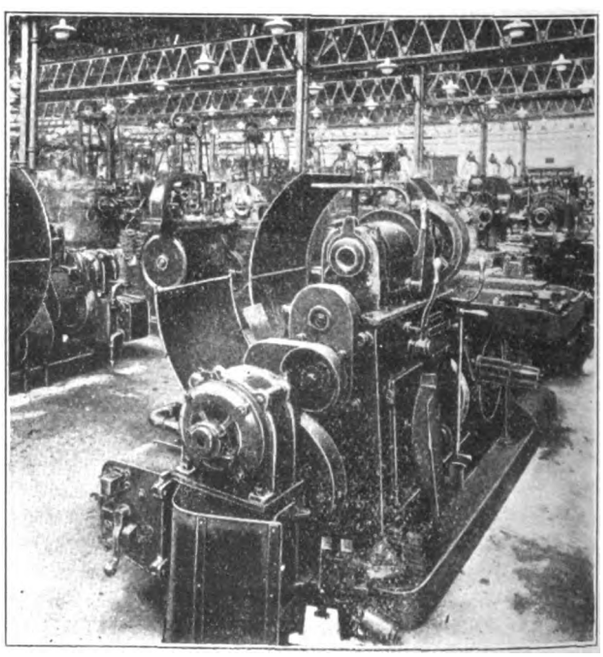

Fig. 6.—Automatic Lathes Direct Driven by Motors.

seen that the motor is fixed on the floor behind the grinder, the starter being attached to the frame of the machine. Fig. 3 shows a row of Parkson milling machines; here the 2-H.P. motor is mounted on the machine itself, and drives by spur gearing. Fig. 4, again, shows a totally different

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device; the 2-H.P. motor, fixed on a short pedestal, drives by belt two short countershafts mounted on the top of a column, from which the Archdale thread-milling machine is driven. In fig. 5 we have a variation of the last device; in this case two rows of Ward turret lathes have been adapted to individual drive by mounting a Vauxhall change-speed gear-box on the top of the column, as the intermediary between the 1-H.P. motor and the lathe, with belt drive.

A row of Potter & Johnson automatic lathes is seen in fig. 6, with 4-H.P. motors geared direct to the main shafts. There are 40 of these machines.

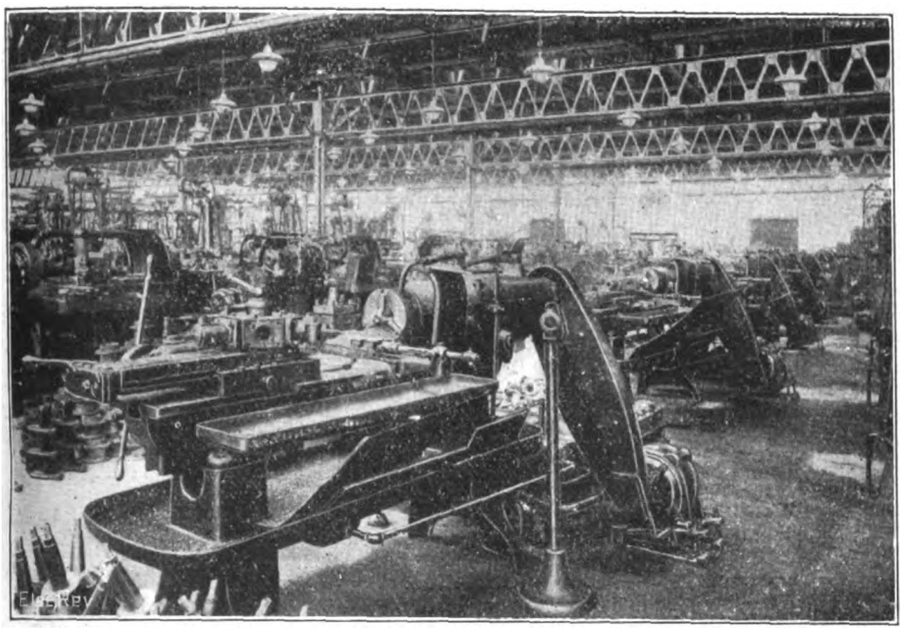

Fig. 7.—Capstan Lathes with Chain Drive.

Fig. 7 shows a range of Herbert capstan lathes driven by Renold chains, the 4-H.P. motors being fixed on the floor, with a device for tightening the chains, and adjusting the guard. Lastly, fig. 8 shows a neat method of arranging the chain and belt drive of a multiple-spindle drill.

Power is brought to the machines in a systematic way.

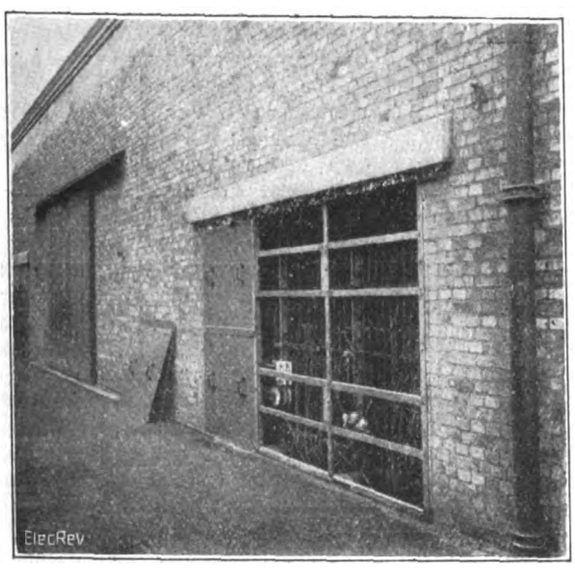

Fig. 9.—Back of Fuseboard.

Three 36-way distribution fuse-boards, by Messrs. Johnson and Phillips, are fixed at intervals in the end wall of the shop, which is about 14 in. thick; the back of the board is accessible from the exterior, as shown in fig. 9, on the removal of iron shutters—an extremely neat and convenient device, which at the same time reduces the space occupied to the minimum. A lighting transformer is housed in a pit in front of each board, and Key fibre ducts are carried from the boards along the end of the shop, and in parallel runs of four, tapering off to three and two, transversely to the shop, with hand-holes at frequent intervals, so that there is a hand-hole near every machine.

There are over 10 miles of cable under the floor of the machine shop; all the large machines are on separate circuits, and in addition to the fuses on the distribution boards, each motor is protected by overload relays and no-volt release coils on the larger sizes and triple-pole switch fuses on the smaller sizes.

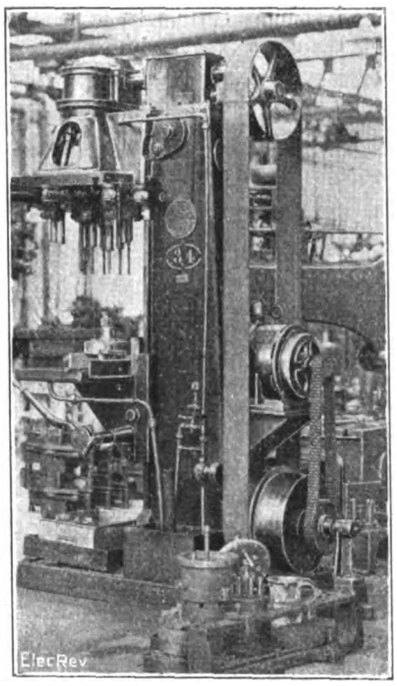

Fig. 8.—Chain and Belt-Driven Multiple Drill.

From the hand-hole a steel pipe is led to the starter, and is connected to the frame of the machine, as well as to an earthing wire in the ducts. No cable is exposed anywhere. The hand-holes are of concrete, and are covered with chequer plates. On each fuseboard is an earth indicator, like that on the main switchboard, by the aid of which a fault can be located and rectified before any serious trouble can develop. Any motor in the shop can be fed from either of the three distribution boards, thus enabling the load on each panel to be balanced. There are 270 motors, ranging from ½ H.P. to 20 H.P.; all from ½ to 4 H.P. are made by the British Thomson-Houston Co., Ltd; the 5-H.P. motors are by the British Westinghouse Co. (now Metropolitan-Vickers, Ltd.), and the larger sizes by Messrs. Crompton & Co., Ltd. Thus the number of spares to be stocked is kept down to the minimum. Motors up to 4 H.P. are switched directly on to the mains without any starter, and, if necessary, are reversed in the same way, without any pause. Above 4 H.P. star-delta starters are used, and for 15 and 20 H.P. auto-transformers are provided.

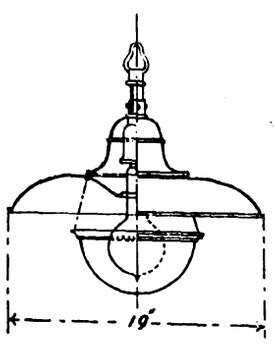

Fig. 10.—Part Sectional Drawing of G.E.C. Fitting.

As we have already mentioned, the lighting of these shops is carried out on a liberal scale, so that the same high degree of accuracy can be maintained as easily under artificial light as in daylight. In accordance with the recommendations of the Illuminating Engineering Department of the General Electric Co., Ltd., the degree of illumination varies in the different shops, according to the type of work done in each, and ranges from 4 to 7 ft.-

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candles; uniform illumination is aimed at throughout the whole area of each shop, eliminating shadows and dispensing with local lighting. The lamps used are 100-, 150- and 200-watt Osrams of the "Atmos" type, and the fitting is known as the G.E.C. FA 9360. It is illustrated in fig. 10, p. 389. There are in the machine shops 275 semi-indirect 200-watt lighting fittings. One-third of the lighting is supplied from each main distribution fuseboard, and there is a Tucker 30-ampere switch on every column con-

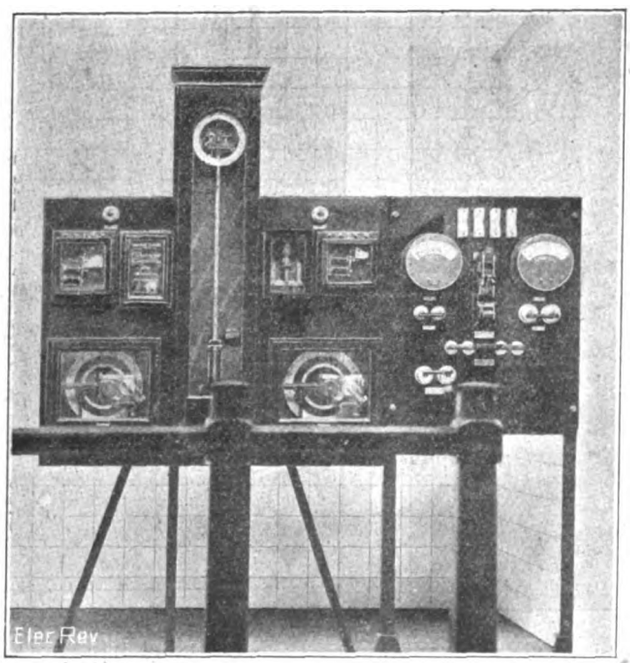

Fig. 11.—Gent Time Control Board.

trolling a group of 10 lamps in the immediate vicinity. No other lamps are used, and, although the lighting consumption is fairly heavy, the company considers the money well spent. The lighting cables are run in screwed conduit.

The lamps are well seen in figs. 5 and 7.

The time-service system was supplied by Messrs. Gent and Co., Ltd., and comprises an accurate transmitter con-

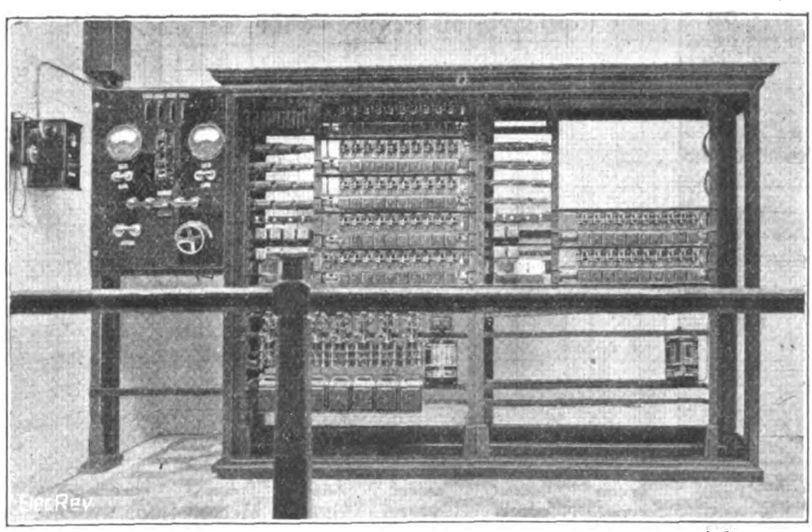

Fig. 13.—Siemens Automatic Telephone Exchange.

trolling some 40 dials and Gledhill-Brook time recorders distributed throughout the shops and offices. The main board is shown in fig. 11; it carries the transmitter, two programme ringers, two relays, and a warning bell, as well as the battery-charging switchgear. The programme ringers each contain a large metal ring with a series of holes into which pegs can be inserted, enabling any desired programme of signals to be automatically given, which can be changed at will. In this case bells in the works are sounded twice at five minutes to the hour of commencing work, and once at the hour. A different programme is provided for the offices. Current impulses are transmitted at half-minute intervals to the dials and recorders, which are all connected in series, the pressure employed being 110 volts. The recorders are controlled by a device similar to that shown in fig. 12, which releases the spring-driven movement every half minute, and allows the mechanism to advance by a corresponding amount. Thus uniform time is maintained throughout the establishment—a factor of no little importance.

An automatic telephone system, supplied by Messrs. Siemens Bros. & Co., Ltd., is installed in the works, in addition to the Post Office private branch exchange; the switchboard provides for 70 lines, with seven selectors, and is illustrated in fig. 13. It is mounted in a handsome cabinet on the switchboard platform, and close to it is a neat little battery room containing the batteries for the time and telephone services.

Central heating is employed in the offices, supplemented by electric radiators. In the messroom, part of the cooking is done electrically, a potato steamer proving most useful,

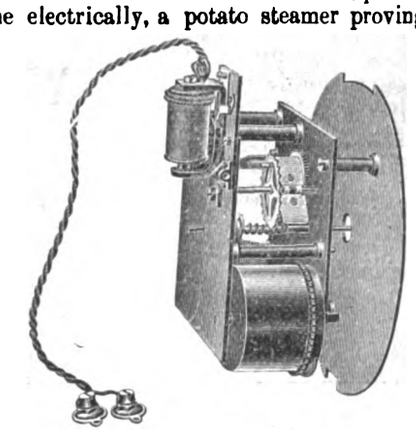

Fig. 12.—Device Controlling Time Recorder.

as well as an electric oven, both of Messrs. Crompton's make.

The offices are very handsomely constructed and equipped. For the purpose of sorting and tabulating the shop time cards, machines made by the British Tabulating Machine Co. are used, which perform their work with extraordinary speed and certainty, and save a vast amount of clerical labour and mistakes.

That the interests of the work-people are well looked after by the company was obvious on every hand.

The whole of the electrical and mechanical equipment was designed and carried out by the company's own staff. The adoption of the individual drive has proved wholly satisfactory; the cost of the installation, allowing for the reduced cost of buildings, and the abolition of shafting, is somewhat greater in the first instance, but the advantages gained far outweigh this drawback. The failure of a motor affects only one machine. When a machine stops, the consumption of energy for it ceases also, and the all-round saving of energy due to this and to the absence of friction losses in the line shafting is remarkable. It is best illustrated by the fact that *since the adoption of the individual drive, the plant has been doubled without increasing the consumption of energy.* The use of three-phase motors has also been justified by the results; even the smallest motors—down to ½ H.P—are fed at 440 volts, and the number of breakdowns has been trifling.

In conclusion, we have to thank Messrs. Vauxhall Motors, Ltd., for the opportunity of visiting this interesting installation, which exemplifies the latest practice, and photographing their machines. We are especially indebted to Mr. G. C. Jack, assistant works manager, for the courtesy with which he conducted us over the works.

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ELECTRICITY IN THE WESTERN WAR ZONE.

By Major T. RICH, O.B.E.

The author, having been connected with the electrical power side of military engineering during the last three years, and having had opportunities of studying war and pre-war methods of the French and Germans in north-east France and Flanders, thinks that some random notes might be of interest. The more the past is discussed, its failures or successes, the greater the chances for the future, and with these views in mind the following notes have been prepared. The work done by the British Army will be noted from time to time, but space does not allow of detailed particulars; good work was done, largely in accordance with local standards, in the face of great difficulties and frequent discouragements; we "muddled through" as in nearly everything done in the war, but there is evidence that the military "powers that be" now realise that electricity in warfare has come to stay.

In France, owing to legislation based on the desire to assist rather than to obstruct, very great development has taken place before and during the war, and although local conditions differ, and we have nothing similar to the Prefectural system, there is no reason why many of the features existing in France should not be adopted in the United Kingdom; the present would seem to be an opportune time for the discussion of such questions.

The author in preparing the following notes wishes to acknowledge the assistance and large amount of information continuously given him in France by officers of the Service Electrique of the French Army, and by the officers of the Military Electric Light Companies, and especially the late Col. Pierart, Major Redan, Capt. Boulanger, and the managers of power companies and others who freely gave particulars of their technical experiences. The Service Electrique supplied the author with a number of plans and photographs to assist in the preparation of this article.

The war has brought many allied professional men together, and it is to be hoped that practical steps will be taken to keep alive the good feeling which existed during the war between British and French electrical men.

Electricity has become since the beginning of the century a valuable factor in warfare; the increase in the use of scientific engines of offence, and methods of defence, has led to its general employment.

France and Germany started the war with the great advantage of national service, with the result that their armies were at one with the people. As practically all engineers and scientific men under such a régime had to take part in some form of military training, the liaison between the soldier, the engineer, and the scientist was much closer than it has been, or probably can be, with a professional army. A nation in arms gives the army the first pick of engineers and electricians, without the backstairs intrigue of local tribunals, and as all members of Parliament must have served in the Army, and have learned something at least of the elements of duty, it is difficult for any trade union leaders to get any trade made immune from service; it was, therefore, much easier for French and German Electrical Companies to get the men they wanted than for us to do so.

When the war broke out the Germans had already studied the problems of the use of electricity in the war zone, and had detailed information ready regarding the lighting and power systems in France and Belgium.

Although electric light work had been the subject of detailed study by French military engineers before the war, a definite electric power organisation was started only about a year after the war began, but the elastic organisation of the French army lent itself to rapid development, and in a very short time 500 km. of H.T. line were erected.

Electric light distribution, with the aid of comparatively inexpensive expedients, is to be found in about 4,000 communes in France and 12,000 communes in Germany, and officers and men in both these armies were accustomed to see power lines along the high roads. The necessity of providing the personnel for such work was recognised, and regulations were drawn up with the approval of the general staff which made the operation and utilisation of such lines a possibility, even in modern warfare.

During the war the Germans probably erected on the West Front over 2,000 miles of H.T. line, of which several hundred were at 30,000 or 45,000 volts; and sufficient steel cross arms were found in stock at one German depot after the armistice for 500 miles of 45,000-volt line, and a large stock of heavy poles for a similar length was being collected. French military engineers put up well over 1,000 miles of H.T. line, and were engaged in the erection of a line, largely with Algerian rough labour, at 90,000 volts. That is to say, the French and Germans combined put up probably more overhead power line during the war than existed before the war in most parts of the British Empire (outside Canada) put together.

Concessions and Regulations in France.

In France it is recognised that if the supply of electricity in rural districts is to become an economic possibility, power lines must be built of an inexpensive character, and the amount of apparatus cut down to the absolute limit. In order to prevent or limit the dangers of local blackmail, maximum payments to communes or other bodies are laid down, the fees diminishing with the population, while the ultimate power of veto practically remains with the Prefect.

The Government laws and regulations compared with those in the British Isles are very fair, although some American officers have considered them more stringent than those in some States of the U.S.A. The laws and regulations do not have penalties on every page, in fact, when looking through them, it is difficult to find any. The Government telegraph authorities are comparatively reasonable, and the railways have come to the conclusion that H.T. crossings, when designed with common sense, are not a continuous source of danger. In many areas even where steam is the motive power, electricity has become the poor man's light; the use of 110/190 volts A.C. naturally tends to obviate the use of expensive fittings and wiring, and fatalities at this voltage are exceedingly rare.

It has at times been urged by those, whose sense of technical propriety is offended by inexpensive structures or lines, that the climate of the Continent is much more favourable to overhead distribution than that of the United Kingdom; but those who have spent several years in the Departments of the Nord or Pas de Calais agree that there are storms as severe and snow as thick as any experienced at home.

The regulations relating to electricity are formed after consultation with a permanent Government Electrical Committee of 30 members; half of the number are professional and business representatives of the large electrical industries, and the other members are co-opted from the Government Ministries of the Interior, Public Works, Commerce and Industry, Posts and Telegraphs, War, and Agriculture. The rules are revised from time to time to conform with the progress of technology and business, therefore there is little danger of their becoming a stumbling block to the development of electricity supply. It is usual to get an electricity supply declared a "Utilité Publique," whereby certain privileges of the Public Works are enjoyed, and the planting of posts, trimming of trees, attachment of conductors to houses and other easements, can then be usually obtained with-

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out much trouble or expense. The engineer of a large power company told the author that he had once obtained concessions in 15 communes after only a few days' work. Owing to the earlier development of gas lighting the law allows a monopoly of illumination, but not for power or for industrial lighting of factories as an adjunct to the power supply. Electric light and power is, therefore, usually in the hands of gas and electricity companies. As a rule this fact does not seem to have checked the use of electricity very much, although some cases have occurred where the Germans connected a town to power mains, and after the war the lines were not repaired or lighting continued, because of the gas monopoly. Although France is a democratic country, the local authorities are usually sufficiently intelligent to understand that the development of electricity is of public and national interest, and that for efficient working and development, especially in rural districts, it is best to leave the business in the hands of experts, rather than to allow self-advertising tradesmen or "friends of the people" to interfere in matters they do not understand, taking a certain proportion of the receipts of the companies, directly or indirectly, by way of octroi, wayleaves, and other forms of contribution. In Paris, however, where the professional politician has perhaps more scope, some of the electricity and traction companies have been very badly treated.

There is always a tendency for people to think that arrangements elsewhere are the best, especially when faced with worrying opposition or formalities at home, but as far as France is concerned "the proof of the pudding is in the eating," and the very rapid development of electric transmission during the three years before the war, even in areas where there is no extensive water power available, is proof that investors are confident of having fair play, and "a run for their money." This is a remarkable contrast to the treatment of a large Scottish water power scheme during the war, when a Bill was thrown out mainly because there was a danger that the promoters and owners might make a profit out of their enterprise, despite the large amount of labour likely to be employed.

Factory owners in a number of country districts supply light and power to surrounding areas, the supply being often facilitated by the initial supply to the houses of their employés; the cost of obtaining the concessions is trifling in comparison with the general convenience to the neighbourhood, good lighting being naturally attractive to good workmen. In one place visited a mill supplies several villages along about ten miles of road from a 30-KW. alternator, transmitting at 5,000 volts. In another case the owner of a water mill obtained a concession as a hobby for his son, and supplied a neighbouring village from a turbine-driven alternator of 25 K.V.A. generating at 3,000 volts, the sole staff during the war being the proprietor, aged about 70, and his wife.

Many people do not realise that in many ways the Frenchman's methods and laws are based on sound common sense. He wants to keep workpeople in the country where they can have healthy surroundings, and not fall so ready a prey to professional grievance-mongers as if they were cooped up in large cities; he realises that a convenient supply of electricity is a most powerful factor in this direction. In many parts of the north of France village industries abound, especially the making of embroideries and such work, extra work being done in the winter when there is less to be done in the fields or small holdings; in some villages or small towns the horse power in small motors connected is astonishing. When the Germans ransacked the north they took away with them much of the small machinery in order to teach their own people, and rob France of the trade.

When "Long Bertha" (named after Bertha Krupp) began to bombard Paris, the process of removal of several important factories and industries out of Paris was accelerated, and a number of new factories sprang up in the south and west, especially in the Seine Valley. The process of removal to more healthy surroundings was distinctly encouraged by the Government, and the result of the bombardment may have an important bearing on the life of the future. It must be said that since the war France has "found herself" as a manufacturing nation; the development of Lyons, Clermont-Ferrand, and many other towns outside the danger zone has been astonishing, and there is little doubt that before long she will be able to replace or rival Germany in the trade of the world in many items.

When the public roadway is used for erection of power lines or roadside sub-stations, the following charges are paid to the State, Department, or Commune, for "Routes Nationales," departmental, or communal routes respectively:—

Situation.	Annual payments. Per km. line overhead or underground.	Per post or support.	Per sq. metre occupied.*
Paris	100 fr.	10 fr.	25 fr.
Communes of 100,000 inhabitants and over ...	20 „	2 „	5 „
Communes of 20,000 to 100,000...	10 „	50 cm.	2·5 „
Communes under 20,000	5 „	25 „	1 „

* For transformer sub-stations or other structures.

Where more than one line is put on the same support or cables are placed side by side in the same trench, the length is considered as one line. When special concessions are made by a commune, and as an alternative to the above, the following maximum charges can be made:—

	Percentage of receipts. Lighting.	Power.
Paris	10 p.c.	5 p.c.
Communes of 100,000 inhabitants and over	4 „	1·5 „
Communes of 20,000 to 100,000	3 „	1 „
Communes below 20,000	2 „	0·5 „

The lighting which is accessory to the use of power for industrial purposes is included with power in the percentage payments. Certain small charges are made for the expenses of Government control. Propositions for large schemes are examined by committees nominated by the Prefect, or in the case of smaller schemes covering a commune or syndicate of communes, by a commissioner nominated by the Prefect, after notice has been sent to Mayors of Communes. Regulations have been drawn up to prevent delay and to allow of the rapid subsequent execution of secondary lines and branches. During the war an arrangement was arrived at in many districts, with the assistance and approval of the Ministry of Public Works, for the charges for power to be increased by 2 mils, that is 2/10 of a centime, for each franc rise above the pre-war price of coal per ton. As there are 1,000 mils to the franc, and 1,000 kilos to the ton, this means an allowance of 2 kg. of coal per unit sold, which, after allowing for inferior war-time coal, expensive oil and stores, went some way towards extra war costs; in some cases of small stations a further extra charge was allowed. Some British officers who based their estimates of the cost of power upon the estimated consumption of petrol alone at 1s. a gallon, looked upon French charges for power as exorbitant.

It cannot be said that all French power companies are paying concerns, some distinctly are not; a number of the companies own six or more systems, some are connected with manufacturing concerns, and others are quite independent.

(To be concluded.)

The Portsmouth "Leader" Cable.—The "Leader" electric cable which has just been installed at Portsmouth Harbour is likely to prove of very valuable assistance to the navigators of ships when low visibility prevails. The cable, which is an armoured one, lies at the bottom of the fairway, the land end being connected with an alternating source of supply. Interruption of the current corresponding to prearranged signals of the Morse code, conveys to ships fitted with the necessary receiving apparatus their position in the fairway to within 500 yards of either side of the cable. An Admiralty order on the subject gives certain details relative to the position of the cable at various points in the approaches to Portsmouth. The advantages of the "Leader" system in thick weather are very obvious.

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THE LONDON FAIR AND MARKET.

The second annual Fair and Market organised by the International Trade Exhibitions, Ltd., was opened at the Royal Agricultural Hall, Islington, on March 16th. It was the only trade fair of its kind held in this country that was international in character, and at which were displayed many and varied fancy goods, jewellery, and toys. The public was not admitted, the fair being held for the transaction of strictly wholesale business. The exhibition closes this evening.

The exhibits included goods contributed by Czecho-Slovak firms, and others came from France, Italy, Spain, Holland, Japan, Canada, and the United States of America. It was estimated that 70 per cent. of the exhibits were British. Goods were displayed on 421 stands, on some two dozen of which electrical or allied manufactures were shown. The stands devoted exclusively to exhibits of an electrical nature were few in number.

Electrically-operated vacuum cleaners were shown on five stands, being exhibited by the Electric Appliances Co., Ltd., London; "Gem" Labour-Saving Device Co., Manchester; Hoover Suction Sweeper Co., U.S.A. and London; Magic Appliances, Ltd., London; and the Rex Import Co., Ltd., London.

The latter firm also exhibited a compact self-generating pocket electric lamp, the dimensions of which were about 1·5 in. by 3 in. diameter. The lamp is held in one hand, while with the other a ring attached to a cord is pulled, thus operating a ratchet and revolving magnet mechanism, which generates the necessary power to light the lamp. The cord, on being released, is automatically re-wound ready for the next pull; meanwhile, the lamp burns steadily.

Another novelty shown by this firm was an electric hair-brush, illustrated in figs. 1 and 2, which generates its own energy. The "Rex" brush, which is no larger than an ordinary hair-brush, and the metal bristles of which are carefully made so as not to irritate the scalp, applies, it is claimed, a high-frequency current to the

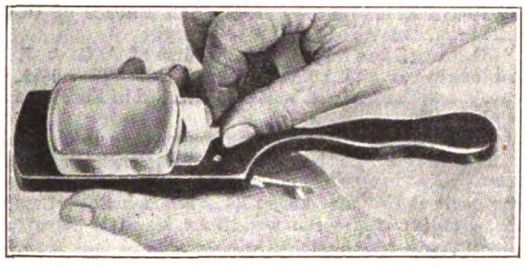

Fig. 1.—Self-generating Electric Hair Brush, showing how the Regulator is operated.

scalp and roots of the hair, giving a tonic and invigorative effect. A sponge attachment is supplied with the brush to be used for treatment of the skin, and for applying the current to different parts of the body for the relief of pains. This sponge attachment is an insulator when dry, but when slightly damped it conducts the current to the face or skin without the slightest burning or shock. The operation of the brush is simple—a thumb pressure of a small, conveniently-placed lever, as shown in fig. 1, being all that is required to generate a continuous electric current; the power of which may be strengthened or weakened at will by adjusting the regulator on the back of the brush, also shown in fig. 1. No batteries are used in this brush; a small dynamo on the

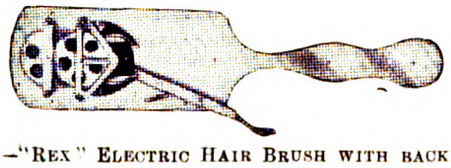

Fig. 2.—"Rex" Electric Hair Brush with back cover removed.

back of the brush, fig. 2, generates the power. It may be worked at a speed as high as 10,000 r.p.m. The magneto armature is wound with very fine wire having almost 1,000 ohms resistance, and when the thumb lever is worked slowly, this armature spins at the approximate rate of 3,000 r.p.m.

Electrically-operated mechanical toys were on view on four stands, and were shown by the following firms:—Messrs. Roberts and Pitt, London, electrically-propelled boats; Indian and Colonial Supply Association, London, small motors and generators, coils, lamps, bells, batteries, &c.; Dubilier Condenser Co., Ltd., London, small motors and parts; and the Gilbert A.C. Co., U.S.A. and London, miniature chemical and electro-plating outfits, together with manuals for "magic" performances with the outfits, a complete outfit for teaching the fundamental principles of static electricity and magnetism, parts for assembling small motors, working miniature telephone and telegraph sets, including a wireless set whereby messages may be sent and received over short distances, different types of 110-volt motors, transformers, switches, shocking machines, &c.

Some seven firms exhibited electric lamp fittings and shades as under:—Messrs. Bulpitt & Sons, Ltd., Birmingham, aluminium lanterns; Albert Lee & Co., Ltd., London, electrical fittings, glassware, silk shades and batteries; Messrs. A. A. Mackenzie, Glasgow, agents for aluminium and brass candlesticks, mantle rod brackets, &c.; Messrs. Charles Sely, London, silk and painted lamp shades and telephone covers; Messrs. W. Soutter & Sons, Ltd., Hockley, Birmingham, electric lamp fittings, floor and reading lamps, kettles and stands, &c.; Messrs. Henry Wolff and Co., London, linen, silk and chintz lamp shades; and the Excelsior Shade Manufacturing Co., Nottingham, "Betterway" silk lamp shades and metal bands, as illustrated in figs. 3 and 4. This is an effective and inexpensive attachment which is

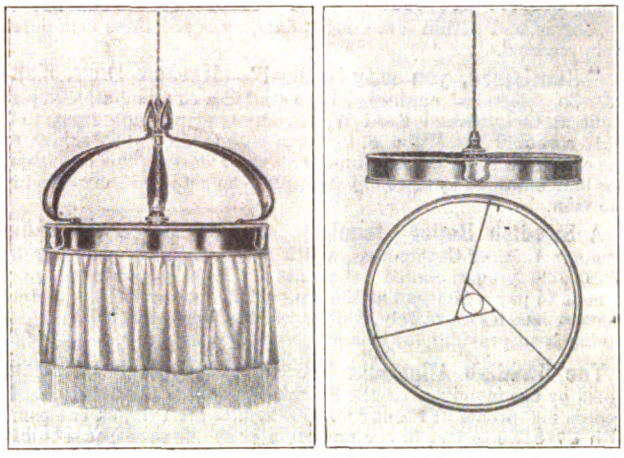

Fig. 3. Fig. 4.

"Betterway" Lamp Shade and Band.

supplied with a ceiling plate and three chains, or with scrolls, as shown in fig. 3, and a fixing disk which can be easily removed without detaching the lampholder. The band, together with the loose wire ring for fixing, is illustrated in fig. 4. The flounces are made of various materials, white lined, and are of artistic shades and designs.

Messrs. Beatty Bros., Ltd., London, had on view a number of washing machines and wringers, including an electrically-driven model.

The British Ever-Ready Co., Ltd., London, showed a selection of electric pocket, hand, cycle, inspection, and reading lamps, signalling lamps, lanterns, and various types of dry cells, batteries, and accumulators.

Messrs. Chollot, Paris and London, had a working exhibit of powerful "Tenor" motor horns, and factory sirens of various sizes and types both manually and electrically driven.

The Ebonestos Manufacturing Co., London, showed a variety of moulded articles suitable for motor-car lighting, medical appliances, and all classes of electrical work.

Messrs. Hooper & Edman, Ltd., Birmingham, amongst other exhibits, showed lamps, mirrors, aluminium ware, and electric motor-car lighting sets.

The Northern Rubber Co., Ltd., Retford, Notts., showed all kinds of mechanical rubbers, also asbestos and leatherite hose, tubing, sheets, blocks, &c., and electrical gloves.

The Remoline Co., London, in addition to hardware, had on view batteries for pocket lamps and other electrical goods.

Messrs. United Merchants, Ltd., London, exhibited, amongst other things, "Majestic" electric radiators, which are made in one pattern only, but can be supplied with either a single or double coil. The radiators, circular in shape, are very portable, light in weight, and the heat can be focused to any desired point.

Messrs. Siemens Brothers & Co., Ltd., London.—This exhibit comprised a large variety of fluid and dry cells and batteries, in the numerous sizes manufactured at the firm's Woolwich works, and included batteries for pocket lamps, torches, bells, telephones, indicators, medical apparatus, electric clocks and time distributors, laboratories, electrical testing, &c. The products shown on this stand were very similar to those that were on view at the recent Birmingham and Crystal Palace Exhibitions.

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BUSINESS NOTES.

Industrial Council.—The following is a list of representatives who will act on the employers' side of the Home Counties (No. 9 Area) District Council :—

Municipal.—Messrs. Alderman Wilkinson, Reigate (chairman); Alderman Vaughan, Maidstone; Councillor Radford, Southend; Councillor Legg, J.P., Reigate; Mr. R. N. Torpy, M.I.E.E., Tunbridge Wells; Mr. R. W. L. Phillips, Bedford; Mr. C. A. Blascheck, Canterbury.

Company.—Messrs. A. I. S. Baron (Frinton-on-Sea and District Co.); W. E. Brandreth (Wycombe (Borough) Electric Light and Power Co.); H. Leslie Dixon (Leatherhead and District Electricity Co.); J. Eustace (Electric Supply Corporation, Ltd., Chelmsford); Arthur Grover (Hindhead Co.); T. Hesketh (Folkestone Co.); G. W. Spencer Hawes (Reading Co.); A. J. Wray (Banbury Co.). Secretary, T. W. Cole.

New Indian Electrical Companies.—Among the new companies recently formed in India are the British India Electric Construction Co., Ltd., 103, Clive Street, Calcutta, capital, 1,000,000 rupees, to carry on an electrical engineering business; and the Tata Electro-Chemical Co., Navassari Buildings, Hornby Road, Bombay, capital, 2,500,000 rupees.

A Satisfied "Consumer."—An electrical manufacturing firm that has been advertising in our pages for considerably over 20 years, writes expressing appreciation of the value of our advertising space. In a recent issue the firm advertised a new type of apparatus, and within seven days 27 inquiries and three firm orders were received.

"Gentlemen, you may Smoke!"—Messrs. Dick, Kerr and Co., electrical engineers, have started a three months' experiment at their Strand Road Works, Preston, in which from 10 to 10.15 a.m. and 3 to 3.15 p.m. the men will be allowed to smoke, on the condition that they continue with their work. This concession has been obtained by the shop stewards, who acted on the request of the men.

A Swedish Boiler Cleaning Co.—The Elektriska Pannrensings A. B., of Gothenberg, which has an ordinary share capital of 100,000 kroner, earned net profits of 92,300 kroner in 1919, and intends to pay a dividend at the rate of 20 per cent. The patent account has been entirely written off, the sum of 250,000 kroner having been provided for this purpose last year.

The Swedish Allmanna Co.—A preliminary statement issued by the managers of the Svenska Allmanna Elektriska A. B. records net profits of about 8,000,000 kroner for 1919, as compared with 7,718,000 kroner in the preceding year. It is proposed to pay a dividend of 10 per cent., this contrasting with 15 per cent. in 1918 and 20 per cent. in 1917.

Norwegian Cable Works.—The A. S. Nordiska Kabel og Traad Fabriker reports a surplus of 4,969,000 kroner for 1919, and a dividend at the rate of 25 per cent.

Catalogues Wanted.—The Peto-Scott Co., of 17, Frome Road, Wood Green, London, N., want catalogues, price-lists, samples, &c., from manufacturers of accumulators, dry cells, small motors, switches, small instruments, and miniature fittings.

Catalogues Wanted for Tanganyika.—The manager of the Electric Light Works P.W.D. Tanganyika Territory, Dar-es-Salaam, would be glad to have contractors' lists of electrical supplies of all descriptions suitable for a 440/220-volt D.C. supply, as the station is being rebuilt. The department is also supplying motors, lamps, fans, and cooking apparatus, with easily renewable elements.

Catalogues Wanted for Cuba.—The Commercial Secretary to H.M. Legation at Havana (Mr. G. T. Milne, O.B.E.), is desirous of obtaining for filing in his office, catalogues, price lists, &c., issued by United Kingdom firms, who are accordingly invited to forward copies of trade literature, to the Commercial Secretary to H.M. Legation, Havana.

Tramcars Wanted for Denmark.—According to Press reports from Copenhagen, the director of the street car system, which is owned and operated by the municipality, announced a short time ago that a number of new cars would be purchased in the near future. The motors in many of the cars were in bad condition and had been found to be too weak for the heavy traffic. This necessitated the installation of new motors in many of the old cars and the strengthening of many of the old motors. It was also planned to install electric heating in the cars. Nearly 1,000,000 crowns were to be expended for these improvements.

New French Company.—La Bougie R.S., Société Anonyme, is the style of a company formed at Courbevoie (3, Rue Louis Ulbach) for the making and sale of igniters for explosion motors, and more particularly the R.S. igniters patented in France. The capital is 425,000 fr.

Lyons Fair.—At the spring meeting of the Lyons Fair, held from March 1st—15th, the class of electricity was absent. It will, however, be included in the autumn meeting, and it is stated that already 3,000 exhibitors have entered their names, while 17 foreign countries, Allies or neutrals, will be represented.

Correction.—In their advertisement on page xxvii in our last issue, the City Electrical Co. quoted in error £81 as the price of the 1-KW. direct-coupled sets. The figure should be £91.

Book Notices.—"Pitman's Technical Bookshelf," March, 1920. No. 2 (23 pp.). London: Sir Isaac Pitman & Sons.—A general review of recently-published and forthcoming works of a technical nature, dealing with practically all branches, including wireless telegraphy, house lighting, textile weaving, &c. The notes form a complete guide as to the nature of each work, enabling the reader to tell at a glance whether it meets his requirements.

"The Amount of Steam Used by Steam Jets" (14 pp.). By D. Brownlie, B.Sc., &c. Reprinted from *Engineering*. London and Manchester: Brownlie & Green. Price 1s. 6d. This is No. 3 of a series giving exact data on the running of steam-boiler plants.

"Talks with Workers on Wealth, Wages, and Production." London: Sir Isaac Pitman & Sons. Price 2s. net.

Scientific Paper No. 361 of the U.S. Bureau of Standards, "Magnetic Testing of Straight Rods in Intense Fields" (13 pp.). Notes on the magnetic properties of ferro-magnetic materials. Scientific Paper No. 368. "Ionisation and Resonance Potentials for Electrons in Vapours of Lead and Calcium" (14 pp.). Copies of these papers may be obtained from the Government Printing Office, Washington. Price 5 cents each.

"Water Powers of British Columbia." By A. V. White. Ottawa (Canada): Commission of Conservation.

"The Practical Electrician's Pocket Book." London: S. Rentell and Co., Ltd. 520 pp. and diary. Price 2s. 6d. net. The 1920 edition of this useful and comprehensive work has been carefully revised and brought up to date with an addition of 40 pages. New features are notes on electric welding, electric furnaces, meters, &c. The wiring tables have been rearranged in accordance with the new specifications of the Engineering Standards Association.

Trade Announcements.—The Klaxon Co., Ltd., and their sister company, the O. S. Speedometer Co., Ltd., transferred their head office to 38, Blandford Street, Marylebone High Street, London, W. 1, on 24th inst. The works remain at Landor Street, Birmingham.

Messrs. Johnson & Phillips, Ltd., have removed their Cardiff branch address to 2A, Court Road, Cardiff. Telegraphic address and telephone number unchanged.

On Tuesday last, Messrs. Berkeley & Young, Ltd., returned to their old offices, Finsbury Court, Finsbury Pavement, E.C. 2 (which had been temporarily occupied by the Government). Their associated businesses, the New British Electric Supply Co., Ltd., the Enclosed Motor Co., Ltd., and B. K. B. Electric Motors, Ltd., have also returned to that address.

Messrs. Chiswell & Co. have returned to their former offices, Imperial House, Kingsway, W.C. 2, after an absence of two years, due to the requirements of the Air Ministry.

Mr. A. G. Smith has retired from the firm of A. G. & J. Smith, electrical engineers and contractors, of 122, Titchfield Street, Kilmarnock, and the business will be continued in his own name by Mr. Joseph Smith.

Mr. James Mercer has commenced business as an electrician at 44, East Trinity Road, Leith, in succession to Mr. F. C. Pentland.

Messrs. W. J. Attack & Sons have commenced business as electrical engineers at Lewknor Lodge, 11, Ellington Road, Ramsgate.

Mr. A. Berkeley has removed from Newhall Street to 111, Granville Street, Birmingham.

Messrs. Cuirass Products, Ltd., have removed to 69, Victoria Street, London, S.W. 1. Telephone number: "Victoria 5419."

Messrs. Automatic and Electric Furnaces, Ltd., have appointed Messrs. Ingenieurs-Bureau, "Econoom," Zutphen, Holland, as agents for the Wild-Barfield furnaces for the Netherlands and the Dutch East Indies.

The title of the Société des Carberies Belges, of Brussels, has been changed to that of the Belgian Electric and Rubber Works.

The German Wire-drawing Industry.—The *Economic Review* quotes a German paper, dated February 26th, to the effect that at a meeting held in Hagen i./W. some hundred firms of wire manufacturers decided to form an Association for safeguarding the interests of the consumers of rolled and drawn wire.

Plant for Sale.—Clyde Navigation Trustees invite offers for obsolete plant at Prince's Dock power station, consisting of a Belliss compound engine coupled to a Silvertown 60-KW. 250 V. D.C. compound dynamo, and a Mirrlees, Watson engine with dynamo of similar type and size, pipes, switchboards, &c.

Croydon Corporation Electricity Department has for disposal one 1,100-B.H.P. Belliss & Morcom triple-expansion engine, coupled to 750-KW. English Electric alternator and exciter, one 450-B.H.P. Belliss & Morcom tandem compound engine, coupled to G.E.C. 250-KW. alternator, surface condensing plant, and air and circulating pumps. For particulars see our advertisement pages to-day.

Auction Sale.—The Assets Auctions Co., Ltd., will sell by auction, on March 30th, at 119-21, Newington Causeway, S.E., the stock of an electrical contractor; for particulars see our advertisement pages to-day.

Translation of Catalogues.—H.M. Commercial Secretary at Santiago, Chile, points out that several catalogues of British manufactures and books of British industries printed in the Spanish language and sent to Chile have been translated into incorrect Spanish. It is a pity that firms and trade associations going to the expense of issuing publications in Spanish should try to save a few pounds by employing cheap and inefficient translators.—*Board of Trade Journal.*

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Socials and Concerts.—An entertainment and dance, organised by the Ediswan Girls' Musical Society, was held on Friday and Saturday, March 12th and 13th, at Ponders End, and was largely attended by employés of the Edison Swan Electric Co., Ltd., and their friends. The affair was stage managed by Mr. D. Lishman, assisted by Mr. B. White, and the scenic effects and lighting were very effective. The Committee responsible for the arrangements consisted of Misses Jordan, E. Piggott, E. Smith, F. Boydon, M. Almond, L. Wake, V. Briggs, N. Farrell, and Mrs. Oldland. The Girls' Musical Society has only been in existence a few months; it is under the direction of Madame Carradine. One of the chief items in the programme was a musical absurdity entitled "Everything Electrical." The instrumental music was supplied by the "Ediswan" Orchestra, under the leadership of Mr. F. Dean. Miss E. Smith was accompanist.

A smoking concert of the electrical trade in Warrington, was held on Friday, March 12th, in the Pelican Hotel. Mr. F. V. L. Mathias, M.I.E.E., borough electrical engineer, presided over a representative gathering, which included among the guests Mr. W. Shaw, chairman, Manchester Branch of the Electrical Contractors' Association, and past president of the E.C.A.; Mr. R. A. Irvine, district secretary of the Electrical Trades Union; Mr. Smith, local chairman of the Electrical Trades Union; and many others. Mr. Shaw, in proposing the toast of the "Employés," stated that in his long experience of the electrical trade, the gathering was quite unique, and the first of its kind to be held in this country. They had the supply authority, the contractor, and the Trade Union, as a happy family for that evening at least. If similar gatherings could only be organised throughout the country, many labour disputes could be more amicably settled owing to the spirit of good feeling which they must create. Mr. Smith, in replying, spoke of the harmony that prevailed at the gathering, and of how much they were indebted to Mr. Robertson, of Messrs. Harry Rogers, for organising the evening, which could only bring benefit to the trade in the district. Mr. Irvine proposed the toast of "The Employers." He said that the time had come when employer and employé must pull together, or this country would be left in the lurch. Mr. C. J. B. Barlow, Warrington Electrical Co., Ltd., replied. Mr. J. B. Robertson, who subsequently spoke, said that his idea in organising the concert was the formation of a debating society on electrical subjects in Warrington. The proposition was put to the meeting and adopted, and a Committee was appointed to carry out arrangements for the formation of such a society for next winter. Other toasts followed.

A dramatic performance is taking place this week at the Metropolitan-Vickers Club, Moss Road, Stretford, where the Metropolitan-Vickers Dramatic Society are producing a musical comedy entitled "The Squire and the Devil." The production is an entirely original effort, that is to say, employés of the Metropolitan-Vickers Co. are responsible for the libretto, lyrics, musical composition, arrangement of dances, scenery, dresses, and lighting effects, besides furnishing the dramatic and musical talent. Similar performances have been given by the British Westinghouse Co. (to give the firm its old title) employés for the past 10 years, though it is only during the last three when the addition of the large new stage was made to the Club Hall that they have been presented, in the complete fashion of this latest performance. It would, therefore, seem that this annual function is in a fair way to become an institution. The parts of Squire and Devil are taken respectively by A. Cecil Busby and H. Cranfield Matthias, the principal ladies' parts being interpreted by Miss Mabel Winstanley and Kitty Shute. Miss Doris M. Walker arranged the dances. The orchestra was conducted by A. M. Parkinson, who also orchestrated the music, which was composed by G. H. Rowlands, and Maurice Hird wrote the lyrics and libretto, additional lyrics being written by Alec. J. Crawford, who also took a part on the stage.

A new social club for the employés of the Bradford Corporation tramways department was opened on March 17th, at 4, Leeds Road, by the Lord Mayor of Bradford (Alderman Wm. Wade), Mr. R. H. Wilkinson (tramways manager) presiding.

Electric Heating Plugs for Chicago.—According to a report received from H.M. Consul-General at Chicago, a firm in that city invites particulars of attachment plugs for electric heating appliances; many millions could be sold. The name and address, &c., of the firm can be obtained, and samples seen, at Room 49, at the Department of Overseas Trade, 35, Old Queen Street, S.W. 1, until April 7th, after which they will be available for inspection in the provinces.

Payment by Results.—A very important decision was arrived at on Thursday, last week, at a conference of the National Federation of General Workers, which has a membership of about 1½ million workers, a large proportion of whom are employed in engineering workshops. The conference decided to adopt the principle of "payment by results" in the engineering and shipbuilding industries. The engineering Unions are balloting on the same question, but their decision will not be known until the end of April. Should this principle be generally adopted, a large increase in output may safely be counted upon, together with a corresponding increase in the wages earned by the employés.

Mr. W. T. Kelly, of the Workers' Union, says that the question of payment by results was considered from the point of view of industry generally, and not merely as affecting the engineering trades. The various Unions had decided that payment by results was a form of payment they could well agree with, and that the safeguards they intended to attach to it—as in the engineering trades—would enable the system to be brought into operation with more beneficial results than the present time-rate method of payment.—*Daily Telegraph.*

Catalogues and Lists.—Automatic and Electric Furnaces, Ltd., 281-283, Gray's Inn Road, W.C. I.—An illustrated leaflet showing two types of electric drying ovens.

The Klaxon Co., Ltd., 1, King Street, St. James's, S.W.—Three priced and illustrated pamphlets dealing with "Klaxon" warning signals and motor horns.

The Greengate and Irwell Rubber Co., Ltd.—A well-produced catalogue (68 pp.) of Association, non-Association, and cab-tire sheathed rubber-insulated cables and wires.

Pontelec Welding Patents, Ltd., 46, Constitution Hill, Birmingham.—A list, illustrated by photographs, of electric spot and butt welding machines, with reports on various tests carried out by them.

Messrs. A. Reyrolle & Co., Ltd., Hebburn-on-Tyne.—Pamphlet No. 335, dealing with new horizontal telephone-cable dividing boxes.

The General Electric Co., Ltd., 67, Queen Victoria Street, E.C. 4.—Pamphlet K 2,295, dealing with telephone brackets.

Sterling Telephone and Electric Co., Ltd., Telephone House, 210-212, Tottenham Court Road, W. 1.—Bell Catalogue No. 276 (24 pp.), a comprehensive list of bells and buzzers and accessories, including accumulators, dry cells, indicators, &c. Fully priced and illustrated.

Mr. C. F. Elwell, Craven House, Kingsway, W.C. 2.—"Continuous Wave Installations" (22 pp.). Printed on art paper and profusely illustrated by photographs, this publication describes the advantages of the Poulsen continuous-wave arc system of wireless telegraphy, showing generators, controls, and instruments. Incorporated in the volume is a data form for the use of prospective clients.

Messrs. Ward & Goldstone, Ltd., Sampson Works, Salford, Manchester.—Illustrated pamphlet dealing with the "T. R. S." (tough rubber sheathed) wiring system, wires, and accessories.

The British Thomson-Houston Co., Ltd., Mazda House, 77, Upper Thames Street, E.C. 4.—List No. 10,336B. A profusely illustrated catalogue (30 pp.) showing the application of "Mazdalux" metal reflectors to industrial lighting. Prices and data are given.

Messrs. Drake & Gorham Wholesale, Ltd., 67, Long Acre, W.C. 2.—Pamphlet No. 280. The "Hoadley" current limiter. Priced and illustrated.

Liquidations and Dissolutions.—Telephos Domestic and Street Lighting Co., Ltd.—Winding up voluntarily for reconstruction purposes. Liquidator, Mr. H. H. Foster 805/9, Salisbury House, London Wall, E.C.

Trafford Power and Light Supply (1902), Ltd.—Meeting of creditors called for to-day at 60/62, Spring Gardens, Manchester.

Pollock & Macnab, Ltd.—Meeting April 23rd, to hear an account of the winding-up.

Quain Electric Co., Ltd.—Mr. C. W. Rooke, of 2 and 3, Norfolk Street, Strand, W.C. 2, has been appointed receiver and manager for the debenture holders, under an order of the Court dated March 12th.

D. O. Williams & Co., electrical engineers and contractors, High Street, Clydach-on-Tawe, Swansea Valley.—Messrs. H. D. Roberts, B. H. Davies, and J. T. Davies, have dissolved partnership. Messrs. B. H. and J. T. Davies will attend to debts and continue the business.

The Electric and Engineering Specialities Co., electrical manufacturers and factors, 79, Great George Street, Liverpool.—Mr. B. L. Myer and Mr. W. Fraser have dissolved partnership. Debts will be attended to by Mr. T. E. A. Killip, of 21, Tempest Hey, Liverpool.

Co-operative Shareholding in Engineering Trade.—The Joint Committee appointed to investigate the economic relation of production to hours of work in the shipbuilding and engineering industries has now been constituted. It was stated last week that both the shipbuilding and engineering employers were prepared to announce to their workmen, as soon as the Committee's decision on payment by results was made known, a large scheme of co-operative shareholdings.—*Birmingham Post.*

Rotary Snap Switches.—In order to avoid confusion, The Hart Manufacturing Co., of Hartford, Conn., U.S.A., ask us to announce that they have not appointed any company or firm their agents; and that the "Diamond H" switches and other appliances are imported solely into England by their London office at 76 and 77, Rochester Row, Westminster, S.W. 1.

Sparking Plugs for Japan.—Official intimation has been received in London concerning an immediate demand in Japan for aero engine sparking plugs. They are required by a Japanese company who are building aero engines for the Japanese Government, whose name and address may be obtained from the Department of Overseas Trade, 35, Old Queen Street, S.W. 1.

Apparatus Wanted for Hong-Kong.—The D.O.T. reports that the following apparatus is required for the Royal Observatory at Hong-Kong:—Electrical clocks, magnetic, astronomical, meteorological, and electrical apparatus. Catalogues with prices of such apparatus should be sent to the Director, Royal Observatory, Hong-Kong.

Patents and Designs Act, 1919.—The Board of Trade has ordered that Sections 1 and 2 of the Patents and Designs Act, 1919, shall come into operation on April 1st, 1920.

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Electric Lamp Manufacturer: A Tribunal Decision.—The Manchester Munitions Tribunal has occupied two days in an inquiry whether a firm manufacturing miners' electric lamps is entitled to employ female labour in the production of certain parts. The Amalgamated Society of Engineers contended that prior to the war the work was done by male labour, and that women were introduced in 1916 as an emergency measure. By not reverting to the pre-war practice the employers were infringing the Restoration of Pre-war Practices Act. The employers urged that before 1915 or 1914 the manufacture of miners' electric lamps was practically in the experimental stage in this country, the bulk of the supplies coming from Germany. Efforts, more or less successful, had been made to produce a British article, and though male labour was employed during the experimental stage it had become customary to have minor parts done by women. The work was largely of a repetition character, and analogous to that done by women in the electrical fittings industry.

Mr. J. W. H. Graham (chairman of the Tribunal) had the assistance of two assessors, one of whom dissented from his decision, which was given on March 19th. He said there was very substantial evidence that women, although not in large numbers, were engaged in Manchester, Birmingham, and other places on similar work, which came within the electrical branch of engineering. The society had failed to establish any practice or custom not to employ women in the manufacture of the lamp. Apart from that he was of opinion that in this case the making of miners' electric lamps must be regarded as a new industry.

German Commercial Propaganda.—H.M. Consul-General at New York says that Germany is making serious efforts to regain her foreign markets, as is shown by the tremendous advertising campaign being organised by the Reichsverband Deutscher Industrieller (Society of German Engineers).

The National Foreign Trade Council has received the information that under the management of the "Ala" (Allgemeine Anzeiger Gesellschaft m.b.H.), a notorious propaganda centre of German war industry, foreign countries are to be flooded with German periodicals. A manufacturers' export paper, published in four languages—German, English, French, and Spanish—is now being published. Engineering concerns are subscribing heavily to this enterprise in the shape of advertising contracts, and prepaid subscriptions for a large foreign circulation during a period of five years. Individual firms like Krupp's have contracted to pay the fees for over 3,000 free copies to be sent out regularly during that period. Further, a combine or trust of the German industrial Press is in the course of formation with a view to making concerted efforts in the same direction.

The "Ala" intends to establish officers in all foreign capitals to act as advertising agencies and as distributing centres and news gatherers for the Uberseedienst (Overseas Service), a large German agency for commercial news affiliated with the "Ala." In the former capacity it is hoped to wield much influence in the foreign Press and trade periodicals.

Copies of *Ubersee-Post*, published first in October, 1919, to which this report probably refers, may be seen in the library of the Department of Overseas Trade, 35, Old Queen Street, S.W. 1.

Trade Opportunities in Mexico.—American manufacturers are hopeful of retaining the trade with Mexico which has come to them as the result of European disability to compete. They have been warned, however, to improve their methods of packing, and be prepared to give quicker deliveries than they have done of late. In reporting on the market for electrical installations in the State of Vera Cruz, the American Consul points out that the district is largely agricultural. Conditions at present are not favourable to the development of lighting plants or to the sale of electrical machinery for manufacturing plants, &c. However, a few of the larger and better protected sugar plantations are large users of electrical materials, all such purchases being made, usually, before the grinding season, which commences about the middle of December. Catalogues and price lists should be sent to the sugar planters. The literature should be in English and Spanish, as many of these plantations are owned by Americans and managed by natives, and the native managers are frequently not familiar with the English language. In Orizaba, State of Vera Cruz, where there is considerable manufacturing, electric power is largely used; some of the factories generate their own electricity, as in the case of the Compania Industrial de Orizaba, S.A., which has a model hydroelectric plant at the cascades of Rincon Grande, near Orizaba, and another at the Cocolapam factory. The power used is over 8,000 H.P., and there are 18 turbines and four electric motors. Under more favourable conditions there is every reason to expect an even larger use of electricity in the Orizaba neighbourhood, and an increased demand for lighting plants in many of the smaller towns.

There is a good market for all kinds of modern electrical material and household appliances, and during the long hot season, especially, for electric fans, of both overhead and desk types, which are found in many homes and offices. Although the local people are somewhat slow to adopt modern inventions, particularly in the home, there is an increasing interest in electric irons, toasters, and ovens—the latter being especially desirable, as many of the best homes have only charcoal braziers for cooking. When the political unrest subsides there should be excellent scope for widening the sale of house installation material in Vera Cruz, Orizaba, and Jalapa.

Tampico, Mexico, is considered by the American Consul to offer good opportunities for the sale of small electrical material. This is due to the general progress brought about by the exploitation of the oil wells in the district, and in particular to extension of building operations. The housing problem has been one of the city's foremost concerns during the past year, and naturally the question of fittings has received attention. Electrical installation, wiring fixtures, electric pumps for supplying water, &c., have been factors occasioning delay in the fulfilment of building contracts. Doubtless the placing of an agency in the hands of a contracting engineer would result in the securing of much business, particularly since the oil drilling appears to be forever finding new locations, thereby necessitating new housing construction and equipment.

Engineering Amalgamations and Specialisation.—Speaking at the recent annual meeting of Crossley Bros., Ltd., Mr. J. J. Carter, the managing director, regarded amalgamations in the engineering trade with favour. He said it must be realised that, with constantly increasing costs of production, the only way the progressive manufacturer could expect to deserve a share of the world's markets was to limit the range of manufactures and greatly to increase the production of the reduced range of types. That was what his firm was doing. Specialising in internal-combustion engines ranging from 3 B.H.P. to several thousands of H.P., it was impossible to build that enormous range in one factory under economical conditions. They had, therefore, decided to divide the range between the several works, and had acquired the business of the Premier Gas Engine Co., Ltd., Nottingham. At Nottingham it was the company's intention to build engines from 300 to 3,000 B.H.P. Extensions of the works were in hand which, when completed, would treble the output of the Premier works. At the Openshaw works engines with five sizes of cylinders would be built instead of 25 sizes, as was the case before the war, but the production of those five sizes alone would be at least double the whole pre-war production. At the Erwood Park works, near Stockport, engines from 3 to 30 B.H.P. would be built on mass production lines.—*Machinery Market.*

Liverpool Dispute Settled.—Our correspondent writes: "As foreshadowed in the last issue of the Electrical Review, the lock-out in the Liverpool electrical contracting industry terminated last week, and on Thursday there was a general return to work, on the mutual understanding that there would be no victimisation on either side. Thus is ended one of the most stubbornly-fought of recent disputes in the electrical trade, and reviewing the whole circumstances, both before and since drastic action was resorted to, there cannot be much doubt in the assertion that the employers have not emerged from the struggle with flying colours. So far from this being the case, by agreeing to the intervention of a conciliator for an award on a wages question, which first saw light of day when the lock-out had been in progress six or seven weeks, they are obliged now to pay increases in wages which total 6s. 10d. per week to the electricians they employ. All that they have obtained in return are a few modifications in rules, which might have been obtained much sooner than they were, had the position been clarified in the way that it eventually was by both sides discussing their grievances at a round-table conference. From what the writer has been able to gather, but for the support given the Electrical Trades Union members by their outside branches, and other work on ships being opportunely available, a much earlier return to work would have been inevitable."

The settlement of the lock-out was celebrated by a dinner given at the Bee Hotel, Liverpool, which was attended by both electrical contractors and manufacturers. Mr. A. E. Chesters presided.

Proposing "The Allied Electrical Trades," Mr. J. E. Lloyd Barnes observed that if Labour could only be persuaded to put its shoulder to the wheel and give a fair return for the wage now being paid, great progress would be made in the industry. Too often employers had made the mistake of leaving issues to be decided in a haphazard manner. Mr. G. A. Sutton, who replied, observed that in the Liverpool electrical industry there would never be such a good understanding as now, and petty troubles between manufacturers and contractors had been swept away. Greater prosperity might be looked for in the Liverpool industry, said Mr. J. Dennis. Numerous developments were taking place, and there was the probability of a large super-station being erected in the Garston area, in which case electricity would in many cases supersede steam.

Mr. G. Barnes, replying to the toast "Our Guests," made reference to the formation of the Consultative Committee of the Liverpool employers. The battledore and shuttlecock game which the trade unions were able to play on employers was a very serious matter, and this could not be helped unless all employers were brought closer together. Before they could hope to stop the increasing wages, they must find ways and means of decreasing the cost of living.

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Alleged Profiteering in Lamps.—Our Leeds correspondent writes: "Interviews with members of various branches of the electrical trade here elicited a good deal of opinion that the margin of profit on electric lamps has not been unreasonably large, in view of all the conditions of production and distribution. The big percentage of breakages has to be allowed for, and the trade generally appreciates the custom of replacing defective lamps. A Leeds representative of the associated producing undertakings mentioned by the committee report says none of the firms have ever declared a dividend of more than 10 per cent., and he says a comparison of lamp prices during the past 20 years shows that there is no unjustified increase. He points out the great cheapening of the various half-watt lamps in general household and commercial use, due to their manufacture in this country now, as against their previous general importation. Another trader said it was only fair to the British producers to draw attention to their enterprise, which had captured the lamp trade from the Austrians. On the other hand, traders not associated with the activities of the Electric Lamp Manufacturers' Association contend that the 'ring' has practised methods which had the object of crushing those outside. One such trader, however, frankly admitted that he did not believe the 'ring' had forced up prices in the manner suggested in the report, and did not think traders would ever be able to sell lamps at 2s., in view of the increasing cost of labour, materials, and transport. All kinds of manufacturing and distributing charges had advanced so greatly that he could not think any producer could have made an excessive fortune. This trader held that the Association certainly had too much control over the trade, and he blamed the Board of Trade for having allowed it so long. The activities of the Association had a tendency, in certain ways, to the restriction of trade."

Overseas Touring Exhibitions.—As already announced the Department of Overseas Trade is organising a number of touring exhibitions of British manufactured goods, which will visit the principal commercial centres in the British Dominions, South America, the Far East, and the United States of America respectively. At present four touring exhibitions are contemplated. The first, the preparations for which are most advanced, will make a tour of the British Dominions. It is anticipated that it will leave England in June next, visiting the chief cities in South Africa, Australia, New Zealand, and Canada, and returning about July, 1922. The other three tours which are under contemplation will visit the principal commercial centres in South America, the Far East, and the United States of America respectively. It is estimated that the displays will be on view for about a fortnight in each city. The exhibits will be packed, carried, and displayed in specially designed show cases and packing cases, which will remain the property of the firms. The scheme is self-supporting, and it is anticipated that on a basis of 500 exhibitors each tour will cost from £200 to £250 (excluding the cost of show and packing cases) per unit of space. Firms may apply for a half unit, or for one or more units, and there are five different types of show cases adapted to the varying requirements of particular trades.

It is hoped that the three tours to foreign countries will leave England during the last few months of this year. The Far Eastern tour will include in its itinerary some of the chief commercial centres in India, Siam, the Straits Settlements, Dutch East Indies, China, and Japan, and possibly Egypt, the complete journey occupying about two years. The South American tour will leave the United Kingdom in the late summer or early autumn, visiting probably Lima, Santiago, Buenos Aires, and Rio de Janeiro; and the U.S.A. tour will go to New York, Philadelphia, Atlanta, St. Louis, Chicago, and San Francisco. British firms who are interested in any or all of these tours are advised to make early application for an allotment of space, as the total number of units in each tour will be limited to 500. For the Dominions tour only applications received not later than March 31st can be guaranteed consideration. A pamphlet containing full particulars of the four tours, with provisional application forms for space units, may be obtained by interested firms from the headquarters of the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1, where specimens of the special types of standard show cases to be used on the tours are on view. Inquiries are invited from interested firms on any specific points not dealt with in the pamphlet.

Help for Disabled Men.—Probably the longest "honours list" that has ever been published is the recently issued "King's National Roll," which gives the names of about 10,000 employers who, up to the end of last year, had undertaken to show their appreciation and gratitude to those who were maimed in their country's service by giving them employment.

The scheme, which is quite a simple matter of arrangement between employers and the Labour Exchanges, has met with marked success, and practically every branch of industry and commerce is represented in the list. Although the scheme applies to unskilled men, in the main, it is hoped that employers will eventually train them to enable them to be put on the same level of earning capacity as their more fortunate brethren. It is to be remembered that a great number of these disabled men joined the forces to the detriment of their civil careers—training in many cases being abruptly broken off, but there is no doubt that a little care and consideration will help them to become useful citizens, and, moreover, will make them feel that the country they fought for has not forgotten its enormous debt to them. Many big firms and municipal authorities have resolved that contracts shall only be placed with people who have undertaken this obligation, and although this will act as an incentive to employers to enrol themselves under the scheme, it is to be hoped that this will not become the main reason for participation in the scheme.

The notes accompanying the list state that there are still thousands of wounded men unable to find employment, and so it is to be hoped that the scheme will be kept prominently before the public until the great debt is settled.

LIGHTING AND POWER NOTES.

Aldershot.—Proposed Extensions.—The Urban District Council has applied for a loan of £21,550 for additional plant and extensions to the buildings at the electricity works.

Australia.—Government Supply Undertaking.—The report upon the Western Australian Government's supply undertaking for the year ended June 30th, 1919, records a net loss of £120, against a deficit of £5,250 for the previous period.

Barnes.—Extensions Approved.—The Urban District Council has been informed by the Electricity Commissioners that it can proceed to make contracts for generating plant, transformers, converters, &c., needed for extensions at the electricity works. The Council has decided to pay an extra £1 per year for each public electric lamp, making the cost £4 15s., and to increase the supply of electricity to Messrs. Watney, Combe, Reid & Co. from a maximum of 300 kw. to 400 kw., with the right for the firm to require a further supply of 400 kw.

Beckenham.—Price Increase.—In order to recoup the deficit resulting from the last nine months' working, the Council is increasing its charges to consumers as from April 1st. The price for lighting is to be raised from 8d. to 10d. per unit, and for heating from 2d. to 2½d. Special contracts will probably be revised. The new charges are expected to increase the revenue by £4,350.

Bo'ness.—Proposed Extensions.—The Town Council is considering the need for further extension of the electricity works, and the desirability of taking the management of the undertaking into its own hands at the next determining period. The capital sum borrowed up to the present is £49,000. An expert is to be called in to report on the proposed extension.

Bexhill.—Cable Extension.—The electrical engineer's scheme for the construction of new feeder cable contemplated the carrying of the cable for some distance along the L.B. and S.C. Railway embankment, thereby effecting a considerable saving in expenditure as against completing the whole length by means of highway excavation. The railway company will raise no objection, subject to a satisfactory agreement being entered into, to the feeder being laid along the railway line from the electricity works to Sea Road Bridge only. The engineer has submitted a revised estimate of cost of extension covering this route, which amounts to £4,600, and has been adopted.

Bradford.—Strike Threat.—Owing to one of the employés at the Corporation electricity works refusing to join a Trade Union, the remainder of the workmen sent in a strike notice to take effect on Saturday, March 20th, but as the result of overtures from the Corporation, it was decided to place the matter before a joint consultative board of representatives of the Corporation and the Trade Unions on the 22nd, and the threat to strike was accordingly withdrawn.

Bristol.—Parliamentary Bill.—In view of the establishment of the Electricity Commission and the opposition encountered by the Corporation's Bill, it has been decided that, if expedient, any or all of the electrical clauses shall be withdrawn.

Burnley.—Estimate.—The estimated profit on the electricity works for the year is £2,991, which is increased by £935 brought forward. It is proposed to transfer £2,000 to the rates, and place £1,926 to reserve. Reserve and depreciation funds now stand at £26,673.

Continental.—France.—The Energie de Seine-et-Yonne has applied for sanction to the erection of a 20,000-volt overhead transmission line to supply power from Epicy to the pumping station of the Eaux de Sorques, belonging to the City of Paris.

The Conseil Général du Bouches du Rhone has decided to establish a hydroelectric station to generate power for public and private lighting and electric traction. A concession is to be asked for from the State of a waterfall on the Durance River, between Cadenel and Pertuis. Plans for the whole scheme are in course of preparation.

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The Municipal Council of Issoire (Puy-de-Dôme) has transferred the concession for the supply of electricity from the Compagnie du Gaz d'Issoire to the Société Hydro-electrique de Clermont.

The Société des Forges et Aciéries Paul Girod, of Ugine, is building a hydro-electric station at the Beaufort Fall, 270 metres high, on the Dorinet River. A second fall, 240 metres high, at Belleville, will next be taken in hand.

Gas and electric light have now to be shut off at 8 p.m. in all shops at Lille, owing to the coal strike, and cafés and restaurants must close at 9 p.m.—*Paris Daily Mail.*

The "Super Central of Gennevilliers," outlined in the programme of the Union d'Electricité, which is in replacement of the older works of the several Paris companies with which it has amalgamated, will have a capacity of 200,000 KW., raised eventually to 300,000 KW. The turbines, each of 35,000 KW., are on order with the Société Alsacienne, Schneider & Escher-Wyss. One line, at 60,000 volts, will be allocated to serve the Paris district, and several important communities, such as Creil, Meaux, Mantes and Corbeil. The Union will now be able to furnish, with the help of the suburban secteurs associated (Ouest-Lumière, Est-Lumière, Triphasé, Secteur de la Rive Gauche) 700,000,000 KW.-hours per year. An offshoot society, just constituted, is the Société Hydro-Electrique du Sud-Est.

The Chamber of Commerce of Nancy is making a comprehensive study of a project for utilising the water power of the Rhine, by which electric power could be generated and distributed throughout the greater part of Eastern France.—*Financier.*

ITALY.—Application has been made to the Ministry of Public Works on behalf of the firm of Carls Mosca for a concession for a hydro-electric scheme, estimated to cost 120,000,000 lire. The plans propose the utilisation of the torrents of the Valcellina and of the River Cellino, yielding an aggregate force of 41,087 H.P., to be employed in the electrochemical industry. Three falls are to be worked, that of Lesis, 195 metres; the Cellino, 134 metres, and the Barcis, 103 metres.

The Società per le Forze Idrauliche della Sila has under consideration a number of mountain storage reservoirs for impounding the waters of the rivers Arvo, Ampollino, and Noto, capable of generating together 150,000 KW. The electricity will be used not only in Calabria, but in Puglie, Campania, and also possibly so far off as Sicily. One reservoir alone, now under construction, will have a capacity of 61,000,000 cb. metres, drawn from the Ampollino. The reservoir wall will have a height of 29 metres, and the plant installed will develop 496,660 H.P.

SWEDEN.—The managers of the Stockholm Municipal Supply Works state that, as a result of the increasing demand for energy, it is necessary to make provision for the erection of new works, and for this purpose they have entered into a provisional agreement for the acquisition of all the shares in the A. B. Svarthalsforsen, at the price of 2,250,000 kr. This company's waterfall, which is situated between Hammarfossen and Stadsforsen, is 263 miles distant from Stockholm, and is capable of yielding considerably greater power than the Untra works, from which power is already transmitted to the Stockholm works. It is calculated that the fall will be able to deliver 60,000 H.P., and a pressure of 200,000 volts will be necessary for the transmission, as compared with 100,000 volts in the case of the Untra works. It is considered desirable, however, for economic reasons, for a still larger quantity of energy to be directly transmitted to Stockholm than that represented by the capacity of the Svarthalsfors, and the question arises as to the acquisition of other water powers for the possible further needs of Stockholm. As as alternative, it is suggested that the municipal authorities might co-operate in the transmission of power with the State's hydro-electric works at Stadsforsen, or with the Krangede works.

BELGIUM.—A Royal Decree has recently been issued, under which companies and firms holding concessions for the public supply of electricity, are authorised to increase their charges to the extent of 50 centimes per KW.-hour, so long as the advance does not increase the charge to more than 1 fr. per KW.-hour. The Decree supersedes any condition as to the price to be charged to consumers that may have been agreed upon between the authority or authorities, granting the concession and the concessionnaires.

Cupar (Fife).—TOWN LIGHTING.—With regard to the proposed installation of electrical plant for the town, the Fife Electric Power Co. has pointed out that its powers to supply electricity in all parts of the county are still in force, and accordingly the Council can only obtain powers by means of a special order by the Electricity Commissioners. In view of this, the Council is considering the question of taking a bulk supply from the Fife Electric Power Co.

Dublin.—STREET LIGHTING.—In reply to a letter from the Citizens' Association, the town clerk states that there has been no appreciable saving consequent upon the Corporation's decision to cut off all public lighting at 11.30 p.m., as the plant had to be kept running as usual.

Dundee.—LIGHTING CHARGES.—The new flat-rate proposals recently formulated by the electricity department are meeting with great opposition from tradespeople. The new terms are £1 per annum per 100 sq. ft. of space plus ½d. per unit plus 15 per cent., and are considered unnecessarily involved, and apt to work unfairly.

Glasgow.—SUB-STATIONS.—The Town Council has received permission to erect sub-stations at Cathedral Street and Mauldslie Street, Partick.

Halifax.—REPAIRS.—In consequence of repairs being effected to the condensing plant at the electricity works, the supply of electricity was cut off from daylight till 2 p.m. on March 28th.

High Wycombe.—PROPOSED PRICE INCREASE.—The Electric Light and Power Co., Ltd., is seeking to advance the price of electricity for lighting as from the quarter ending June next to 10d. per unit.

Hull.—EXTENSIONS.—Preliminary sanction has been given to the Electricity Committee's scheme of extensions, which involves an expenditure of £143,125. In his letter, Sir John Snell said that he was prepared to advise the Corporation to let the necessary and more urgent contracts, and he would advise the Commissioners to sanction the proposed loan in due course. He could not say whether it would be necessary to hold an inquiry, but, owing to the isolation of Hull, it was not likely to be affected by any district scheme for many years to come. The Committee decided to proceed with the scheme as speedily as possible. To meet the position caused by the 10s. reduction in the price of coal, it was agreed, pending actual experience, to make an allowance to consumers at the rate of 0·3d. per unit sold, the same to be deducted in a lump sum at the end of the March quarter, the allowance to be adjusted as deemed necessary, from time to time.

Liverpool.—ISSUE OF STOCK.—Of the £4,000,000 being raised by the creation of 6 per cent. City stock, £1,000,000 is required for electrical developments and extensions, and £300,000 for the tramways.

ADDITIONS.—Arrangements have been made for contractors to carry out building works, &c., at five power sub-stations.

London.—HACKNEY.—The Electricity Commissioners have notified the London County Council that they raise no objection to the sanctioning of a loan of £305,580 for electrical extensions as they are of opinion that such extensions are necessary. The London County Council concurs, but requires the Borough Council to account for outstanding balances on loans raised for the purchase of any of the present plant that may be displaced.

Lymington.—PUBLIC LIGHTING.—The Town Council has accepted the tender of the Electric Light Co. for public lighting at £429 per annum.

Stockton Heath.—ELECTRICITY SUPPLY UNAVAILABLE.—The Council has been informed that Warrington Town Council is not in a position to supply electricity to the parish, as the Warrington undertaking cannot meet the requirements of local manufacturers.

Tullamore.—ELECTRICITY SUPPLY.—Prominent business people are forming a company to provide electricity for power and lighting for the town. The estimated cost of the project is £12,000.

TRAMWAY AND RAILWAY NOTES.

Australia.—YEAR'S WORKING.—A net loss of £4,046 was the result of the working of Western Australian tramways during the year ended June 30th, 1919. This deficit, it is stated, is due in the main to a strike which commenced on December 21st, 1918, and was not settled until February 7th, 1919, causing an estimated loss to the system of £21,000. The influenza epidemic was also responsible in part, the loss from this cause being £600.

Blackburn.—LECTURES.—An interesting lecture was given to the Corporation tramway employés on March 18th, by Mr. W. Willets, armature winder to the department, on the "Electrical Equipment of Tramcars." He gave full details of the many minor faults which could be rectified by the men themselves, and fully explained the uses and abuses of the electric brake, pointing out the damage caused to the equipment by the frequent use of this emergency brake. There were about 60 employés present, also the manager, and other officials. Mr. Cowell, the manager, in proposing a vote of thanks to the lecturer, pointed out that if the men followed the instructions given by Mr. Willets, a great saving would be brought about both in reducing the quantity of energy consumed, and in lessening the expense of repairs. The lecture was repeated on Thursday, the 25th, for the benefit of those employés who were unable to attend owing to being on duty. The management is also arranging for two lectures to be given to the conductors by Chief Inspector Riley on "How to Become Efficient in your Duties."

Brazil.—RAILWAY ELECTRIFICATION.—A contract has been concluded between the Cia. Paulista and the Empreza Electrica de Jundiahy and the S. Paulo Electric, in connection with the electrification of the lines of the Cia. Paulista. The value of the contract is 3,025 contos, and its duration 10 years, renewable for a further similar period. The minimum supply of electric power is to be 8,400,000 KW.-hours, which may be raised to 20 million when the company decides on the electrification of all its lines. The first section to be converted is that between Jundiahy and Campinas.—*Board of Trade Journal.*

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Burnley.—Estimated Loss.—There is not expected to be any balance on the working of tramway department, either for profit or renewals. The estimates for the coming year show a loss of £3,417, without any provision for renewals, and a revision of fares will have to be reconsidered at an early date.

Continental.—Austria.—The Austrian State Railway Administration has drawn up a five years' electrification programme, for the realisation of which foreign capital will be enlisted. According to the *Neue Freie Pr.*, the Steniach-Irdning-Attnang-Puchheim line is to be supplied with energy from the power station of Stern and Hasserl, in Gosau; the Innsbruck-Bludenz line from a power station in course of construction on the Spullersee. The Ruetz Works at Innsbruck, now supplying the Mittenwaldbahn, are to be extended so as to supply the eastern portion of the Arlberg railway. The Salzburg-Schwarzach-St. Veit line is the next one to be dealt with, and a power station of its own will be erected in the Stuppachtal. Experts at present are engaged in discussing ways and means for this scheme, and in determining financial preliminaries.—*Economic Review.*

Sweden.—The Narvik Railway, which carries iron ore from Sweden to the ice-free harbour in Norway for transhipment to England, has been electrically worked for some years on the Swedish side—that is, from the ore deposits to the Norwegian border. Electrification of the line from Lulea to Narvik is, however, in progress, and it is expected that the line will be completely electrified by the commencement of 1922. A further portion of the Swedish line as far as Gällivara will be ready by the end of the current year, but further extensions, requiring about £950,000, are awaiting the sanction of the Swedish Parliament. The Norwegian portion is expected to be fully electrified by the end of 1921.—*Iron and Coal Trades Review.*

The Railway Administration in Sweden has handed the Government its estimates and plans for the electrification of the Swedish railways. The Stockholm-Gothenburg Railway will be first taken in hand, and its electrification is expected to cost Kr. 65 mill. The electric power will be obtained from the Trollhättan and Matala falls; the Jaerna-Norköpping and the Patternholm-Malmö lines are also to be electrified.—*Economic Review.*

France.—An extension of the departmental railways is contemplated by the Conseil Général of the Bouches du Rhone. It is proposed to build a new line to link Salon with Marseilles, passing through Roquefavour, Le Realtor, Peuves, Saint-Antoine and Aygalades. Avignon will be linked with Châteaurenard-Provence and Eyguières with Orgon. The line will be electrically worked, and the power supplied by the central station at Meyrargues, on the River Durance.

Italy.—A scheme, mooted at the beginning of the war, for an electric tramway network to open up the valley of the Cesano has been revived and extended by Signor Romano Andreoli, who has applied for a concession. The new line proposes to start from the Adriatic coast at the mouth of the Marotta and run as far as the city of Pergola, continuing thence to Fabriano-Urbino. A branch is to be built out to the sulphur mines at Bellisio, and another along the coast as far as Fano and Senigallia.

Glasgow.—Employes' Deputation.—A deputation of the National Amalgamated Workers' Union (M.E.A.) was recently received by the Tramway Committee. The object of the deputation was to urge the Council to find other employment for motormen and conductors who had been certified as medically unfit for their duties. The manager stated that only 20 out of a total of 1,423 men examined had proved physically unfit, and an endeavour was being made to provide them with suitable employment in the department. The deputation urged, in addition, that previous service should be taken into account when these men were placed in new positions.

Leeds.—Proposed Fare Increase.—The Tramways Committee has recommended the adoption of the full statutory limit of 1d. per mile. One mile-stages will be charged for at the present rate, there will be a ½d. increase for 2 and 3 miles, 1d. on 4 miles, and 1½d. on 6.

London.—Accidents.—Official figures published this week show that nearly 60 persons were killed or injured in the London streets every day during the past year. The actual figures for the Metropolitan Police District were:—Killed 687, injured 18,998, a total of 19,685. The casualties were caused as follows:—Tramcars, killed 41, injured 2,906: omnibuses, killed 136, injured 1,953; other vehicles, killed 510, injured 14,139.

Milnrow.—Suggested Railway Electrification.—The District Council has been in communication with the Lancashire and Yorkshire Railway Co., suggesting the advisability of extending the electrification of the line from Manchester to Oldham and Shaw onward to Rochdale. The company has replied that the suggestion is being considered.

New Zealand.—Tramway Extensions.—The Department of Overseas Trade states that the following loan proposal has been carried:—Wanganui: £140.000 for tramways, plant, and extensions. Particulars regarding this loan, and the sums allocated, are as follows:—For extension to the existing tramway, £36,310; for construction and erection of buildings and sheds, alterations and improvements to existing buildings, supplying machinery, plant, tools, apparatus, and appliances for generating power by steam, hydro-electric, gas or other approved motive power in connection with the tramways, and the supply of electric power and light to private consumers, £56,053; for constructing, providing, and supplying electric tramcars, trailer-cars, trucks, motors, equipment, and appliances, £19,351; for constructing, making, supplying and providing poles, cables, sub-stations, transformers, meters, and all other material, plant or appliances necessary, £28,086. Tenders will be called for the supply and erection of all machinery and plant, and for the materials necessary for the track and overhead equipment. Orders have already been placed for car and trailer bodies and the necessary equipment.

Pontypridd.—Accident.—Several persons were injured through the overturning of a car after a backward run of half-a-mile down a steep incline. Three vehicles were collided with during the run.

TELEGRAPH AND TELEPHONE NOTES.

Austria.—It is proposed to double the postal, telegraph, and telephone rates.

Belgian Congo.—There is a complete system of wireless telegraphy between Banana and the coast, and between Boma, Kinshasa, Coquilhatville, Basankusu, Umangi, Basoko, Stanleyville, Kindu, Kongolo, Albertville, Kikondja, Elizabethville, Lusambo, and Kilo. It is proposed to construct an intercontinental station to connect the Colony with Belgium, and to strengthen the stations at Benna, Coquithatville, and Elizabethville.—*Board of Trade Journal.*

Continental Telephone Charges.—The Postmaster-General gives notice that from March 22nd the charges for telephonic communication between the United Kingdom and France, and between England and Wales and Belgium, have been fixed according to a schedule in the *London Gazette* of March 19th, and now vary from 6s. to 12s. 10d. for a three-minute conversation with France according to the zone in which the call originates. The charges for calls between 9 p.m. and 7 a.m. are three-fifths of the charges during the day time. The charge for a three-minute conversation with Belgium is 8s. In the case of a call to or from a call office, a fee of 6d. for a period of three minutes, and 1s. for six minutes is payable, in addition to the above charges.

Finland.—The receipts of the Finnish Telegraph Office in 1919 amounted to F.Mk. 10,519,164, and the expenses to F.Mk.6,517,181, giving a surplus of F.Mk.4,001,983. The number of foreign telegrams dealt with was 739,904, as against 231,423 in the previous year. Corresponding figures for internal telegrams are 325,825 and 253,490 respectively. According to *Uusi Suomi*, a project is on foot for inter-State telephone connection between Finland and Sweden. It is suggested that a line should be opened between Uleaborg and Torneaa.—*Economic Review.*

Naval Wireless Stations.—The Admiralty announces that officers in charge of tropical wireless stations will be appointed normally for a period of one year, and those in charge of non-tropical stations for two years. Officers appointed in charge of stations coming under either category will be allowed the option of an extension of their appointment up to a maximum of three years. An appointment of two years' duration entitles its holder to repayment of half the cost of passage of his wife and family, but the privilege of free passages for wives and families is restricted to officers holding appointments the duration of which is five years or upwards. In the new Navy Estimates, under the Works Vote, a sum of £12,400 is taken for the provision of living accommodation at the wireless stations at Bathurst (West Africa), Demerara, and Jamaica. The new quarters for the staff at the first-named station will cost altogether £16,800, of which £7,400 remains to be voted in future years.—*The Times.*

Restoration of Cables.—It was decided in July last to re-open telegraphic communication with Germany, and the new cable ship *Monarch* started repair work in the North Sea on the Bacton-Borkum cables during the early part of August. Faults were cleared on Bacton No. 1 cable, and working commenced on August 23rd. The *Monarch* commenced the repair of Bacton No. 2 cable early in September, and on the Mundesley-Norderney cable in the middle of the same month. The repair of these three cables has provided 11 workable wires to Germany. One conductor in Bacton No. 2 cable, however, is faulty and unworkable; and two of those in Bacton No. 1 are also faulty, though workable with simplex Hughes apparatus. There thus remain for repair, when other work permits, the following Anglo-German cables:—Bacton-Borkum No. 3, Lowestoft-Norderney, and Lowestoft-Borkum, each of which has four conductors. During the war the repeater station at North Walsham had been dismantled of all repeating apparatus for use in other spheres; it was decided at the end of July to re-equip the station on the pre-war basis, and the station was ready for work in time for the re-opening of telegraphic communication with Germany. It was found necessary to replace several of the secondary cells, and some of the wiring had also to be renewed, but, on the whole, the condition of the equipment that had been left *in situ* was good.—*T. and T. Age.*

Sweden.—The Swedish Telegraph Administration has placed before the Government a scheme for the establishment of a large wireless station for communication with the United States. It is considered that the existing station at Karlsborg cannot be extended so as to deal with American messages, and it is, therefore, suggested that a new station should be erected near Falkenberg,

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with masts 200 metres high, of a capacity of from 300 to 400 KW., and a wave length of 17,000 metres. The expenditure is estimated at 10,000,000 kr. and the annual working expenses at 850,000 kr., and it would be possible to complete the work early in 1923.

It is reported from Stockholm that the State telegraph authorities have tested a Swedish invention which is claimed to enable wireless messages to be kept secret. The device is said to consist in the use of "a kind of electrical vibrator."

Telephone Delays.—Mr. Illingworth, replying to questions in the House of Commons, last week, stated that the number of applications received for telephones from January 1st, 1919, to January 1st, 1920, was approximately 94,300; the number of new installations completed, excluding those for Government Departments, was 61,987. The total number of telephone intruments provided in these new installations and in extensions of existing installations was 103,686. The delay in providing telephone circuits in certain districts was generally due to shortage of spare wires in the underground cables or want of accommodation for additional circuits on the exchange switchboards, and to difficulty in obtaining from contractors an adequate supply of manufactured material, including underground pipes, switchboards, and other plant. There were a large number of contractors for various classes of telephone equipment; any firm might compete on furnishing satisfactory evidence of ability to meet Post Office requirements. As a general rule tenders would not be invited from manufacturers outside the United Kingdom. Of 27,547 instruments recovered from Government Departments, it was not possible to say how many were included in the 103,686 telephones installed for private subscribers. The instrument was only a relatively small part of the apparatus required to give telephonic service.

Telephone Exchanges.—Two new telephone exchanges—Broadway and Latchmere—have recently been put into operation, and others will shortly be added. These two are extensions of the Stratford and Battersea exchanges, and were installed to relieve the pressure in those districts. Four new telephone exchanges will be set up at the Tower, Holborn (the old Inns of Court Hotel), Marylebone, and Clerkenwell. Alterations and extensions are also contemplated at Erith, Esher, Harrow, Redhill, Sidcup, and Woodford. In addition, a new exchange, to be known as the Toll Exchange, is to be opened in the City, and will deal solely with short-distance trunk calls, up to about 50 miles.

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the ELECTRICAL REVIEW *in which the "Official Notice" appeared.)*

OPEN.

Australia.—MELBOURNE.—April 12th. City Council. Two 2,000-KW. rotary converters; H.T. switchgear, 6,600 v.; D.C. switchgear, 600 v. (January 30th.)

Bacup.—March 27th. Electricity Department. Annual contracts, including cables, fuses, lamps, meters, &c. (March 19th.)

Bedford. — March 31st. Electricity Department. Twelve months' supply of electricity meters and H.T. and L.T. cables. (March 5th.)

Bedwellty. — April 12th. Urban District Council. Electric wiring, fittings, &c., at Pengam and Aberbargoed. (See this issue.)

Belgium.—April 7th. The municipal authorities of Ixelles, Brussels. Supply of a quantity of armoured cable for low-tension distribution mains. Specifications may be obtained from the Maison Communale, Ixelles, for two francs.

April 6th. Municipal authorities of Chassepierre (Province of Luxenbourg). Tenders for a central electric lighting station in the town.

Bradford.—Board of Guardians. Installation of a telephonic system at St. Luke's Hospital, and extension of electric lighting system at Bowling Park Institution. Mr. F. Holland, engineer, 22, Manor Row.

Canterbury.—April 19th. Electricity Department. One 1,000-KW. three-phase turbo-alternator, surface condensing plant, two rotary converters, superheater, &c. (See this issue.)

Durham.—Board of Guardians. Installation of electric lighting at the Workhouse. The Clerk.

Eastbourne. — April 16th. Electricity Department. Supply and erection of one water cooling tower. (See this issue.)

Edinburgh.—March 29th. Electricity Supply Department. Condensing plant for Portobello station. Specification No. 23. (February 27th.)

Great Yarmouth.—April 16th. Electricity Department. One 2,000-KW. turbo-alternator, one 750-KW. rotary converter and transformer, and one 750-KW. frequency changer. (March 19th.)

Leith.—Town Council. Materials for the year, from May 16th, including overhead, electrical and car fittings, and insulated wire, &c. Mr. J. A. Greig, Town Clerk.

Lincoln.—April 8th. Electricity Department. Pipework, and motor-generator and switchgear for St. Swithin's power station. (March 5th.)

Limerick.—March 31st. Electricity Department. General stores, cable, meters, lamps and accessories. (See this issue.)

London.—SHOREDITCH.—Electricity Supply Department. Water-tube boiler, 5,000-KW. turbo-alternator, E.H.T. and D.C. switchgear. (March 19th.)

HAMMERSMITH.—March 31st. Electricity Department. E.H.T., H.T. and L.T. cables, 3½-in. and 4-in. conduit, E.H.T. and H.T. switchgear, static transformers. (See this issue.)

Margate.—April 15th. Town Council. Electric light installation, pavilion and winter gardens. Mr. J. E. Saxby, Manager.

Newport (Mon.).—March 27th. Tramways Department. Tramway bodies, trucks, electrical equipment. Mr. A. Nichols Moore, Borough Electrical and Tramways Engineer, Town Hall.

Peterborough. — Electricity Department. 1,000-KW. turbo-alternator with condenser and pipe work, switchgear, 500-KW. rotary converter, superheaters, induced draught fan, two sets forced draught furnaces, foundations and builders' work, and H.T. cables. (March 19th.)

South Africa.—April 24th. Oudtshoorn Municipality. Time for receipt of tenders extended from March 24th to April 24th.

Spain.—Municipal authorities of Lora del Rio (Province of Seville). Tenders for the concession for the electric lighting of the town during a period of 20 years.

CLOSED.

Aldershot.—Urban District Council:—

Boilers for the electricity works.—Babcock & Wilcox, Ltd., £8,495.

Belgium.—The municipal authority of Couckelaere has placed a contract with the Anglo-Belgium Co., of Ghent, and the Société Electricité et Mecanique, of Brussels, for plant for an oil engine-driven central electricity generating station, the first named concern supplying the engines, and the Brussels Co. the electrical plant.

Glasgow.—Electricity Committee. Recommended:—

Bruce Peebles & Co., Ltd.—Four 6,500-volt, 1,500-KW. rotary converters, with transformers, £36,400.

Metropolitan-Vickers Electrical Co., Ltd.—Three 20,000-volt, 1,500-KW. rotary converters, with transformers, £29,310; and one 6,500-volt, 500-KW. rotary converter, with transformer, £8,790.

British Thomson-Houston Co., Ltd.—One 20,000-volt, 1,500-KW. rotary converter, with transformer, £8,750.

The Committee has accepted the offer of the Corporation of Alloa, for the purchase of second-hand plant, at the Partick Electricity Works, consisting of boilers, engines, converters, &c., at £20,000.

Town Council. Accepted:—

50 pressed-steel gear cases.—Wm. Little & Sons.
Forgings for car trucks.—English Electric Co., Ltd.
Trolley cable.—B. I. & Helsby Cables, Ltd.

Government Contracts.—The following Government contracts have been placed during February, 1920:—

ADMIRALTY (CONTRACT AND PURCHASE DEPARTMENT).

Armature drying plant.—Manlove & Alliott.
Centrifugal circulating pump.—Brush Electrical Engineering Co., Ltd.
Electric crane.—Cowans, Sheldon & Co., Ltd.
Conversion of steam crane.—Ransomes & Rapier, Ltd.
Electric lighting.—Foot & Milner.
Electrical boxes, &c.—Basebe, Sadler & Co., Ltd.; Hawkers, Ltd.
Blast fans.—Jas. Keith & Blackman Co.
Generator and switchboard.—The British Electric Plant Co.
Gas-filled lamps.—General Electric Co., Ltd.; Siemens Bros. Dynamo Works, Ltd.
Motor and control gear.—Electromotors, Ltd.
Motor generator set and switchgear.—Brush Electrical Engineering Co., Ltd.
Reconstruction of motor.—British Electric Plant Co., Ltd.
Underground cables and electric lighting.—Macintosh Cable Co., Ltd.
Motor-driven sewage pumps.—Pulsometer Engineering Co., Ltd

MINISTRY OF MUNITIONS.

Electric storage battery.—Chloride Electrical Storage, Ltd.
Generators.—Eastgate Meller, Ltd.; Leading Light Syndicate, Ltd.
Insulators.—G.E. Co., Ltd.; Siemens Bros. & Co., Ltd.
Telephones.—G.E. Co., Ltd.

POST OFFICE.

Protective apparatus.—Phœnix Telephone & Electric Works, Ltd.; Siemens Bros. & Co., Ltd.; Western Electric Co., Ltd.
Telegraph apparatus.—Automatic Telephone Manufacturing Co., Ltd.; B.I. & Helsby Cables, Ltd.
Telephone apparatus.—Automatic Telephone Manufacturing Co., Ltd.; British L.M. Ericsson Manufacturing Co., Ltd.; International Electric Co., Ltd.; Western Electric Co., Ltd.
Telegraph and telephone cable.—Callender's Cable & Construction Co., Ltd.; W. T. Henley's Telegraph Works Co., Ltd.
Lamp caps.—C. A. Apperley.
Casing and cover.—Siemens Bros. & Co., Ltd.
Insulator cloths.—Thomas Brigg (London), Ltd.
Cords for telephones.—London Electric Wire Co. & Smiths, Ltd.; Phœnix Telephone & Electric Works, Ltd.; Western Electric Co., Ltd.
Earthenware ducts.—Doulton & Co., Ltd.; Stanley Bros., Ltd
Insulators.—Taylor, Tunnicliffe & Co., Ltd.
Insulating tape.—Siemens Bros. & Co., Ltd.
Telephones.—Siemens Bros. & Co., Ltd.
Troughing.—Doulton & Co., Ltd.
Copper enamelled and silk covered wire.—Concordia Electric Wire Co., Ltd.
Switchboard wire.—London Electric Wire Co. & Smiths, Ltd.
Accumulators.—Tower, Bishopsgate, Marylebone and Holborn Relief Exchanges.—D. P. Battery Co., Ltd.

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Laying conduits.—City of London, Westminster and Chelsea: J. Mowlem & Co., Ltd. Stepney, &c.: Foot & Milne, Ltd. Hammersmith: Laing & Co. Willesden, &c.: O. C. Summers. Hornsey, &c.: O. C. Summers. Fulham, Battersea, Wandsworth and Merton: Laing & Co. Maidenhead: J. A. Ewart, Ltd. Clerkenwell area: J. Mowlem & Co. Maryhill: Greig & Matthews. Heywood-Middleton: A. Armistead. Blackwall Lane: O. C. Summers. Cuckmere-Eastbourne: W. Dobson. Bexley Heath: J. Mowlem & Co., Ltd. Wimbledon-Earlsfield: J. Mowlem & Co., Ltd.

Motor-driven compressor plants.—Leafield and Cairo Wireless Stations: Reavell & Co., Ltd.

Telephone exchange equipment.—Hornsey: Western Electric Co., Ltd. Leith: Western Electric Co., Ltd. Hurley: Siemens Bros. & Co., Ltd. Glasgow (South): Western Electric Co., Ltd.

INDIA OFFICE (STORES DEPARTMENT).

Armatures.—Greenwood & Batley, Ltd.
Low-resistance cells.—Siemens Bros. & Co., Ltd.
Motor converters.—Bruce Peebles & Co., Ltd.
Electrolytic copper.—Elder Smith & Co.
Carbon cups, &c.—Peel Conner Telephone Works, Ltd.
Cell elements.—General Electric Co., Ltd.
Induction motor.—Siemens Bros. & Co., Ltd.
Motors and control panels.—Lancashire Dynamo & Motor Co., Ltd.
Pumping machinery.—Worthington-Simpson, Ltd.
Copper wire.—T. Bolton & Sons; Callender's Cable & Construction Co., Ltd.; Elliotts Metal Co.; R. Johnson & Nephew; Shropshire Iron Co.; F. Smith & Co.

CROWN AGENTS FOR THE COLONIES.

Telephone cables.—Siemens Bros. & Co., Ltd.
Lux cells (parts for).—Chloride Electrical Storage Co., Ltd.
Insulators.—Taylor, Tunnicliffe & Co., Ltd.
Insulator spindles, &c.—Bayliss, Jones & Bayliss, Ltd.
Telegraph instruments.—Elliott Bros. (London), Ltd.; Automatic Telephone Manufacturing Co., Ltd.
Telegraph line material.—Siemens Bros. & Co., Ltd.
Telephones, &c.—British L.M. Ericsson Manufacturing Co., Ltd.; Gent & Co., Ltd.; Western Electric Co., Ltd.
Wireless apparatus.—Marconi Wireless Telegraph Co., Ltd.

H.M. OFFICE OF WORKS.

Engineering services.—Electric passenger lift, Manchester Pensions Offices: Marryatt & Scott, Ltd.

Lanarkshire.—With reference to the notice appearing under this heading in our last issue, Messrs. Ferranti, Ltd., inform us that they have not offered to supply an imported meter.

London.—L.C.C. The Highways Committee recommends that it be authorised, during the Easter recess, 1920, to open any tenders involving capital expenditure over £1,000, which may be received for the supply of materials, &c., and for the execution of work included in the order of reference to the Committee.

BATTERSEA.—Electricity Undertaking Committee. Recommended:—

Fan for the upper rotary room at the generating station, £90.—Sturtevant Engineering Co., Ltd.

5,000-KW. turbo-alternator and Mirrlees condenser, £35,335.—Fraser and Chalmers Engineering Co., Ltd.

HACKNEY.—Electricity Committee. Recommended:—

Extension and completion of the sub-station at Northwold Road:—

L. H. & R. Roberts	**£4,421** (recom.)
Stapleton & Sons	4,490
Marrable Bros.	4,600
W. Shurmur & Sons	5,468
Barrett & Power	6,682

Supply of E.H.T. cables in connection with the extension scheme adopted January 28th last.—B. I. & Helsby Cables, Ltd.

Hull.—Electricity Committee:—

Richardsons, Westgarth & Co., Ltd, £17,784.—New condensing plant. Stirling Boiler Co., £15,470.—Two new boilers.

FORTHCOMING EVENTS.

Royal Institution of Great Britain.—Saturday, March 27th. At Albemarle Street, Piccadilly, W. At 3 p.m. Lecture on "Positive Rays," by Sir J. J. Thomson, F.R.S.

Institution of Electrical Engineers.—Monday, March 29th. Informal meeting. At the Albert Tavern, 52, Victoria Street, S.W. At 7.30 p.m. Social evening (smoker).

Illuminating Engineering Society.—Tuesday, March 30th. At the Royal Society of Arts, John Street, Adelphi, W.C. At 8 p.m. Discussion on "Motor-car Headlights in Relation to Traffic Requirements," to be opened by Mr. J. W. T. Walsh.

Association of Engineering and Shipbuilding Draughtsmen.—Tuesday March 30th. At Liverpool University. At 7.30 p.m. Lecture on "Elementary Calculus," by Mr. S. Clowes.

Technical Inspection Association.—Tuesday, March 30th. At the Royal Society of Arts, John Street, Adelphi, W.C. At 5 p.m. Annual general meeting.

Rontgen Society.—Tuesday, March 30th. In the X-Ray and Electrical Departments of St. Bartholomew's Hospital, E.C. At 8.15 p.m. General meeting.

NOTES.

The Batti-Wallahs' Society.—The following is a list of new officers elected at the annual meeting on March 15th:—

President.—W. Wyld. *Vice-President.*—W. E. Ireland. *Past Presidents.*—H. T. Harrison, L. M. Waterhouse, W. Riggs, M. S. Chambers, F. J. Collis, J. S. Huddleston, J. F. Avila.

Committee.—E. Barralet, A. W. Blake, L. S. Richardson, J. P. Maginnis, R. Smith, H. Foulds.

Hon. Sec. Treasurer.—F. Pooley.

Hon. Entertainment Secretary.—A. J. Greenly.

Appointments Vacant.—Cable jointer (88s. 4d.), for the Tynemouth Corporation Electricity Department; E.H.T. plumber jointer (87s. 11d.); meter superintendent, for the Borough of Tunbridge Wells Electricity Works; electrical engineer, for the installation and inspection of consumers' meters (Rs. 540 per month); electrical engineer, for the position of deputy engineering agent (Rs. 1,250 month), for the Calcutta Electric Supply Corporation, Ltd.; charge engineer (88s.), for the Dewsbury Corporation Electricity and Tramways Department; boiler house superintendent (£400), for the Bristol Corporation Electricity Department; telegraph inspectors (£200 + £65) for the Tanganyika Territory Posts and Telegraph Department. See our advertisement pages to-day.

Glass Manufacture for the Electrical Industry.—The figures which were recently given in the ELECTRICAL REVIEW, in reference to the output of electric bulbs by a Westlake machine at Leamington-on-Tyne, have since been exceeded. It was regarded by the trade as a remarkable performance that the machine should produce 24,000 perfect articles in an eight-hour shift, especially as the normal weekly productivity of 180 men was somewhere about half a million. Last week, however, the machine in question turned out 570,000, which constitutes a world's record. The moulds scarcely missed during the whole week, which is a reflection of the good work of the metal gatherers. The firm marked their appreciation of this by voluntarily increasing wages by 5 per cent. Makers generally are moving rapidly in the glass trade. This week it is announced that a new combine, involving £1,000,000, is to be floated, with the primary object of increasing the output of table glass, but in the production from the new machines which are about to be introduced, electric lighting goods, and illuminating ware generally, will eventually find a prominent place. Manufacturers are in the happy position of being able to export bulbs. In this direction they have recovered quicker than any other section of the trade. The arrangements which have been made between Philips, of Holland, and the Edison Swan Co., at Ponder's End—referred to in the annual report of the former company, abstracted in last week's ELECTRICAL REVIEW—are more important than at first sight would appear to be the case. Philips's is the finest glass house in the world, and, to ascertain the methods of work there, the Ponder's End firm sent a deputation of workmen over to Holland. They found that six men were working at a pot, instead of three, as is the case in this country, and this, of course, meant that fewer moulds of the machines went round empty. It is now stated that the workmen in this country have undertaken to work the same system.

Siemens Copper Works in Russia.—It is reported that the managers of SIEMENS COPPER WORKS, at Kadabek, near Elisabetpol, South Russia, have been compelled almost entirely to stop working, as the copper deposits are exhausted. On the other hand, the second mine—the Quarz Chana, near Batoum—still contains ore, and the production could be raised to 10,000 poods of pure copper monthly. Operations at present, however, are in considerable, chiefly owing to the difficulty that funds are not available for the payment of wages. It is thought that if the Siemens Works at Tiflis had energetic representatives who could induce the Georgia Government to make advances on the copper produced, so as to defray the working expenses, it would be possible again to bring about an increase in the output.

Educational.—UNIVERSITY COLLEGE, LONDON.—At a luncheon last Friday in connection with the Engineering Equipment and Endowment Fund, at which Prince Arthur of Connaught, the President of the Fund, was chairman, he warmly commended the scheme to the audience, pointing out that 3,000 members of the University served in the war, that all the departments had been occupied in war work, and that the new chemical laboratories had done work of extreme national importance. So far £24,000 had been subscribed out of the £100,000 required. The Vice-Chancellor explained the scheme, and Sir Robert Hadfield regarded it as a national matter. Sir Gregory Foster said the college was crammed to overflowing; since September last, 400 applicants had been refused admission for lack of accommodation, and next session their difficulties would be seriously increased.

A further appeal has been issued on behalf of the Ramsay Memorial Fund, in order that an adequate sum may be provided to erect a Ramsay Memorial Laboratory of Chemical Engineering. A sum of £25,000 has been allotted to that purpose from the fund, but an additional sum of £50,000 is required to complete and endow the Laboratory.

IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY.—An appeal is being made by this College for funds required to carry on its work efficiently. In May last year there were 841 students in attendance, and the accommodation will this year be taxed to the utmost. A committee has been appointed to conduct the appeal, of which Mr. Otto Beit is the chairman: donations may be sent to the Marquess of Crewe, Crewe House, Curzon Street, W. 1, or to the Secretary of the College.

Electric Club Dinner.—The Birmingham and District Electric Club held its annual dinner at the Grand Hotel, Birmingham, on Saturday, March 20th. The president, Mr. H. W. Wolton, was in the chair. The evening was greatly enjoyed by over 100 members and friends, the toast list and musical programme being both well selected and well received. The club is looking for a considerable increase in membership as a result.

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Inquiries.—Makers of the "Zodiac" electric lamp are asked for. Information regarding electric incubators is desired; names of manufacturers and catalogue; also makers of plant for manufacturing calcium carbide.

Electric Vehicle Progress.—The Accrington Gas and Water Board is applying for permission to borrow £2,500 for the purchase of an electric storage battery locomotive. The Rotherham Corporation is applying for permission to borrow £2,740 for the purchase of two electric vehicles to be used by the Highways Department. The South Shields Cleansing Committee is to purchase two electric vehicles. An electric vehicle for refuse collection purposes has been ordered by the Stockton Corporation. The Torquay Town Council is purchasing two 2-ton electric vehicles at a cost of £1,372 each, from Edison Accumulators, Ltd. Mr. J. Jackson, superintendent, Birmingham Salvage Department, states that they "have four electrics working, 25 on order, and hope shortly to place an order for another four, making our total fleet for this year 33, which will, I think, be the largest number in use by any Corporation in this country. They are doing excellent work, and we are well satisfied with the vehicles."—*Electric Vehicle.*

Sir E. Geddes on Transport.—Sir Eric Geddes, Minister of Transport, discussed at length the future of British railways in his presidential address on Monday at the inaugural meeting of the newly-formed Institute of Transport, held at the Institution of Civil Engineers. There was a large attendance, and Sir John Griffiths, President I.C.E., presided. The following were, according to *The Times*, the chief points in Sir Eric's address:—

None of the transport agencies of this country could carry on on the basis of their pre-war revenue. This applied to railways in a marked degree; it also allied to roads, canals, tramways, and docks, yet the healthy existence of these agencies was vital to the State. The maximum charges which could be imposed by statutory undertakings were no longer sufficient, and the community must review the whole position. The old bargain must be altered to enable the companies to raise more money; but to avoid waste there must be more co-operation between the agencies, more amalgamation, more national control. He was not discussing the question of ownership. The State must have power to reduce working costs in every possible way, and it must be supplied with figures showing that the management was efficient and economical. The man in the street must be provided with full, accurate, and "live" statistics of operation, without which suspicion would never be dispelled. The community had a right to say what was a reasonable service for a statutory company to perform; what reasonable improvements should be made; and what reasonable rates should be charged. The State must also harmonise the operation of the different agencies in the interests of the community, allocating to each the share of the total work which it could best perform. They were on the eve of great extensions of the application of electricity to railway traction; a revolution was taking place in the organisation of transport in this country. The Institute could hardly perform a service of greater practical utility than to act as an impartial umpire, in the battle between alternating and direct current, remembering always that the scientifically ideal best, was not necessarily the same as the best practically possible.

British Engineering Standards Association.—In conformity with the Articles of Association, providing for rotation of office on the Main Committee, whereby one-third of the nominees retire each year, the Councils of the Technical Institutions which founded the Association have now made their new nominations, which take effect on March 31st. The Main Committee will then be constituted as follows:—

Sir Archibald Denny, Bart. (Chairman).

Sir Maurice Fitzmaurice, C.M.G. (Vice-Chairman).

* Sir John Aspinall, † Sir Arthur Duckham, K.C.B., Sir William Ellis, G.B.E., Sir William Matthews, K.C.M.G., Mr. Alexander Ross, Dr. W. C. Unwin,	Nominated by the Institution of Civil Engineers.
‡ Sir Henry Fowler, K.B.E., Sir Vincent Raven, K.B.E., Dr. William H. Maw.	Nominated by the Institution of Mechanical Engineers.
Dr. Arthur Cooper, § Mr. M. Mannaberg, ‖ Mr. Benjamin Talbot.	Nominated by the Iron and Steel Institute.
Sir W. E. Smith, C.B., Sir Thomas Bell, K.B.E.,	Nominated by the Institution of Naval Architects.
Col. R. E. Crompton, C.B., Sir John Snell, ¶ Mr. C. H. Wordingham, C.B.E.,	Nominated by the Institution of Electrical Engineers.
Mr. F. W. Gilbertson, Mr. F. R. Davenport,	Co-opted by the nominated members to represent the Federation of British Industries.
The Hon. Sir Charles Parsons, K.C.B., Sir Richard Glazebrook, K.C.B., Sir Robert Hadfield, Bart.,	Co-opted by the nominated members.

* Sir Douglas Fox, retiring.
† Sir Robert Elliott-Cooper, K.C.B., retiring.
‡ Mr. H. A. Ivatt, retiring.
§ Mr. George Ainsworth, deceased.
‖ Mr. Illtyd Williams, retiring.
¶ Mr. C. P. Sparks retiring.

Freemasonry.—The members of the Kelvin Lodge are reminded of the regular meeting which is due to be held to-night (Friday, 26th inst.) at Mark Mason's Hall, Great Queen Street. Early attendance is requested.

Railway Electrification.—As we recently announced, the Ministry of Transport has appointed a Committee to report to the Minister on the question of railway electrification. The Committee, which met for the first time on Monday last, is constituted as follows:—Sir Alexander Kennedy (chairman), Sir John Aspinall, Mr. A. R. Cooper (representing the London Electric Railways), Mr. Philip Dawson, Sir Alexander Gibb, Mr. C. H. Merz, Sir Philip Nash, Sir John Snell, Mr. Roger T. Smith, Sir Henry Thornton (representing the Railway Companies' Association); Major Redman, secretary.

The terms of reference to the Committee are that the Committee should report on:—

1. Whether any regulation should be made for the purpose of ensuring that the future electrification of railways in this country is carried out to the best advantage in regard to interchange of electric locomotives and rolling stock, uniformity of equipment, and or other matters.
2. If any such regulations are desirable, what matters should be dealt with, and what regulations should be made.
3. How far it is desirable, if at all, that railways or sections of railways already electrified should be altered so that they may form parts of a unified system.

INSTITUTION NOTES.

Royal Institution.—The following are included in the list of forthcoming arrangements:—

Friday, April 16th, at 9 p.m.—"Ions and Nuclei," by Dr. J. A. McClelland, F.R.S.
Friday, May 21st, at 9 p.m.—"The Thermionic Valve in Wireless Telegraphy and Telephony," by Dr. J. A. Fleming, F.R.S.
Friday, May 28th, at 9 p.m.—"Crystal Structure," by Prof. W. L. Bragg.
Tuesdays, April 13th and 20th, at 3 o'clock.—"Recent Advances in X-ray Work," by Major G. W. C. Kaye, D.Sc.
Tuesdays, May 25th and June 1st, at 3 o'clock.—"The Evolution of Large Bridge Construction," by Major C. E. Inglis.
Thursdays, April 15th and 22nd, at 3 o'clock.—"New Experimental Studies in the Liquid State," by Mr. Sidney Skinner.
Saturdays, April 17th and 24th, at 3 o'clock.—"The Thermionic Vacuum Tube as Detector, Amplifier and Generator of Electrical Oscillations," by Dr. W. H. Eccles.
Saturdays, May 29th and June 5th, at 3 o'clock.—"Recent Revolutions in Physical Science," by Mr. J. H. Jeans, LL.D. (Secretary Royal Society).

Bradford Textile Society.—On March 15th, Mr. Edwin Preece, consulting engineer, lectured on "Electric Driving of Textile Mills," and in the course of his observations gave a full description of the Tata Hydro-Electric Power Co.'s scheme in Bombay. Mr. A. M. Chapman presided.

Bristol Association of Engineers.—The concluding meeting of the 1919-20 session of the Association was held, under the presidency of Mr. J. McDonald, on March 17th. After dinner a paper was read by Prof. David Robertson, D.Sc., M.I.E.E., on the "Principles of Radio-Telegraphy," and a discussion followed. The election of officers and members of Committee for the next session was as follows:—President, Mr. Nicholas Watts; vice-president, Prof. David Robertson; hon. sec., Mr. H. T. Sully; and hon. treasurer, Mr. B. de Sayres, together with Messrs. A. E. Livermore, R. Robertson, and A. Davis.

Chief Technical Assistants' Association.—The annual general meeting of the above Association was held at Anderton's Hotel, Fleet Street, E.C., on the 16th inst. The retiring chairman, Mr. J. H. Parker, A.M.I.E.E. (President E.P.E.A.), reviewing the work of the Association during the past year, referred to the Electricity (Supply) Act in which, due to the activities of this and other Associations, a fairly satisfactory Compensation Clause had been inserted. He found that the papers read and discussed were very beneficial indeed in the discharge of their duties, as they were all directly connected with the work of electricity supply. Mr. A. P. MacAlister, A.M.I.E.E., was elected chairman, and in thanking the members for the honour, said he had hoped that Mr. Parker would continue in office for another year, so as to occupy the unique position of chairman of the C.T.A.A., and President of the E.P.E.A. at the same time, but, unfortunately, Mr. Parker could not find time for both. The following were the other officers elected for the ensuring year:—Vice-chairman, Mr. J. R. J. Bowden (Hackney); hon. treasurer, Mr. A. Murdoch (Fulham); hon. secretary, Mr. H. F. J. Thompson (Battersea); executive committee, Mr. J. H. Parker (Croydon); Mr. W. Young (Stepney); Mr. G. C. Law (Barnes).

Association of Mining Electrical Engineers.—The North of England Branch of the Association entertained a number of prominent members of the mining industry to luncheon on March 20th, at Newcastle-on-Tyne, following which a meeting was held. More than one speaker mentioned that since the Association was inaugurated the efficiency of electrical plant in mines had appreciably advanced. It was stated that during 1918, 11 accidents occurred in the North of England which could, in any way, be attributed to the use of electricity, while in 1919 the number of accidents fell to seven, although the installed horse-power had increased from 144,259 to 250,000 H.P. The figures represented one accident per 13,000 H.P. in 1913, against one per 36,000 H.P. in

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1919. All the foregoing accidents, except one, were non-fatal. It was stated that the efficiency of colliery officials and engineering staffs had been improved by the exchange of ideas and visits to other works.

Institution of Electrical Engineers.—At a meeting of the Western Centre at Bristol, on March 1st, Prof. D. Robertson gave a lecture on "Electric Impulse Clocks." After explaining the principle of the pendulum and the methods of compensation for errors due to temperature, friction, &c., the lecturer described the electrical impulse systems of the Synchronome Co., Messrs. Gent & Co., and the Silent Electric Clock Co. The lecture was illustrated with lantern slides and a collection of clocks in motion. In the discussion which followed, Mr. F. Hope-Jones emphasised the importance of imparting an impulse to the pendulum only at the centre of its swing, and of controlling the dials in series in such a way that their self-induction ensured their receiving an adequate impulse. Mr. H. T. Sully described the clock installation at the Southmead Infirmary, Bristol.

Coventry Engineering Society.—Mr. E. A. Watson, M.Sc., A.M.I.E.E., gave an instructive lecture, on March 19th, on "Electric Sparks, Spark Gaps and Spark Plugs, and their Relation to the Magneto." He dealt with the nature and meaning of dielectric stress, and the influence thereon of gap length and electrode shape. Discussing the nature of the spark, he explained the formation of disruptive sparks without corona and sparks accompanied by corona, and illustrated this phase of his subject by some interesting experiments. He explained the behaviour of different spark gaps with different forms of spark generator, the effect of wave form, and submitted a number of charts showing the impulse ratio. Factors governing the incendivity of the spark, and the best sort of spark to produce ignition, were particularly noted by the audience, and, proceeding to deal with the reaction of the spark gap upon the magneto, the speaker described the effect of voltage characteristics and spark-gap resistance. Mr. A. P. Young presided, and a hearty vote of thanks was passed to the lecturer.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

We read in the *Times* that on March 17th Sir Richard Glazebrook, late Director of the National Physical Laboratory at Teddington, was presented by the staff with his portrait in oils,, painted by his cousin, Mr. Hugh de T. Glazebrook. Accompanying the gift was an album, containing an illuminated address, followed by the signatures of past and present members of the staff, and a photograph of the laboratory taken from an aeroplane. Mr. F. E. Smith, F.R.S., presided, and Dr. T. E. Stanton made the presentation.

Whitehaven T.C. has referred back to the Lighting Committee a recommendation to increase the salary of the electrical engineer, Mr. Hogarth, to £500 a year.

Swindon T.C. is recommended to increase the salary f the borough electrical engineer from £350 to £450 a year.

Mr. J. M. Keenan, deputy borough electrical engineer at Torquay, has been appointed engineer and manager of the Thanet Electrical Co., Ltd., of Margate.

Walsall T.C. has advanced the salary of the electrical engineer from £650 to £800 a year.

Mr. W. W. Lackie, C.B.E., M.Inst.C.E., M.I.E.E., chief engineer and manager of Glasgow Corporation electricity department, who is leaving Glasgow on his appointment as one of H.M. Electricity Commissioners, was presented on Friday night with a silver tray from the employés of the department. Mr. R. B. Mitchell presided over a large gathering.

Mr. W. H. Hellyar, formerly engineer and manager of Chipping Norton electricity works, has been appointed resident mechanical and electrical engineer on the King's Estate at Sandringham.

The *Times* states that Lieut.-Col. W. H. D. Clark, O.B.E., H.M. Patent Office, and late Controller of the Munitions Inventions Department, has been appointed Chief Examiner of H.M. Patent Office, London.

The London County Council Highways Committee recommends that a gratuity of £500 be granted Mr. J. Terry, acting traffic operation superintendent of the Council's tramways, who is retiring after nearly 40 years' tramway service.

Mr. N. W. Prangnell has joined the staff of Messrs. C. A. Parsons & Co., at Newcastle. After being demobilised from his war service with the Navy he did not return to his old post of distributing engineer to the Metropolitan Electric Supply Co. While waiting for a new opening he has been acting as Controller of the Engineers' Stores Section of the Disposal Board.

Messrs. Handcock, Dykes & Trotter, consulting engineers, of 11, Victoria Street, Westminster, S.W. 1, announce that, owing to the decision of Mr. A. P. Trotter to retire to the country, where he will devote himself to his special scientific subjects, the firm has from the 25th inst., resumed the old name of Handcock & Dykes, under which it was founded in 1894.

After numerous postponements of the matter, the Bray Urban District Council has increased the salary of Mr. W. J. U. Sowter, electrical engineer and manager, from £330 to £425 per annum as from March 31st, 1919, and that of Mr. V. Dempsey, assistant electrical engineer, to £250 per annum as from March 31st, 1918. These increases, together with similar increases to the other officials of the Council, have been granted as the result of an award made by an arbitrator appointed by the Ministry of Labour. A section of the Council was reluctant to accept the provisions of the award, but it was pointed out that failure to comply with the findings of the arbitrator might result in a strike of the officials concerned. In the end, after considerable acrimonious discussion, the Council decided to adopt the terms of the award.

Obituary.—Mr. A. G. Lyster.—The death occurred last week, at the age of 68 years, of Mr. Anthony G. Lyster, who several years ago retired from the position of engineer-in-chief to the Mersey Docks and Harbour Board, and entered the consulting engineering firm of Sir John Wolfe Barry.

Mr. E. Duckworth.—News from South Africa reports the death, at Cape Town, of Mr. Ernest Duckworth, due to collapse following an operation for appendicitis. Since 1903 Mr. Duckworth had been on the staff of Cape Town electricity works, holding a responsible position at their Dock Road power station.

Mr. E. Lee.—The death is announced of Mr. Edwin Lee, who had for some years carried on business as an electrical engineer at 111, Union Street, Torquay.

NEW COMPANIES REGISTERED.

Palmer, Riley & Co., Ltd. (165,386).—Private company. Registered March 17th. Capital, £10,000 in £1 shares. To take over the business of electrical manufacturers and factors carried on by W. Palmer and J. E. Riley at Market Chambers, Backburn Road, Accrington, as "Palmer, Riley & Co." The first directors are: W. Palmer, 291, Blackburn Road, Accrington; J. E. Riley, 12, Royle Road, Chorley. Secretary: J. E. Riley. Registered office: Market Chambers, Blackburn Road, Accrington.

Magnetic Transmission Co., Ltd. (165,420).—Registered March 18th. Capital, £300,000 in £1 shares (195,000 preferred ordinary). To take over the right to manufacture and sell in the U.K. the system of power transmission known as the "Entz Magnetic Transmission," together with the right to export to any place outside the U.K. motor cars and automobiles after the same have been completed and the Entz transmission installed therein, or any other article for which the said transmission may be useful, and to adopt an agreement with L. Crown and the Owen Magnetic Transmission Syndicate, Ltd. The subscribers (each with one preferred ordinary share) are: L. V. Rothschild, 25, Sackville Street, W.1), engineer; R. G. Wilson, 23a, Bruton Street, W.1, engineer; J. L. Crown, Gwydyr Mansions, Hove, engineer; and four others. Minimum cash subscription, £7. J. L. Crown is the first director. Solicitor: N. P. Arnold, 35, King Street, Covent Garden, W.C.

R. J. Richardson & Sons, Ltd. (165,142).—Private company.—Registered March 11th. Capital, £10,000 in £1 shares. To carry on the business of mechanical, electrical and general engineers, manufacturers of dynamos, lamps, cycles, motor and accessories, &c. The first directors are: R. J. Richardson, The Croft, Ravenhurst Road, Harborne, Birmingham; J. J. Richardson, 67, Carless Avenue, Harborne, Birmingham; R. R. Richardson, 66, Carless Avenue, Harborne, Birmingham. J. T. Richardson, The Croft, Ravenhurst Road, Harborne, Birmingham. Registered office: Commercial Street, Birmingham.

Taylor, Hunter & Co., Ltd. (165,152).—Private company. Registered March 11th. Capital, £5,000 in £1 shares. To carry on the business of electric and general engineers and contractors, builders, builders' merchants, &c. The subscribers (each with one share) are: W. Baines, Broad Street House, E.C.2, clerk; C. R. J. Enever, Broad Street House, E.C.2, articled clerk. The subscribers are to appoint the first directors. Solicitor: C. R. Enever, Broad Street House, E.C.

Phœnix-Tester, Ltd. (165,138).—Private company. Registered March 11th. Capital, £2,000 in £1 shares. To carry on the business of electrical and mechanical engineers, &c. The first directors are: F. H. Lemaire, 80, Cowley Road, Mortlake, S.W.; A. Mungovan, 35, Parolles Road, Highgate, N.; J. F. Tester, 44, Doneraile Street, Fulham, S.W.; T. E. Turner, Owls Park Avenue, Potters Bar. Registered office: 76, Gamage Building, Holborn, E.C.1.

Road Guides, Ltd. (165,231).—Registered March 13th. Capital, £250,000 in £1 shares. To take over patent 131,235 of 1919, for the U.K. and Isle of Man, in respect of improvements in route indicators for use on road vehicles, &c. The first directors are: A. E. Newton, 50, Pall Mall, S.W., managing director of British Motor Trading Corporation, Ltd.; J. I. Ker, J.P., General Buildings, Aldwych. Qualification, £100. Solicitors: Dodd and Blaker, 50, Pall Mall, S.W.

Simms Motor Units (1920), Ltd. (165,482).—Registered March 19th. Capital, £120,000 in £1 shares. To take over the business of Simms Motor Units, Ltd., except debts and cash, and to carry on the business of manufacturers of and dealers in magnetos, magneto parts and accessories, motors, flying machines and cycles, &c. The subscribers (each with one share) are: J. B. Purchase, 14, Regent Street, S.W.1, solicitor; A. T. Hales, 14, Regent Street, S.W.1, secretary; and five clerks. Minimum cash subscription, £7. The subscribers are to appoint the first directors. Solicitors: J. B. and F. Purchase, 14, Regent Street, S.W.1.

Scottish Aluminium Co., Ltd. (11,043).—Private company. Registered in Edinburgh, March 17th. Capital, £25,000 in £1 shares. To carry on the business of manufacturers and producers of and dealers in aluminium and aluminium products, &c. The subscribers (each with one share) are: A. W. Stewart, 55, West Regent Street, Glasgow, engineer; W. M. Stewart, 55, West Regent Street, Glasgow, engineer; F. C. Stewart, 55, West Regent Street, Glasgow, engineer. The first directors are: A. W. Stewart, W. M. Stewart and F. C. Stewart. Secretary: F. C. Stewart. Registered office: 150, Helen Street, Govan, Glasgow.

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OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Launceston and District Electric Supply Co., Ltd.—Particulars of £3,500 debentures created July 24th, 1920, filed pursuant to Section 93 (3) of the Companies (Consolidated) Act, 1908, the whole amount being now issued. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trustees.

Bradbury & Jarvis, Ltd.—Land registry charge on 9, Charlotte Place and 5, Bennett Street, N.W., dated March 4th, 1920, to secure all moneys due or to become due from company to London Joint City and Midland Bank, Ltd.

Burnham and District Electric Supply Co., Ltd.—Debenture dated March 2nd, 1920, to secure £3,000 charged on the company's undertaking and property, present and future, including uncalled capital. Holder: T. G. Tolliott, High Street, Burnham-on-Sea, and W. Moon, Blue Boar Row, Salisbury.

Sun Electrical Co., Ltd.—Satisfaction to the extent of £275 on March 1st, 1920, of debenture stock dated March 31st, 1911, securing £7,000.

Howard Electrical Engineering Co., Ltd.—Issue on March 4th, 1920, of £1,000 debentures, part of a series already registered.

Oliver Engineering Co., Ltd.—Particulars of £1,000 debentures created February 6th, 1920, filed pursuant to Section 93 (3) of the Companies (Consolidation) Act, 1908, the amount of the present issue being £500. Property charged: The company's undertaking and property, present and future. No trustees.

Penrose Lifts, Ltd.—Particulars of £5,000 debentures created March 1st, 1920, filed pursuant to Section 93 (3) of the Companies (Consolidation) Act, 1908, the whole amount being now issued. Property charged: The company's undertaking and property, present and future. No trustees.

Camden Metal Works, Ltd.—Debentures to secure all moneys due or to become due from company to British Electric Transformer Co., Ltd., Hayes, registered February 13th, 1920, charged on the company's undertaking and property, present and future, including uncalled capital.

Cape Electric Tramways, Ltd.—Capital £500,000 in £1 shares, of which to December 31st, 1919, 491,222 have been issued, £91,222 paid, £400,000 considered as paid. Mortgages and charges, £276,300.

Francis Barker & Son, Ltd.—Mortgage on 219, Blackstock Road, Islington, registered February 13th, 1920, to secure all moneys due or to become due from company to London County Westminster and Parr's Bank.

Yale Electric Power Co., Ltd.—Debentures for £6,000 registered February 9th, 1920, charged on the company's undertaking and property, present and future, including uncalled capital. Satisfaction registered February 12th, 1920, of charge for £3,000, registered February 2nd, 1914.

CITY NOTES.

The British L. M. Ericsson Manufacturing Co., Ltd.

At the annual meeting, held on March 17th, Mr. W. M. Crowe, who presided, said that though profit for the year was smaller than in the previous two years, comparing the results with those of some of their competitors in the telephone industry, it was satisfactory. The past year had been a difficult one for telephone manufacturers. The Post Office officials left it late in the year before they decided to place orders on a large scale. Those officials were not to blame for that as they had the Treasury to deal with, and the Treasury were not now allowing any money out of their hands if they could help it. Then after large orders were placed (and they had placed large orders) there came the difficulty of getting raw material, the imports of which had been far below the requirements; and after that the difficulty of getting the workpeople to turn out sufficient output. The prospects of the present year were extremely bright for the company if they could only count on getting raw material and sufficient output. They had already in hand very large orders for telephone material of all kinds, and they were informed by the British Post Office that there were plenty of further orders only waiting to be placed. In addition to the supply of telephones for the home markets there was an immense demand from the Colonies and from foreign countries. He referred last year to the country's necessity for increased output so as to save a very serious situation; things had become worse instead of better. His calculation was that the American worker turned out about 40 per cent. more per worker per annum than men doing the same work in this country; and in Sweden and other neutral countries practically the same percentage held good. We were not likely to overcome and overtake the immense expenditure of the past six years unless the workpeople of the country saw through the evil of their ways. The whole world was crying for material of every kind and description, and the supply of that material could be made the means of getting the country on its feet again. British-made material was demanded probably more than the manufactures of any other country in the world, America included. It would be to the immense advantage of both sides if labour in this country would do its share and deliver the goods as they were being delivered in other countries. If, on the other hand, the trade unions were to force workers to limit the output—and that even against the wishes of a large proportion of the workers who, to his knowledge, would rather work hard and earn, say, £4 or £6 a week, than slack and take only the allowance granted them under trade union rules—then the country must thank the trade unions for leading towards disaster. There was no other way to save the country than by increased output. What the unions were doing was putting a premium on inefficiency and laziness, and making their first-class men into second and third class, so that presently there would be no first-class workers, but everyone would be on an equality. The fear of the unions that there was a likelihood of a shortage of work must appear to anyone who knew the facts of the case a useless fear. There were more orders waiting than could be handled during the next five years, and plenty afterwards for a further five years. The orders already in the hands of every manufacturer in the country, and the thousands of orders waiting to be placed were infinitely greater than the world had ever known, and the country which could turn out most would, of course, get the largest share of these orders. If the claims of the Labour Party for State control of the mines, the railways, shipping, &c., should become accomplished facts, the beginning of the end was near. After the speaker had briefly summarised the financial results, the report was adopted. The chairman said the question of raising additional capital had been before the directors, and when the time was opportune an issue would be made, and the claims of the preference shareholders would be considered.

Chelsea Electricity Supply Co., Ltd.

At the annual meeting, on March 17th, the chairman said that the accounts proved that the industry had quite extraordinary powers of recuperation. All the companies operating in the great centres of population had shown remarkably improved results, although notwithstanding a rise in prices generally of 100 to 200 per cent. on pre-war figures the price of electricity had only been raised from 25 to 33 per cent. Although he prophesied a year ago that they might look for improved results at no distant date, he must confess he did not think the change for the better was so near at hand. The total costs had risen by £2,700, nearly the whole being due to increases in salaries and wages. The receipts from sale of current increased by nearly £10,000. They had spent large sums on renewals and renovations, and must also spend largely during the current year on work which could not be carried out during the war, and was therefore much in arrear. The outlook for the present year was promising. They were selling more current and getting a somewhat better price. Repairs and maintenance costs which jumped £2,000 last year should show a reduction. Unless the unexpected should happen they ought to be able to recommend another increase in dividend next year. If the Government would leave them alone and allow them to carry on their business under the terms of their provisional order which expired in 1931, they could look forward with reasonable hope for a modest prosperity during the next eleven years. Their provisional order provided that if taken over in 1931 they were to be paid the "then value" of their capital expenditure. If Parliament decided to expropriate them earlier, common honesty would have proposed at least values as defined by the provisional order plus compensation for loss of profits of the unexpired term. But the Bill as introduced during last session provided for the compulsory acquisition of electrical undertakings at cost price, less depreciation, a figure very far below the present value of their undertaking as laid down in the provisional order, so that a solemn undertaking by Parliament under guarantee of which their capital was subscribed, was proposed to be broken by the Bill of last year. Fortunately the compulsory clauses of the Bill were withdrawn. The Government threatened to reintroduce the compulsory clauses during the present session, but if the proposals for amalgamation of leading London companies were approved, he hoped that they would not suffer as at one time appeared probable.

Notting Hill Electric Lighting Co., Ltd.

Mr. A. E. Franklin, presiding at the annual meeting on March 9th, said that new consumers were coming on so rapidly that it had been impossible to obtain delivery of meters as fast as they wanted them, but that condition was improving. The increase in profit was from £20,017 to £31,225; it would not have been so satisfactory but for the serious setback during the war. They had now made good their loss of ground, and continued their former rate of progress. The revenue from the sale of current increased by about £12,000, due largely to the higher rate charged coming into effect. They had lent to the Kensington and Notting Hill joint works £8,350, and as orders had been given for a considerable quantity of new machinery to cope with the increasing output, it would be necessary for the joint committee to obtain further capital to meet that expenditure. The estimated amount to be spent this year was about £50,000, and the committee was considering how to obtain this on the cheapest terms, but he feared that the cost of borrowing was now a very serious figure. The articles restricted their borrowing powers, so they were proposing an alteration which would give them a free hand, and enable them, in case of necessity, to borrow in order to lend further amounts to the joint station, and also for the necessary extensions to the system of distribution. At the present time the generating station at Victoria Gardens was being kept as a standby, as the whole of the current required was being taken from the joint works, as this was more eco-

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nomical. After referring to the Electricity (Supply) Bill, the speaker said that with regard to the prospects for the coming year, the output was still increasing rapidly, and everything pointed to a prosperous year's working, unless unforeseen trouble arose.

Bruce Peebles and Co., Ltd.

Mr. F. E. Andrews, presiding at the annual meeting, at Edinburgh, on March 19th, said that early in 1919 all their Government war contracts were cleared up, and they were to a considerable extent engaged in turning over from war work to their normal engineering business. This involved the dismantling of the shell shop, so they took advantage of the opportunity to effect other considerable rearrangements, which had resulted in increased efficiency and marked improvement in output, in spite of the moulders' strike, which greatly hampered their operations. Their relations with their own workpeople were of a satisfactory nature. They paid them well. He was hopeful that the unrest, which was perhaps a not unnatural sequence of the war, would gradually die away, so that they might steadily deal with the large number of orders on the books. The past year had not been without its anxieties, but notwithstanding the difficulties experienced, it was gratifying to know that with their enlarged works and the larger number of men employed, the output for 1919 was more than 50 per cent. greater in value than the previous year, and this increase was reflected in the improved financial results. The issued share capital remained as before. The mortgage debenture debt was being steadily and satisfactorily reduced year by year by the operation of the sinking fund. Debts owing by the company were £91,657, whilst debts owing to it amounted to £136,009; both these items showed an appreciable increase, due to the increased business. With regard to the suspense account, which consisted of reserves made from time to time for various contingencies and especially to meet any liabilities for excess profits duty, all outstanding questions up to the end of 1918 had now been finally adjusted, and they were therefore enabled, by transferring the balance available from the suspense account, to start a general reserve account, to which they also proposed to allocate £20,000 from the profits of the year. Owing to the amount of work on hand and in prospect, they gave out contracts last autumn for a considerable extension to the new heavy engineering shop. The building was already erected, and very shortly would be finished, provided with the requisite machine tools, and in full working order. Stock, stores, and work in progress were higher than a year ago, whilst debts owing to the company were over 50 per cent. higher, but all were quite good. The profit from manufacturing and trading, after making provision for excess profits duty, amounted to £51,810, as compared with £20,390 a year ago. It was proposed to pay the fixed dividend of 7½ per cent. on the cumulative preference shares, together with the further dividend of 2½ per cent., to which they were this year again entitled, all less income tax, of course, and as the balance sheet was now cleared up, and all outstanding questions with regard to excess profits duty, &c., had been settled, they recommended a dividend of 7½ per cent., less tax, on the ordinary shares.

British Engine, Boiler and Electrical Insurance Co., Ltd.

At the annual meeting, held at Manchester, on March 19th, the chairman (Mr. R. C. Longridge) stated that the company had again achieved a record increase in the volume of business transacted, the premium and fees for the year 1919 amounting to £208,970, as compared with £174,162 in 1918, but there was a falling off in the profit earned. The following table shows that although the income from premiums and fees has almost doubled during the past five years, the amount of profit earned was £3,978 less than in 1914, or a reduction of over 22 per cent. In other words, the ratio of profit to premium income has fallen from 15.5 per cent. to 6.5 per cent.

Year.	Premiums and fees.	Claims, expenses and provision for unexpired liability.	Trading profit.	Ratio to income from premiums and fees.
1914	£112,465	£94,933	£17,532	15·5%
1919	208,970	195,416	13,554	6·5

The net dividend paid in 1914 was £13,176, and in 1919 it was £12,495. The explanation is that the costs of working have risen more rapidly than the premiums. The following are particulars of the cost of effecting identical repairs in 1914 and 1919 respectively:—

	Year 1914.	Year 1919.
Steam Engines.		
Valve spindle	£5	£10
Two-cylinder covers and pistons (same size in each case)	100	307
One 21" cylinder (Corliss engine)	180	350
Crosshead for horizontal engine	36	86
Gas Engines.		
Cylinder jacket for 7" cylinder engine	9	20
Crankshaft of 14" cylinder engine	34	123
Flywheel of 18½" cylinder engine	125	330
Exhaust valve box for 18½" cylinder engine	12	31
Motors.		
Rewind of armature for 2-h.p. motor	5	11
" " " " 5-h.p. "	6	14
" " " " 25-h.p. "	16	32

Apart from the cost of repairs, the salaries of the staff had been put on a higher basis to meet the new conditions. The company employed a large number of fully-qualified and experienced surveyors, some of whom were engaged on mechanical and some on electrical work. Their duties brought them into contact with other engineers whose wages had in many instances been raised more rapidly than those of the company's surveyors, and it had been a source of regret to the board that circumstances had not enabled them to deal more generously than they had done in the matter of staff salaries. The whole burden of the increased costs had been borne by the company, and to distribute the load equally higher rates were necessary, the increases charged hitherto having proved totally inadequate. The board decided during the year to establish a subsidiary company under the name of British Electrical Repairs, Ltd., for carrying out repairs to insured electrical plant. This should result in advantages to the company as well as to its clients, who would enjoy the benefit of having repairs carried out expeditiously and by the most modern methods.

Automatic Telephone Manufacturing Co., Ltd.

Mr. James Taylor presided at the annual meeting, held at Liverpool on March 16th. He said that the war and its after-effects had hit the company much more severely than had been the case with most other industrial concerns. During the war the company's efforts had been concentrated on war work that had now ceased, and an important factor which seriously affected the company's interests had been the failure of the British Post Office to place orders for automatic exchanges, which represented the chief item in the company's business. Leading Government officials had said that the Post Office had declined to place orders of the kind because of the high prices prevailing, but so long as they continued the policy of ordering in driblets instead of in bulk they could not expect cheap prices, and it was a matter of regret considering the successful manner in which the automatic exchanges erected by the company were working that the Post Office should adopt this attitude. Prior to the company purchasing automatic patents the Post Office had been consulted, and the promoters of the company were led to expect sympathetic support. To be put to the immense trouble and expense of preparing estimates for the Post Office only to be told that prices were too high had been a source of bitter disappointment to the directors. In view of the delay in the introduction of automatic exchanges on a large scale the company had given considerable attention to other branches of business, and had extended its work in railway signalling apparatus. In other branches new development work had taken place the costs of which were debited to the past year, while the profits could not come in until a later date. A large new machine shop had been erected, and they were now equipped to turn out much larger quantities of work in the most economic way. The company had suffered very severely from the increase in labour rates, mostly granted by way of award of the Court of Arbitration, and in some cases made retrospective. Thus goods had already been delivered before the award was given, and it had been impossible to collect the extra cost from the buyer. It was estimated that from this source alone the company's profits had suffered to the extent of £15,000. There had also been difficulty in recovering from the Government in respect of contracts made with various departments the extra cost due to increase in labour and material. The directors were still persevering in trying to get Government officials to meet the company in a reasonable manner. In regard to the arrangement made with the International Syndicate for the exchange of shares, a large majority of the shareholders had agreed to the new scheme, and they had therefore proceeded with the arrangements, and the new company had been formed. The contract having been ratified they could now go ahead and manufacture on a mass production scale, under which costs were bound to go down very considerably, and the British Post Office would no longer have the excuse to say that automatics which the world was adopting were too high in price.

British Aluminium Co., Ltd.

The report shows that the profits for 1919, after making provision for excess profits taxation, were £348,108, plus £31,380 brought forward. Income tax, depreciation of investments, and proportion of profits payable to directors, come to £94,500; prior lien debenture service fund £48,000; debenture stock service fund £43,224; reserve for depreciation £50,000; to reserve account £50,414. After paying the preference dividend and a total of 10 per cent., less tax, on the ordinary shares, £15,314 is to be carried forward. The reserve account has been increased to £520,414 by the transfer of £50,414 from the profits of the year. The articles are to be altered to allow for the capitalisation of the reserve fund. At a meeting on 30th inst., resolutions will be proposed for increasing the capital and capitalising £400,414, part of the reserve account, to be applied for the payment in full at par of £400,414 ordinary shares of £1 each, and the distribution of two of such fully-paid ordinary shares for each three ordinary shares now held, except as to resulting fractions, the shares represented by which will be sold and the proceeds distributed among the shareholders who would otherwise be entitled to the fractions. If all the resolutions referred to are confirmed and passed the balance remaining in the reserve account will be £120,000. The depreciation reserve account, including £50,000 charged against

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the profits of the year, amounts to £500,000. Owing to the falling off in demand after the conclusion of the war, the output of the various works of the company was considerably curtailed during the first seven months of the year. Thereafter, the demand in this country and abroad increased rapidly and the various works were again put on full output. These conditions have since continued, and the present outlook s satisfactory. During the greater part of the year a substantial percentage of the sales was applied in reducing the stocks of metal in the hands of the Government, in accordance with agreements made by them with the producers. Since the beginning of the current year the balance of Government stock remaining to be sold has been purchased by the company, thereby relieving the general situation in the industry.

Metropolitan-Vickers Electrical Co., Ltd.—The profit for 1919, including £77,747 brought forward, amounts, after providing for excess profits duty, to £303,007. There is appropriated to special depreciation of plant, machinery, &c., £35,000; to general reserve £100,000; to dividend on the preference and ordinary shares at 8 per cent. per annum, less income tax, £116,917; and carried forward £51,089. The year has been one of considerable anxiety owing to labour troubles, not only in connection with transport, but with the iron foundries. Though these difficulties coming at the latter part of the year did not seriously affect the accounts of the period, they will without doubt have some adverse effect on the results of the current year. The dividend is calculated from the date of allotment on April 14th, 1919, to December 31st, 1919. During the year 10,086 preference shares have been converted into 20,172 ordinary shares, which will receive 8 per cent. for the year. During the remaining period of the option conversion dates will be quarterly. New office premises have been secured at 4, Central Buildings, Westminster, S.W., where all the London staffs of the various associated companies will be, as far as possible, accommodated in one building. It is hoped to remove there before the end of April. Meeting: Monday, March 29th; London.

Davis & Timmins, Ltd.—At the annual meeting, on March 16th, Sir Henry Mance, who presided, said that the prospects were extremely good. Their main object at present was to increase their capacity for work and prompt delivery, and with that view they were obtaining additional machinery and making extensions at the works. Mr. G. E. Davis, the managing director, also said that the company's policy must be one of expansion. They were enlarging the works; new buildings covering the larger portion of the available land would probably be handed over to them for occupation early in May, and additional plant would be installed. They must be in a position to meet the demands made upon them for their manufactures. Five years of war had depleted the stocks of the world. The shelves of the nation were bare, and an effort must be made to make good the deficiency and the wastage of war if they were to hold their own in the markets of the world. Their order book had never been so full as it was to-day. They had lately developed the Colonial side of their business.

Newmarket Electric Light Co., Ltd.—Mr. F. E. Gripper presided at the annual meeting on the 15th inst. He said that owing to new connections and existing consumers' new demands they had increased the output by 10 per cent. The increase of £960 in revenue was practically swallowed up by increased working costs. The company had increased its charges by only 33 per cent. (from 6d. to 8d.), whereas everything else had gone up by 100 or 150 per cent. or more. He expected that their application for power to increase the charge to 10d. would be granted. Increased cost of plant, &c., meant that double what they had put away in the past would be required for renewals. They must make up the renewal fund to a reasonable figure to meet future liabilities.

Scarborough Electric Supply Co., Ltd.—During 1919 there were connected the equivalent of 7,541 30 watt lamps, making the total 144,703. Units supplied 1,057,707, an increase of 215,561. After paying bank interest, and putting £1,500 to depreciation, the profit on the statutory undertaking is £3,389, and the revenue from other sources £1,439, making £4,828, plus £3,431 brought forward. Dividend at the maximum rate allowed under the Scarborough Electricity (Temporary Increase of Charges) Order of 1918, namely, 2½ per cent., leaving £6,008 to be carried forward.

Automatic Telephone Manufacturing Co., Ltd.—It was announced at the recent meeting that preference shareholders who had not already availed themselves of the option to convert their shares into shares of the new International Automatic Telephone Co., Ltd., would be given an opportunity of reconsidering their decision, as the option would remain open until March 31st.

Wood & Cairns, Ltd.—Presiding at the annual meeting on 16th inst., Mr. R. K. Hill stated that trading results were very satisfactory. A dividend of 10 per cent., less tax, on both the ordinary and preference shares was declared; £1,150 was placed to reserve, and £1,001 carried forward.

Tucuman Tramways, Light & Power Co.—The profit for the year ended June, 1919, was £421. Debit balance carried forward is reduced to £61,141.

Stock Exchange Notices.—Application has been made to the committee to appoint special settling days in:—

British Electric Transformer Co., Ltd.—48 ordinary shares of £1 each, fully paid, Nos. 135,380 to 135,393, and 135,466 to 135,498.

Mann, Egerton & Co., Ltd.—11,207 ordinary shares of £1 each, fully paid, Nos. 1 to 11,207.

The committee has specially allowed dealings in the following under temporary regulation 4 (3):—

Stewarts & Lloyds, Ltd.—850,000 deferred shares of £1 each, 5s. paid, Nos. 850,001 to 1,700,000; 82,500 deferred shares of £1 each, fully paid, Nos. 1,700,001 to 1,782,500.

The Committee has ordered the undermentioned to be officially quoted:—

British Electric Transformer Co., Ltd.—62,500 6 per cent. cumulative preference shares of £1 each, fully paid (Nos. 200,001 to 262,500).

Oxford Electric Co., Ltd.—1,000 5 per cent. cumulative preference shares of £5 each, fully paid (Nos. 10,001 to 11,000).

The Committee has specially allowed dealings in the shares of the following:—

Mann, Egerton & Co., Ltd.—68,357 preference shares of £1 each, fully paid (Nos. 1 to 68,357); and 11,207 ordinary shares of £1 each, fully paid (Nos. 1 to 11,207).

Brompton & Kensington Electricity Supply Co., Ltd.—Mr. H. R. Beeton, presiding at the annual meeting, on March 18th, said that they connected more customers than ever before during 1919, and the lamp connections were higher than any previous year but one. This was mainly due to the growing conversion of large houses, many of which stood empty, into flats and maisonettes, all of which were occupied. The record load factor was largely attributable to the sedulous cultivation of the accessory load. The cost per unit sold was the same as last year, in spite of an increase in cost of coal and labour. The proposed appropriation of profits which was justified by the present circumstances and future prospects, might be regarded as some compensation for the abatement of dividend sustained for two years owing to Government interference and obstruction. The outlook was good if the general course of events were at all propitious. The Accessories Co. continued to justify its existence, and constituted an asset which was beyond the reach of compulsory purchase. The speaker referred briefly to the Electricity (Supply) Act, and to conciliatory agencies at work for the adjustment of the interests of Capital and Labour, and paid a tribute to the staff.

Metropolitan Electric Tramways, Ltd.—The revenue for 1919, apart from dividends receivable, was £805,777. After deducting expenses and debenture and loan interest, but without making provision for future renewals, the surplus was £14,151. Including the amount brought forward, and the dividend on the company's holding in the North Metropolitan Electric Power Supply Co. (£15,750), the available balance is £30,427, out of which £10,195 is put to reserve. A balance dividend of 3 per cent. in respect of 1917, and one of ½ per cent. in respect of 1918, on the preference shares, are to be paid, requiring £17,500, and £2,732 is carried forward. The company is promoting in the present session of Parliament a Bill to authorise increased fares, &c. In the early part of the year the N. Met. Electric Power Supply Co. experienced a large reduction in output in consequence of the smaller demand by power-users previously engaged in the manufacture of munitions, but towards the end of he year this was regained by increased consumption of electricity for industrial purposes. That company has declared a dividend on the ordinary shares at the rate of 4½ per cent. per annum for 1919. In July, 1919, Mr. W. M. Ackworth and Mr. W. C. Burton were appointed directors of the company. Mr. Burton was also appointed managing director in place of Mr. Devonshire, who resigned this position but remained a director of the company. Mr. Burton has resigned his position on the board on his return to America.

South London Electric Supply Co., Ltd.—Mr. H. B. Renwick, in addressing the annual meeting on March 16th, said they had to record a more successful year than for some time past. He said that the expenditure of £9,209 chiefly on mains and meters was a sure indication of the vitality of the business. Now that the company was taking bulk supply, nine-tenths of its future expenditure would be under those heads. In regard to the current year, the units sold since the commencement of 1920 showed an increase of 17½ per cent., and the KW. applied for, 18 per cent., as compared with 1919. The speaker, in referring to the Electricity (Supply) Bill, said that he was confident that, should the Government introduce another Bill this session, it would not again attempt to thrust upon the electricity supply companies a compulsory purchase clause on terms so harsh or unfair as those in the original Bill. The company was quite prepared to take a bulk supply from a central source and to hand over its generating station to a central authority, but the terms must be fair and reasonable.

Salisbury Electric Light & Supply Co., Ltd.—Gross profit on working during 1919 was £5,733, against £5,623 for 1918. A final dividend at the rate of 8 per cent. for the second half-year is to be paid, making 6 per cent. for the year; £3,000 to depreciation and reserve; £3,327 carried forward.

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Waste Heat & Gas Electrical Generating Stations, Ltd.—The profit for the year ended January 31st, 1920, after deducting administration expenses, is £39,626 (against £38,646), less £13,500 put to reserve. The amount brought forward was £17,337. Of the available £43,464, the dividend of 8 per cent absorbs £25,600, and £17,864 is carried forward. The reserve account is now £113,851. The redemption funds in respect to plant supplied on hire purchase terms amount to £15,651. There has been considerable delay in the delivery of the plant for the new power station at Horden, and it is not expected that it will be completed and ready for operation until the middle of this year. The new generating plant at Weardale has been run satisfactorily, but it is not yet in continuous operation. Capital expenditure during the year amounted to £45,039 14s. 6d., mainly in connection with the new power station at Horden; against this, however, plant on hire of the value of £25,985 has been purchased by the hirers. A further £1,470 has been expended on the experimental work; it has been charged to the account opened for that purpose. The units generated at all the power stations show a reduction of about 2 per cent.

London Electric Wire Co. & Smiths, Ltd.—The report for 1919 states (according to the *Financial Times*) that the contracts and orders now on hand far exceed any total previously recorded. The usual provision has been made for depreciation of plant and machinery, and £49,000 has been placed to reserve, making the general reserve £50,000 and the special reserve £20,000 respectively. During the year the issued capital has been increased by £350,000. The new capital will be employed in extending the company's manufacturing facilities. The directors recommend a final dividend on the ordinary shares, making 7½ per cent., less tax, for the year, leaving to carry forward £28,414.

Aster Engineering Co. (1913). Ltd.—Mr. R. H. Wheeler, who presided on March 17th at the annual meeting, said that the company was fully booked up for 18 months ahead, and in view of further business that was offering it had become necessary to increase the output. For that purpose it was proposed to increase the capital by £100,000 in £1 cumulative and participating preference shares. The dividend for 1919 was 10 per cent., the same as for 1918. The company's export trade in Aster engines was increasing rapidly. It was their policy to create a world-wide demand for their products and not to limit themselves to any one line of production.

Hadfields, Ltd.—The report for 1919 states that £200,000, the premium received on the 1919 issue of ordinary shares, has been carried to special reserve. In addition to the interim dividend paid on the ordinary shares, a further 1s. 6d. per share, free of income tax, is proposed, and £133,755 is to be carried forward. An agreement has been entered into with Messrs. Harper Bean, Ltd. (which has £6,000,000 capital), a combination of a number of motor and kindred companies, under which that concern will obtain its supplies of steel from Hadfields, Ltd.

Para Electric Railways & Lighting Co., Ltd.—Gross receipts for the year ended November 30th, £299,282, compared with £284,255; net revenue earned in Para, after allowing for loss in exchange, £129,383, compared with £113,008; to reserve for depreciation and renewals, £20,000. Final dividend of 5 per cent. on the ordinary shares, making 8 per cent., against 7 per cent., less tax, for the year; to general reserve, £22,000, against nil; forward, £21,932, against £35,425 brought in.—*Times*.

Midland Electric Corporation for Power Distribution.—A meeting is called for April 19th, at which resolutions will be submitted for dividing the £5 preference and ordinary shares into £1 shares, and for increasing the capital by 200,000 £1 ordinary shares. The directors are placing £5,000 to reserve, and after writing £12,594 off expenses of debenture and share issues, and putting £14,000 to depreciation, the dividend on the ordinary shares is 10 per cent. for the year, carrying forward £29,818.

Hong Kong Tramway Co., Ltd.—Gross profit for 1919 £47,930. Final dividend 1s. 3d. per share, making 2s. total. Carried forward £7,116. Debentures redeemed. Debenture redemption reserve (£11,224) transferred to credit of profit and loss.

Isle of Wight Electric Light & Power Co., Ltd.—After providing £5,500 for debenture interest and sinking fund, £600 is applied to writing down investments, £6,500 is put to renewals fund, and £483 is carried forward.

Spanish & General Wireless Trust.—A meeting is being held to-day to consider a proposal for reconstruction under the title of the Spanish & General Corporation, Ltd.

Rangoon Electric Tramway & Supply Co., Ltd.—Dividend on the ordinary shares for 1919, 7 per cent. (against 5 per cent. for 1918), free of tax. Carried forward, £4,361.

Robey & Co., Ltd.—Dividend on preference and ordinary shares 7½ per cent., less tax. Carried forward £49,746.

Para Telephone Co.—Dividend 10 per cent. for 1919, carrying forward £6,426.

Shawinigan Water & Power Co.—Quarterly dividend on the common stock, 1¼ per cent.

STOCKS AND SHARES.

Tuesday Evening.

The financial year of the Stock Exchange came to its end on the Thursday in this week, and the present subdued condition of markets is indeed different from the excited buoyancy prevailing no longer than six weeks back. Investment money is either chary of existing Stock Exchange securities or else is finding employment elsewhere—probably both factors operate, along with the Budget and foreign exchange considerations, to lay strong restraint upon activity. Markets are so quiet that it is a matter of ease to thread a way even through those which have been so popular, and the Rugby scrums have given way to a state of affairs which discovers the paucity of sitting accommodation in most parts of the House.

New issues are being rushed out as fast as possible in order that the shares may be placed before Easter. Such extensive outpourings of capital as the first three months of the year have seen must constitute a record, and the full figures will be awaited with no little interest. The underwriters have found just lately that their obligations can become far from nominal, and a few of the big issues of the past week have been left, to a considerable extent, in the hands of those who underwrote them.

Bank Rate apprehensions are somewhat allayed by disclosure of an exceptionally strong position by the Bank of England statements. These are sufficient to calm the fears of a 7 per cent. minimum this week, although there remains a degree of uneasiness in regard to money, which the fresh disturbance of the French franc served to underline. Although marked recovery has begun in the German rate of exchange, and although the American dollar is also a shade less expensive, the outlook bristles with such uncertainties as render trading an extremely difficult and speculative business. This reacts, of course, upon wide circles of industrial shares, and even those that are not directly affected, are influenced by Stock Exchange sympathy. The labour troubles at home have a direct bearing upon everything connected with coal, and the investor, baffled and perplexed by a dozen cross-currents, decides to leave stocks and shares alone for a time. In which decision it may probably prove that he shows sound sense.

British Aluminiums fell rather sharply on the issue of the report. From 45s., at which they stood a fortnight ago, the shares have gone back to 38s. The profits of £348,000 are £72,000 down as compared with those for 1918, but the 10 per cent. dividend is maintained, and the report states that the present outlook is satisfactory. At the meeting next Tuesday, resolutions will be submitted for enabling the directors to distribute two new shares for every three at present held, for nothing, the money to be obtained by capitalising £400,414 of the reserve account, and distributing this, in ordinary shares, amongst proprietors in the proportion named. After this, the reserve fund will stand at £120,000, while the depreciation reserve will be £500,000.

Babcock & Wilcox are 6s. 3d. lower, and Metropolitan-Vickers preference lost half-a-crown. Siemens again shed sixpence, a fair number of shares coming to market. Telegraph Constructions have fallen back 30s. to 26½, the comparative smallness of yield on the shares inducing proprietors to seek higher returns elsewhere. Callender's are ½ down. General Electrics are the turn off. The new ordinary, with 7s. 6d. paid, show a good deal of animation round about 12s., but the new B preference, with 7s. 6d. paid, continue heavy at 1s. 6d. discount. The fully paid have changed hands at about 18s. 9d. English Electric ordinary are 25s., the preference 16s., and the 5½ per cent. sinking fund 1st mortgage debentures 85. Electro-Bleach and By-Products ordinary are 20s.

Amongst electricity supply shares, London Electric preference and Westminster ordinary are both ½ down, while Metropolitan preference at 2 13/16 show 1/16 loss. City of London shed its half-crown rise of last week, receding to 14, and the market is once more in a tame and uninteresting condition.

The River Plate Electricity Co., Ltd., has called a meeting for Monday next to pass resolutions that will enable the directors to capitalise some of the profits standing to the credit of the reserve fund, and to allot ordinary shares in respect thereof. Apparently the idea is to distribute the stock for nothing, which would represent a handsome bonus, the present ordinary standing about 148 in the market. For the last two years, the company has paid 7 per cent. dividend on the ordinary stock, the price of which on the outbreak of war ruled at 240.

The cable market continues to be principally occupied with the dealings in the new issues. Eastern new shares have risen to 8s. premium, Westerns and Globes are 3⅛ premium, Eastern Extensions 3½ premium. While a good many people are selling their rights with a view to taking the money as

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extra dividend, a large number of others are adopting the suggestion made here, and paying for their allotments, rounding off their proportions of new shares by the purchase of such oddments as may be necessary to ensure a holding in level amounts. The old issues are beginning to recover, Eastern ordinary, for instance, showing a rise of 4½ to 157½. The other three have been placed on the common level of 153. A rally in Anglo-American Telegraph deferred restored the price to 19, but the feature in this market is the strength of Oriental Telephones, which on their persistent buying were lifted 16s. 3d. to 2⅝, from which they drooped to 2¼. Various rumours are in circulation to account for the demand, but these are so nebulous as to render their repetition of no service. Curiosity is piqued to know what the reason for the jump actually is, and this no doubt will become apparent in due course. United River Plate Telephones have gone back to 7¾, and Marconis reacted sharply to 3 9/16, a drop of 7s. 6d. on the week, Canadians and other members of the Marconi group being disposed to sag in sympathy with the shares of the parent concern.

Brazilian Tractions have fallen back to 52, on further sales from Paris, and there is no recovery yet in the stocks of the British Columbia Electric Railway. Mexican Light preferred at 27½ are 3 points down. Bombay Electric ordinary shares, after being nominally 165, were put down to 150, changing hands at 145½ and rather higher. Still there is nothing to explain the extraordinary rise of the past three months. The shares are 10½ times higher than they stood at the end of July, 1914. The rubber market shows no resiliency, the price of the raw material being dull. Armament and allied shares participate in the depression shown by most of the industrial sections.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1918.	Dividend 1919.	Price March 22, 1920.	Rise or fall.	Yield p.c.
Home Electricity Companies.					
Brompton Ordinary	8	12	63	—	£8 16 10
Charing Cross Ordinary	4	7	83	—	9 0 8
do. do. do 4½ Pref.	4½	4½	53	—	8 8 8
Chelsea	3	4	53	—	6 3 1
City of London	8	10	14	— ½	7 2 10
do. do. 6 per cent. Pref.	6	6	86	—	6 4 8
County of London	7	8	93	—	8 2 2
do do. 6 per cent. Pref.	6	6	9	—	6 13 4
Kensington Ordinary	6	7	53	—	6 13 4
London Electric	Nil	2½	13	—	5 2 6
do. do. 6 per cent. Pref.	6	6	83	— ½	8 17 10
Metropolitan	5	6	83xd	—	8 0 0
do. 4½ per cent. Pref.	4½	4½	21	— ⅛	8 0 0
St. James' and Pall Mall	10	12	63	—	8 16 10
South London	5	6	28	—	7 12 8
South Metropolitan Pref.	7	7	19/6	—	7 3 7
Westminster Ordinary	8	10	53	— ½	8 13 10
Telegraphs and Telephones.					
Anglo-Am. Tel. Pref.	6	6	87½	—	6 17 1
do. Def.	33/6	1½	19	+ ½	7 18 0
Chile Telephone	6	6	6½	—	*4 13 2
Cuba Sub. Ord.	7	7	104	—	*6 18 4
Eastern Extension	8	10	153	— ⅜	*6 10 1
Eastern Tel. Ord.	8	10	157½	+ 4½	*6 7 0
Globe Tel. and T. Ord.	8	10	153	+ ⅜	*6 10 1
do. do. Pref.	6	6	9½	+ ½	6 6 4
Great Northern Tel.	22	—	24	—	9 3 4
Indo-European	18	—	48½	—	6 18 4
Marconi	25	—	3 1/16	— ⅜	7 0 0
Oriental Telephone Ord.	10	—	2⅝	+ ¼	3 12 2
United R. Plate Tel.	8	—	7¾	— ¼	*5 8 3
West India and Panama	1/8	—	1 1/16	—	5 19 0
Western Telegraph	8	10	153	— ⅜	*6 10 1
Home Rails.					
Central London Ord. Assented	4	4	47½	—	8 8 6
Metropolitan	1	1½	21½	+ ½	5 16 8
do. District	Nil	Nil	17½	—	Nil
Underground Electric Ordinary	Nil	Nil	2¼	— ⅛	Nil
do. do. "A"	Nil	Nil	6/6	—	Nil
do. do. Income	5	4	69	—2	5 16 0
Foreign Trams.					
Anglo-Arg. Trams. First Pref.	Nil	Nil	33	—	—
do. do. 2nd Pref.	—	—	3¼	—	—
do. do. 5 Deb.	5	5	69½	—	7 15 0
Brazil Tractions	—	—	52	—1½	—
Bombay Electric Pref.	6	6	19	—	8 8 0
British Columbia Elec. Rly. Pfcs.	5	5	60½	—1	8 5 4
do. do. Preferrred	2½	5	51½	—	9 14 2
do. do. Deferred	Nil	3	41½	—	7 4 7
do. do. Deb.	4½	4½	57xd	—	7 9 1
Mexico Trams 5 per cent. Bonds	Nil	Nil	38½	—	Nil
do. 6 per cent. Bonds	Nil	Nil	29½	—	Nil
Mexican Light Common	Nil	Nil	17½	—	Nil
do. Pref.	Nil	Nil	27½	—3	Nil
do. 1st Bonds	Nil	Nil	51½	—	—
Manufacturing Companies.					
Babcock & Wilcox	15	—	83	— ⅜	*4 10 9
British Aluminium Ord.	10	10	13	— ⅛	5 5 0
British Insulated Ord.	12½	15	2¼	—	7 1 2
Callenders	25	—	83	— ½	7 2 10
,, 6½ Pref.	6½	6½	4½	—	6 16 10
Castner Kellner	20	—	4	—	—
Crompton Ord.	10	—	21/6	—6d.	9 6 0
Edison-Swan, "A"	10	—	1½	—	8 0 0
do. do. 5 per cent. Deb.	5	5	79½	—	6 5 9
Electric Construction	10	—	23/6	—6d.	8 10 2
Gen. Elec. Pref.	6½	6½	18/6	—	7 0 6
do. Ord.	10	—	1 1/16	—	*5 10 4
Henley	25	15	2⅜	—	6 6 4
do. 4½ Pref.	4½	4½	33	—	6 4 2
India-Rubber	10	—	16	—	*6 5 0
Met.-Vickers Pref.	—	8	23	— ½	5 16 5
Siemens Ord.	10	10	29/-	— 6d.	*6 18 0
Telegraph Con.	20	20	26½	—1½	*4 10 6

* Dividends paid free of Income Tax.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Tuesday, March 23rd.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Oxalic	per lb.	1/5	...
a Ammoniac Sal	per ton	£100	£5 inc.
a Ammonia, Muriate (large crystal)	,,	£92	£17 inc.
a Bisulphide of Carbon	,,	...	...
a Borax	,,	£42	...
a Copper Sulphate	,,	£52	...
a Potash, Chlorate	per lb.	11d.	...
a ,, Perchlorate	,,	1/8	...
a Shellac	per cwt.	£42	...
a Sulphate of Magnesia	per ton	£18	£3 inc.
a Sulphur, Sublimed Flowers	,,	£28	...
a ,, Lump	,,	£25	...
a Soda, Chlorate	per lb.	6d.	...
a ,, Crystals	per ton	£12	70/- inc.
a Sodium Bichromate, casks	per lb.	...	...
METALS, &c.			
g Babbitt's Metal Ingots	per ton	£118 to £345	...
c Brass (rolled metal 2" to 12" basis)	per lb.	1/3½	½d. dec.
c ,, Tubes (solid drawn)	,,	1/6½ to 1/6¾	...
c ,, Wire, basis	,,	1/4½	½d. dec.
c Copper Tubes (solid drawn)	,,	1/9½	...
g ,, Bars (best selected)	per ton	£168	...
g ,, Sheet	,,	£168	...
g ,, Rod	,,	£168	...
d ,, (Electrolytic) Bars	,,	£117	£7 dec.
d ,, ,, Sheets	,,	£156	...
d ,, ,, Wire Rods	,,	£142	£3 inc.
d ,, ,, H.C. Wire	per lb.	1/4½	½d. dec.
f Ebonite Rod	,,	8/-	...
f ,, Sheet	,,	2/6	...
n German Silver Wire	,,	3/-	...
h Gutta-percha, fine	,,	18/-	...
h India-rubber, Para fine	,,	2/4½	2½d. dec.
i Iron Pig (Cleveland Warrants)	per ton	Nom.	...
l ,, Wire, galv. No. 8, P.O. qual.	,,	£51	...
g Lead, English Pig	,,	£46	£6 10s. dec.
g Mercury	per bot.	£26 10/- to £27	£2 inc.
e Mica (in original cases) small	per lb.	6d. to 1/6	...
e ,, ,, ,, medium	,,	5/- to 10/-	...
e ,, ,, ,, large	,,	12/6 to 25/- & up	...
g Phosphor Bronze, plain castings	,,	1/7 to 1/11	1d. dec.
g ,, ,, rolled bars and rods	,,	2/2 to 2/6	...
g ,, ,, rolled strip & sheet	,,	2/3 to 2/9	...
d Silicium Bronze Wire	per lb.	1/11½	...
r Steel, Magnet, in bars	,,	1/8	...
g Tin, Block (English)	per ton	£341 to £342	£28 dec.
n ,, Wire, Nos. 1 to 16	per lb.	5/5	3d. dec.
White Anti-friction Metals	per ton	£90 to £345	...

Quotations supplied by—

a G. Boor & Co.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
r W. F. Dennis & Co.

The International Electrotechnical Commission.—We have received from Mr. C. le Maistre, general secretary, a copy of Publication No. 33 of the I.E.C., which is the full report of the fourth plenary meeting of the International Electrotechnical Commission, held in London last October. It includes photographs of the Rt. Hon. A. J. Balfour, Monsieur Maurice Leblanc (the past president), and the delegates. The report contains, in addition to the decisions reached at the last meeting, the programme of future work, which has already been described in our issue of October 31st, 1919. Meetings of the following advisory committees of the I.E.C. will be held in Brussels, commencing March 27th: (1) Nomenclature; (2) Rating of Electrical Machinery; (3) Symbols; and (8) Standard Pressures.

The following delegates of the British National Committee have been nominated provisionally, though it is not yet known whether they will be able to accept the task: (1) Nomenclature and (3) Symbols.—Sir William Slingo, Major K. Edgcumbe, Messrs. A. R. Everest, A. B. Field, and A. J. Stubbs. (2) Rating.—Sir Richard Glazebrook, K.C.B., Messrs. A. R. Everest, C. Rodgers, and Roger T. Smith. (8) Standard Pressures.—Messrs. C. H. Wordingham, C.B.E., A. R. Everest, W. B. Woodhouse, and Roger T. Smith.

The Belgian Electrotechnical Committee is actively engaged in completing the details in so far as the actual meetings are concerned. Although a very busy time is before the delegates, the Belgians are desirous of arranging for one or two excursions for the benefit of the foreign delegates.

The decisions made at these meetings will ultimately be placed before all the National Committees, with a view to their adoption at the next plenary meeting, which is expected to be held towards the end of this year.

The president of the Commission, Dr. C. O. Mailloux (U.S.A.), together with a strong delegation from the U.S. National Committee, will certainly be present at these meetings, and it is hoped that some of them will visit this country before returning to the States.

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POWER FROM BLAST FURNACE GAS.

By S. H. FOWLES, A.M.I.E.E.

(*Abstract of paper read before the* Institution of Electrical Engineers.)

In view of the fact that we as a nation have to make a considerable saving in our fuel consumption, we must first of all look to our efficiency. In many cases this is very low and wasteful. It is for us to look for better methods of using our wasted heat units, and thus make the best use of what we have, before attempting to harness any new powers.

One instance of great wastage is in the form of blast furnace gas, which escapes from the furnaces during the making of pig iron. The amount of energy which is at present being wasted or used at about 10 per cent. efficiency from the blast furnaces of this country is in the neighbourhood of 1 million horse-power. This is a matter that should be seriously taken up in connection with the greater power scheme, and should serve a very good purpose in the cheapening of electrical energy. Where the gas is cleaned and used efficiently, for the same quantity of gas an additional 10 thousand horse-power can be produced, and about 5 to 6 thousand horse-power saved on coal, making a net saving of about 16 thousand horse-power from three blast furnaces.

The gas is a by-product, and has been treated in the past as of very little value, being, therefore, either wasted or used very inefficiently. The furnaces are self-contained, with a large number of boilers for steam-raising to supply the blast engines for the furnace blowing. This blast in turn passes from the engine-driven blowers through the hot stoves to the furnaces. The hot stoves and boilers usually consumed the whole of the gas made, in addition to a very large amount of coal for the boilers.

The gas was used in its crude state, with the exception of the small amount of dust taken out by the dust catchers. This caused great loss in laying off the boilers for cleaning, which was a very frequent occurrence, as the boilers consumed about 1 million cubic feet of gas per hour.

In addition to the dust, the moisture had to be dealt with, and this considerably lowered the temperature of the fire box, thus causing the excessive use of coal with very inefficiently burnt gas. Many of the boilers on this class of work are in the open air and have no shelter; the settings are very often so porous that it is far from economical to use even clean gas in them, but during the transition stage this has to be done. The use of gas for boiler-firing is proving a very bad policy, since in comparison with large gas engines only about 30 per cent. of the engine efficiency is maintained on the boilers of modern design with clean gas.

The old method of using crude gas and coal had an efficiency of about 10 per cent., when compared on a horse-power basis with present-day gas-driven plant. Approximate figures for one furnace on the new method show that each furnace produces 1 million cu. ft. of gas per hour, and only 0.55 of this is required for the furnace, leaving 0.45 million or 450,000 cu. ft. of gas available per furnace for other purposes, and this at 150 cu. ft. per KW.-hour is equal to about 3,000 units of electricity per furnace per hour. Now with 50 furnaces the aggregate would equal 150,000 units saved per hour and 1,080,510,000 per annum; this with the boiler saving represents an economy of about 400,000 tons of coal per annum. This shows that the electrical energy which can be saved annually by generating from blast-furnace gas is almost equal to the total number of units sold during 1911-1912 by all the 303 electricity works of the United Kingdom.

The difference in coal and gas consumed, and the work done under crude and clean gas conditions respectively, is enormous. A great deal depends on the selection of a cleaning plant for this purpose, and while it is not intended to compare the merits or demerits of other plant, yet a great deal can be said for the Halberg-Beth dry gas-cleaning plant. It has considerable advantages, the following being a few of them: The bulk of the potash is recovered in its original state. The dust contents average 0.002 gramme per cu. m. The plant can be worked for long periods up to 30 per cent. overload if required. The moisture can be removed or allowed to remain at will. The total water contents average about 15 grammes per cu. m. The above figures can hardly be surpassed to-day on any plant when the dust and moisture are taken into consideration jointly and the power consumption per volume of gas cleaned.

The author then describes part of the plant at a large iron works, some details of which were given in our issues of January 23rd and 30th, 1920, and says that other cleaning plant is not in a position to guarantee such results of low dust and moisture contents which are common to engines, boilers, and stoves, so that in case of a temporary shortage of crude gas the valves to stoves and boilers can be closed and the engines kept running continuously. Another great advantage of this plant is the fact that, with no complete water passages or seals for the gas to pass for cleaning, in the event of a stoppage occurring on all the fan motors in the cleaning plant the engines will continue on load as usual, and will draw the gas through the plant just as clean as when supplied by the fan. This has been done for a period of an hour at a stretch.

The general operation of the Halberg-Beth gas-cleaning plant is then described by the author (for a similar description see our issue of February 6th, 1920). The plant works continuously and has a very low upkeep and operation cost.

The engines for generation comprise seven sets of 12-cylinder tandem vertical 1,500 H.P., direct-coupled to 1,000-KW., three-phase alternators running at 200 R.P.M., and are run in parallel with a public electric supply at 5,500 volts. In order to get good firing, the sparking plug points are adjusted to about 15/1000ths of an inch, and are of the motor car large type supplied from a L.T. magneto and induction coil, and very little trouble is experienced from dirt or moisture owing to the gas being dry and clean when leaving the gas plant. The throttles for air and gas are arranged on a common spindle, and the air throttles require more cleaning than the gas throttles, which shows that the gas is cleaner than the atmosphere. The machines run very steadily and synchronising is quite as easy as on a steam-driven set.

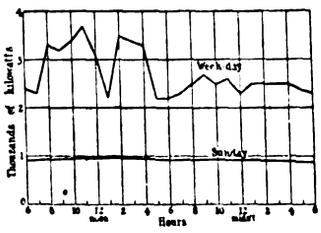

Fig. 1.—Typical Day Load.

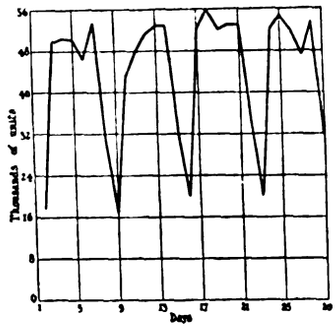

Fig. 2.—Monthly Curve of Units Generated.

The blowing engines of four sets are of the horizontal type with two double-acting gas cylinders and one double-acting blowing cylinder. They run at 85 R.P.M., are of 1,650 H.P., and can deliver 36,000 cu. ft. of free air per minute up to a pressure of 11 lb. per sq. in., or a decreased volume up to 15 lb. per sq. in. These engines supply the blast for the furnaces, and have been in operation for 1½ years very successfully. The ignition is by the L.T. drawn-out plug, operated with a solenoid in series, so that directly the arc breaks, the plunger is spring-returned ready for the revolving contact passing its brushes again on the lay shaft. The gas is quite free from tar, and pistons drawn after six months' running were found to be as clean as when first installed.

A great deal of attention has been given to the operation and maintenance of the cleaning plant. The gas is as clean as town gas and of low calorific value, but very constant, which makes gas engines as reliable as steam engines. After several inspections it was found to be possible to run for twelve months before overhauling. Curves of the various loads given in figs. 1 and 2 show the usual conditions in iron and steel works. A great deal depends on these conditions as to how the electrical world can make great use of the intervals should all the blast furnaces of this country become interconnected with the greater scheme of power supply. In the daily load curve (fig. 1) it will be seen that from 5 p.m. to 7.30 a.m. about 3,000 KW. of plant is idle. The whole of the gas is wasted during this period, and could be very usefully employed to supply power to a network through converting plant, thus allowing several medium-sized towns to take their supply from such a source and reduce considerably their coal, stores, and probably their wages costs during this period. A still greater loss is shown on the Sunday curve from Saturday noon to 7.30 a.m. on Monday, when 4,000 KW. of plant is idle, and could deal with the week-end load of several medium-sized towns, thus allowing the boilers in use and the staff to be considerably reduced and effecting a great saving of fuel and wages. It would also allow of a good many repairs being done, and so decrease the stand-by plant in many cases.

This matter should be considered seriously, as already we are making use of our water supplies which are not so constant as this supply. We have now some 50 places in this country where blast furnaces are working, and these are to be increased during the next few years. Many of these places cannot consume the whole of the gas produced, and with the adoption of cleaning plant such as have been mentioned, and the use of large gas engines, the time has arrived when still more gas will be available from the coke ovens

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and from the coke used in the blast furnaces. The quantity of gas wasted, although small compared with the requirements of our power stations, is nevertheless a large item when taken collectively in the balance sheet. Coke-oven gas is richer in value than blast-furnace gas, and is not such an easy gas to use, but during the last three years a very ingenious valve has been adopted for mixing some of the exhaust-cooled gas from the engines with the coke-oven gas, thus avoiding the trouble of pre-ignition.

The whole of this subject should have a thorough investigation, with the ultimate view of connecting all blast-furnace supplies to the greater scheme of national power supply.

Balance sheets were given in an appendix to the paper showing the difference in the old and new methods of utilising waste heat; the saving that results from cleaning and using the gas efficiently; and a comparison of the 303 electricity works and the estimated waste gas of Great Britain's 50 blast furnace installations. Tables were also added giving the various constituents of the gas, the content value, the gas and oil used in various parts of the works, the number of units generated, and the pressures and temperatures maintained at various positions in the cleaning plant and engine rooms.

Discussion in London.

The above paper, as well as that by Mr. W. H. Patchell (an abstract of which appeared in our last issue), was read before the Institution on March 11th, the discussion, of which a *résumé* is given below, being concluded on March 18th.

Mr. P. Taylor, who confined his remarks to Mr. Patchell's paper, said it was a valuable one, and it contained much useful information on the subject which was usually scarce. He personally had seen the plant described, and he could confirm the statement that it had worked very well. The gas engine tests were taken under everyday running conditions, and it was possible to obtain even better results than were given in the paper. The author was justified in claiming 1.51 lb. of coal per kw.-hour produced, but that would not be the case if power alone were supplied, because credit for the exhaust steam and tar had to be taken into account. From a power point of view, the figure would be 1.7 lb., and the tar could be sold. The author's figure for repairs and renewal costs was too high. It would have served a useful purpose had a separate account sheet been added to show whether it really paid to recover the sulphate of ammonia, and the total amount of coal used should also have been stated. Each separate case should be considered on its own merits, and more detailed figures for comparison with others would be useful.

Dr. Morley thought that Mr. Fowles's paper contained much valuable first-hand information. The economies that could be realised by the efficient use of properly cleaned blast-furnace gas were enormous; there they had a practically untapped source of power. Even in works where the was was being used, there was still scope for economy; the practice of burning the gas under boilers was in some cases being abandoned in favour of gas engines. Two important reports had recently been presented to the Iron and Steel Institute, one by Prof. Bone and Sir Robert Hadfield, which contained much useful information on the subject, and the other by two gentlemen who had visited the Rhine Valley and seen the conditions there. The latter report was a striking and impartial testimony to the efficiency of the gas engine. There was not much to choose between the high and low speed types of gas engine as regarded reliability, neither type gave much trouble. Blast furnace gas was a very remarkable gas, it contained no tar whatever, which was the chief source of trouble to all gas engineers. The question of which type of engine to use required consideration; the advantage in favour of the high-speed vertical engine was that of capital cost, its reliability being equal to that of the horizontal low-speed type, but the life of the engine was an important consideration. It was only necessary to compare the life of a high-speed vertical aero engine with that of a low-speed horizontal gas engine to realise this point. Operating costs were very valuable, but it was also necessary to add maintenance costs. It was noteworthy that in Germany, the home and nursery of the large gas engine, the sole type in use was the horizontal engine. With regard to cooling the cylinders, in the Galway engine the water only passed through one moving part; the valve itself was not cooled, but only its seat and box. It was quite possible to build cylinders up to 55 in. in diameter. Considering the atmosphere in a gas engine station, there was no reason why it should not be as clean and sweet as that in a steam station. The question of the utilisation of waste blast-furnace gas was one of national importance.

Mr. W. B. Woodhouse gave it as his opinion that with the present high price of coal no case could be made for the by-product gas producer plant for the provision of power alone. The high initial consumption of gas rendered the gas engine uneconomical on anything under half load. This fact would necessitate the load factor being high and not 15 or 20 per cent., as was the case with some steam engines. It would certainly not pay to run a gas plant of this description on a load factor of, say, 10 per cent. He was sadly disappointed in Mr. Fowles's paper; it was not clear whether the paper attempted to describe certain plant or whether it was intended as a condemnation of the iron masters. Further, the author had not indicated which of his figures and statements were estimates or predictions, and which were facts. Actually, in the speaker's opinion, the position was not so bad as the author would lead one to suppose; the author did not appear to be aware of what had been done by the iron masters in recent years. It was not possible to utilise all the blast-furnace gas produced, because that would involve problems of storage, and there was also the question of the load factor of the electrical energy to be considered. He disagreed with the author's statement that the use of the gas for boiler firing was bad practice. He had built a small station in which this method was utilised, and very careful tests were taken of its operation. From the results obtained the station was comparable with a turbine station having an efficiency ratio of 75 per cent., and it was his opinion that a large station using gas-fired boilers would show good results. It was not clear what the author was driving at.

Capt. A. P. Pyne, referring first to Mr. Patchell's paper, said that it was unfair to compare the small installation described with large turbo-generator plant, because much better results could be shown if it were necessary to do so. Unfortunately there were not many 2-cycle gas engines that could be considered reliable; there was one type, regrettably of German make, however, that no one would hesitate to rely upon, even in sizes up to 1,500 h.p. The gas plant itself was perfectly to be depended upon. After referring to the financial aspect, the speaker said that those who imagined that the atmosphere in the gas-engine room was any worse than that in a steam station were quite mistaken, in many cases it was much better. Turning to Mr. Fowles's paper, the speaker said that his main contentions were quite correct, although his figures might be slightly optimistic. In spite of Mr. Woodhouse's remarks, there was, in the speaker's opinion, a large amount of blast-furnace gas wasted in this country, and there was much scope for improvement and economy in that direction. It had remained for the Germans to show what really could be done; in Germany he had seen numerous small plant scattered over the countryside driving gas-engine generators, and linked to the h.t. town supply system. Many other cases could be mentioned of plant successfully working on the Continent, and even in Russia. In 1914 there was not a single gas engine installation in this country that could compare with those at work in Germany. Gas engines were equal in reliability to steam plant, although the first cost of the latter was usually lower. He knew of a case where a gas engine had run for 24 hours per day for 365 days without being shut down or cleaned. It should be remembered that the reliability of the engine depended on the cleanliness of the gas, the dust content of which should not be higher than 0.002 gramme per cu. m. The Halberg-Beth dry gas-cleaning plant successfully met these requirements, but it was expensive in first cost, and it was here that electrical engineers had an opportunity of showing what electrostatic methods could do. Another point that should be remembered was that cleaning gas for use in a gas engine and under a boiler were two quite different problems. The point of his remarks was that everything he had said was merely a repetition of what he had told a similar meeting of the Institution some six years ago, and it was regrettable to find that during the interval practically nothing had been done to improve the condition of affairs in this country.

Mr. H. T. Gibbons, referring to Mr. Woodhouse's remarks, said that he had always understood the object of by-product gas producer plant to be the saving of coal, and Mr. Patchell's figures showed that a supply of electricity could be produced by this means at a cost comparable with that of a public supply. The author's figures for repairs and renewals cost were, however, rather high; this might be accounted for in the difficulty of obtaining certain materials during the war period. The makers had such confidence in Premier gas engines that they were prepared to guarantee them under all normal conditions. It was possible to build such engines having cylinder diameters up to 18 in. in diameter; four such units made up a complete engine, and to-day similar sets were giving satisfactory results. For the generation of electricity multi-cylinder engines were preferable, and it was probable that future large engines for this purpose would be a compromise between the vertical high-speed and the horizontal low-speed types. The latter type possibly took up more floor space, and necessitated heavier foundations, but against that could be set its longer life. He instanced a case where a gas engine had run for five months without being shut down and running periods of three months at a stretch were common. It was a significant fact that when once an iron master installed a gas engine in his works he invariably extended the plant, and Mr. Fowles was right in advocating closer co-operation between the iron masters and electricity supply undertakings.

Mr. J. Paton explained that conditions to-day were not so favourable to by-product producer gas plant as they were before the war. It would seem that the Lymn tower washers were not so efficient as the ordinary packed towers. Mr. Patchell's figure for capital cost per kw. of plant installed was too high, he knew of a case where the cost was more like £10.6 per kw. In attempting to treat by-product tar

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satisfactorily it should be remembered that the tar contained a large amount of water; the tar should, therefore, be kept continually agitated until all the water had boiled off. This could be satisfactorily done by injecting compressed air into the bottom of the still.

Dr. J. A. Harker drew attention to the report of the Nitrogen Products Committee, which was appointed by the Ministry of Munitions. It contained, he said, much valuable and interesting information on the subject under discussion, and it was notworthy that Mr. Patchell's conclusions and observations were in strict accord with those expressed in the report referred to.

Mr. Bass expressed regret that neither the managing director nor the chief engineer of Messrs. Hoffmann was able to be present to express their opinions on the plant described by Mr. Patchell. All he could say was that any doubts that might have existed prior to the installation of the plant had been entirely dispelled after two years and eight months' very successful operation. It had been shown that gas plant lacked nothing in point of reliability, and with regard to exhaust boilers there had only been one stoppage in two years and eight months. It was not thought advisable to shut down the plant at the time the defect was noticed, it eventually, therefore, took longer to rectify than would otherwise have been the case. Anyone who cared to visit the works in question would see for himself that the popular conception of the dirty conditions usually associated with producer gas plant was an entirely mistaken one.

Mr. A. H. Lymn, with reference to Mr. Paton's remarks, explained that the efficiency of the Lymn tower washers was in no way behind that of other types if the plant was kept working on full load; with the Hoffmann plant these conditions were not fulfilled. If no gas flowed up the towers, the water falling on the first disk would drop to the bottom of the tower without touching any of the inverted cones. It would, therefore, be appreciated that it was due to the up-flowing gas that the water fell from the disks on to the inverted cones. Efficient washing resulted from the gas actually having to pass through the water as it was falling. It was noteworthy that corrosion did not take place in the Lymn plant to any appreciable extent except at such places as bolt joints, &c., which fact was attributable entirely to the construction of the plant. In horizontal tanks using paddles, and in which the level of the liquid was continually changing, corrosion was much more likely to take place. Mr. Patchell would have been quite justified in adopting manually-stoked producers if it had been possible to procure the quality of coal that it was initially intended to use.

Mr. H. Chaney endorsed Mr. Patchell's figures referring to the production of electricity. Personally, he used the steam first in turbo-generators, from the exhaust of which it passed on to the gas producers. The war had taught a good deal in the direction of utilising bad quality coal, and he himself had used coke dust to dilute the coal. He was of the opinion that the fullest possible use should be made of blast-furnace gases, and that towns in the neighbourhood of such furnaces should be compelled to utilise this source of power.

Mr. F. H. Preece did not understand Mr. Fowles's attitude with regard to using blast-furnace gas under boilers; his statements were misleading, and he (the speaker) could not agree with them. The whole of the trouble experienced with gas-fired boilers was due to dirty gas; they could not use Bunsen burners because they choked up. The firm with which he was connected used an external combustion chamber having air holes that could be adjusted from ¼ in. to 6 in. in diameter according to variations in the pressure of the gas. The difficulties encountered with heavy and frequently occurring variations in the gas pressure could readily be appreciated. With clean gas, however, they were able to use Bunsen burners, and by this means efficiencies of 70 to 76 per cent. could be obtained, or even 78 per cent. for the combined boiler, economiser, and superheater. Mr. Patchell's results obtained from waste-heat boilers were wonderful considering the low-temperature gases used.

Mr. L. Andrews said it gave him much pleasure to hear such papers read before the Institution. Some eleven years ago he had himself outlined to the Institution a similar plant to that described by Mr. Patchell, and it was interesting to compare the results then predicted with those actually obtained by the author. A very considerable saving in coal could be made by the use of gas engines; true, he agreed that for very large plant nothing at present could compare with the turbine, but there was, nevertheless, a large field open to the use of gas plant.

Mr. H. M. Ridge explained that he had only recently returned from a visit to Germany, where he had seen blast-furnace plant in operation, and it was interesting to note that to-day the works could not obtain sufficient coke to keep their furnaces working at anything like full load. He instanced one undertaking in Lorraine, but there were many others like it, which prior to the war had six blast furnaces at work. From these sufficient gas was obtained not only to drive the entire works, including rolling mills and all the electrical power used in them, but there was sufficient surplus gas to furnish the surrounding district with electric power and light. This emphasised the fact that under efficient working conditions an iron works could produce much more gas than it was possible to utilise in the works themselves. The difficulties met with in this country were due to dirty gas, and it was regrettable to see furnaces still working in this country to-day with open tops, from which all the gas was wasted. It was important to clean the gas; stoves would run for periods of two years without being cleaned if using clean gas, but with dirty gas the rich salts soon attacked the brickwork which it was necessary to renew every three to four months. He mentioned a case where the efficiency of clean boilers dropped appreciably after two hours' working on dirty gas, and after six hours they had to be shut down. The difference in the results obtained in the use of clean and dirty gas was equally striking, no matter in what manner the gas was used.

Owing to the lateness of the hour the authors reserved their replies to the discussion for publication in the Institution *Journal*.

THE IMPORTS OF SPAIN.

Statistics have recently been published concerning the import trade of Spain during 1917. Below are given the values of electrical and allied goods imported during that year compared with 1916, a note of increases or decreases being added :—

Country	1916 Pesetas	1917 Pesetas	Inc. or dec. Pesetas
Arc lamps.—			
France	4,000	1,000	– 3,000
United Kingdom ...	2,000	13,000	+ 11,000
Other countries	10,000*	—	– 10,000
Total	16,000	14,000	– 2,000
* Holland 9,000 Ps.			
Carbons for arc lamps.—			
France	1,000	2,000	+ 1,000
United States	2,000	3,000	+ 1,000
United Kingdom ...	4,000	—	– 4,000
Total	7,000	5,000	– 2,000
Incandescent electric lamps, mounted.—			
United States	245,000	227,000	– 18,000
France	60,000	84,000	+ 24,000
United Kingdom... ...	60,000	178,000	+ 118,000
Holland	1,333,000	933,000	– 400,000
Switzerland	309,000	269,000	– 40,000
Other countries	214,000	1,000	– 213,000
Total	2,221,000	1,692,000	– 529,000
Dynamos, electric motors, induction coils, resistances, transformers, &c., up to 100 kg. weight.—			
Germany	6,000	3,000	– 3,000
United States	582,000	1,061,000	+ 479,000
France	271,000	223,000	– 48,000
United Kingdom ...	398,000	182,000	– 216,000
Holland	167,000	21,000	– 146,000
Italy	380,000	185,000	– 195,000
Portugal	—	2,000	+ 2,000
Sweden	147,000	26,000	– 121,000
Switzerland	392,000	295,000	– 97,000
Other countries	8,000	2,000	– 6,000
Total	2,351,000	2,000,000	– 351,000
Ditto, 101-400 *kg.*—			
United States	342,000	510,000	+ 168,000
France	222,000	68,000	– 154,000
United Kingdom ...	310,000	158,000	– 152,000
Italy	137,000	43,000	– 94,000
Portugal	—	4,000	+ 4,000
Sweden	258,000	35,000	– 223,000
Switzerland	248,000	336,000	+ 88,000
Holland	—	2,000	+ 2,000
Other countries	214,000	1,000	– 213,000
Total	1,731,000	1,157,000	– 574,000
Ditto, 401-2,500 *kg.*—			
United States	621,000	550,000	– 71,000
France	132,000	100,000	– 32,000
United Kingdom ...	895,000	350,000	– 545,000
Italy	86,000	41,000	– 45,000
Sweden	137,000	163,000	+ 26,000
Switzerland	460,000	458,000	– 2,000
Other countries	9,000	—	– 9,000
Total	2,340,000	1,662,000	– 678,000
Ditto, 2,500-5,000 *kg.*—			
United States	96,000	360,000	+ 264,000
France	17,000	478,000	+ 461,000
United Kingdom ...	62,000	67,000	+ 5,000
Sweden	87,000	8,000	– 79,000
Switzerland	129,000	98,000	– 31,000
Total	391,000	1,011,000	+ 620,000

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	1916 Pesetas	1917 Pesetas	Inc. or dec. Pesetas
Ditto, over 5,000 kg.—			
United States	1,462,000	404,000	−1,058,000
France	175,000	245,000	+ 70,000
United Kingdom ...	202,000	68,000	− 134,000
Switzerland	444,000	833,000	+ 389,000
Sweden	86,000	—	− 86,000
Other countries	—	1,000	+ 1,000
Total	2,369,000	1,551,000	− 818,000
Accumulators and electric batteries.—			
Denmark	42,000	8,000	− 34,000
United States	41,000	321,000	+ 280,000
France	33,000	29,000	− 4,000
United Kingdom ...	25,000	16,000	− 9,000
Sweden	4,000	1,000	− 3,000
Switzerland	2,000	7,000	+ 5,000
Other countries	3,000	2,000	− 1,000
Total	150,000	384,000	+ 234,000
Cables and wires for electricity, with or without insulating material of 1 cm. dia. or more.—			
United States	3,000	32,000	+ 29,000
France	26,000	58,000	+ 32,000
United Kingdom ...	93,000	147,000	+ 54,000
Other countries	1,000	—	− 1,000
Total	123,000	237,000	+ 114,000
Ditto, under 1 cm.—			
United States	48,000	21,000	− 27,000
France	18,000	18,000	—
United Kingdom ...	45,000	37,000	− 8,000
Sweden	10,000	7,000	− 3,000
Total	121,000	83,000	− 38,000
Telegraph and telephone apparatus, electric meters and parts.—			
Belgium	—	1,000	+ 1,000
United States	1,100,000	1,094,000	− 6,000
France	933,000	376,000	− 557,000
United Kingdom ...	1,033,000	724,000	− 309,000
Italy	19,000	20,000	+ 1,000
Sweden	1,351,000	933,000	− 418,000
Switzerland	129,000	232,000	+ 103,000
Other countries	120,000	2,000	− 118,000
Total	4,685,000	3,382,000	−1,303,000
Electrodes.—			
United States	59,000	54,000	− 5,000
United Kingdom ...	20,000	—	− 20,000
Other countries	—	1,000	+ 1,000
Total	79,000	55,000	− 24,000

	1916 Pesetas	1917 Pesetas	Inc. or dec. Pesetas
Hydraulic motors.—			
United States	29,000	35,000	+ 6,000
France	92,000	30,000	− 62,000
United Kingdom ...	7,000	17,000	+ 10,000
Switzerland	991,000	635,000	− 356,000
Other countries	1,000	—	− 1,000
Total	1,120,000	717,000	− 403,000
Steam and gas engines (stationary) up to 10,000 kg. weight.—			
United States	5,000	5,000	—
France	63,000	10,000	− 53,000
United Kingdom ...	401,000	210,000	− 191,000
Italy	17,000	89,000	+ 72,000
Switzerland	112,000	20,000	− 92,000
Other countries	9,000	—	− 9,000
Total	607,000	534,000	− 273,000
Ditto, from 1,000l to 25,000 kg.—			
France	—	16,000	+ 16,000
United Kingdom ...	159,000	58,000	− 101,000
Switzerland	19,000	22,000	+ 3,000
Total	178,000	96,000	− 82,000
Ditto, over 25,000 kg.—			
United Kingdom ...	—	64,000	+ 64,000
Switzerland	360,000	49,000	− 311,000
Total	360,000	113,000	− 247,000
Cylindrical steam boilers.—			
United States	5,000	9,000	+ 4,000
France	18,000	1,000	− 17,000
United Kingdom ...	36,000	11,000	− 25,000
Switzerland	65,000	15,000	− 50,000
Other countries	3,000	1,000	− 2,000
Total	127,000	37,000	− 90,000
Multitubular boilers.—			
United States	1,000	1,000	—
France	271,000	85,000	− 186,000
United Kingdom ...	1,870,000	962,000	− 908,000
Italy	14,000	20,000	+ 6,000
Switzerland	192,000	35,000	− 157,000
Other countries	7,000	—	− 7,000
Total	2,355,000	1,103,000	−1,252,000

REPORT ON THE ELECTRIC LAMP INDUSTRY.

On March 16th the Board of Trade issued a report embodying the findings of a sub-committee appointed by the Standing Committee on Trusts which had been adopted by the Standing Committee. The members of the sub-committee were: Messrs. John Hilton (chairman), J. E. Baker, M.B.E., F. J. Blakemore, F.C.I., M. V. Loveaux, R. S. Pengelly, and W. H. Watkins.

The terms of reference were as follows:—

To inquire into the existence of any trust or trade combination in the electric lamp industry, and into the effects which the existence of such a trade combination, if proved, is having upon prices of electric lamps.

The report is an extremely interesting document, of considerable importance to the electrical industry, and we commence reprinting it below; but as it is too long to be completed in one issue, we give first the conclusions at which the sub-committee unanimously arrived:—

Conclusions.

(*a*) There is in the electric lamp industry a trade combination—the Electric Lamp Manufacturers' Association—which includes from 90 per cent. to 95 per cent. of the industry, controls factors and retailers, fixes prices at all stages, and regulates output.

(*b*) The prices fixed by the Electric Lamp Manufacturers' Association become the standard prices for all lamps sold in this country, whether made by Association or non-Association manufacturers, or imported from abroad.

(*c*) British lamp manufacturers outside the Association produce and sell to the trade (presumably at a profit) lamps of comparable quality at a lower price than Association firms.

(*d*) Because of the standard price policy originated by the Association, non-Association lamps are sold to the public at the same price as Association lamps, the advantage on the lower-priced lamps going wholly to distributors. Hence, either Association manufacturers are making an undue profit, or they manufacture less economically than non-Association makers.

(*e*) The trading discounts received by factors and retailers are considerably higher than is necessary, and should be reduced.

(*f*) Standard vacuum lamps now sold to the public at 3s. could be sold at 2s., at which price the manufacturer and the distributor would still have a satisfactory working profit.

(*g*) One and a quarter million half-watt lamps sold to the public in 1919 at 12s. 6d. were purchased in Holland by the three associated manufacturers at about 3s. per lamp.

(*h*) These half-watt lamps could have been sold to the public at not more than 8s., which price would still have left ample margins for the importers and distributors. Importers and distributors between them made profits on these lamps of something like £280,000 over and above what would appear to us reasonable.

(*i*) The Electric Lamp Manufacturers' Association has been created primarily in the interests of three firms—The British Thomson-Houston Co., The General Electric Co., and Messrs. Siemens Bros. These impose onerous conditions upon other firms in the Association, *e.g.*, a limitation of output upon licensees, and a stipulation that the validity of their patents shall not be questioned or disputed.

(*j*) The limitation of output imposed upon licensees is contrary to the best interests of the industry, and of the consumer.

(*k*) Since the largest of the three dominant firms in the Association is under majority control of an American electrical concern, there is some danger of the interests of the British lamp industry being subordinated to American interests.

(*l*) There is a possibility of an international combination, comprising British, Dutch, and American manufacturers, which would be able to control supplies and dominate prices over a considerable part of the world.

(*m*) The operations of an association which so effectively controls an important industry should be subjected to public

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supervision and control; and we consider this would best be attained by giving statutory effect to the recommendations of the Committee on Trusts appointed by the Minister of Reconstruction—which, in brief, are that there should be established a department of State charged with the duty of informing itself as to the nature, extent, and development of combinations of all kinds in so far as they tend to the restraint of trade and the creation of monopolies, and of making preliminary inquiry into complaints made with regard to them; and that a tribunal should be set up to which the department could apply for powers to obtain particular information, and would refer for full investigation cases in which combinations appeared to act injuriously to the public interest.

The Committee wish to record their great appreciation of the services rendered by the secretary, Mr. P. Gent, in connection with this inquiry.

REPORT.

To the Chairman of the Standing Committee on Trusts.

1. We were appointed to inquire into the existence of any trust or trade combination in the electric lamp industry, and into the effects which the existence of such a trade combination, if proved, is having upon prices of electric lamps.

We have held nine meetings, and have examined representatives of the Electric Lamp Manufacturers' Association of Great Britain, Ltd., of electric lamp manufacturers inside and outside the Association, as well as factors and distributors of Association and non-Association lamps.

2. Since in our inquiry we have had to investigate the influence of trade combination upon the development of the electric lamp industry in this country, and to relate that influence to questions of patent rights, exclusive processes, and agreements of an international character, we think it well to recount briefly the history of electric lamp manufacture in so far as it bears upon our investigations.

The first incandescent lamp—the carbon filament lamp—was invented simultaneously in 1878 by Swan in England and Edison in America. Although the patents were declared invalid in every other European country, they were upheld in the United Kingdom, and the manufacture of electric lamps in this country thus became, for several years, the monopoly of one company. On the expiry of the Edison and Swan patents other British factories sprang up, and a period of expansion in the British lamp industry followed. Meanwhile German manufacturers, having been free from patent restrictions, had progressed even more rapidly, not only in volume of output but also in technique of manufacture and trade organisation; and on the lapse of the British patents they were able to send lamps into this country at a price with which British manufacturers had difficulty in competing.

For about 28 years the incandescent electric lamp in common use remained practically unchanged, and it was not until 1906 that an Austrian and a German firm produced independently the squirted tungsten filament, based on what appeared to be the same chemical principle, but different processes. The Austrian patent seemed the fundamental one, but the German process was better adapted to commercial manufacture. In 1907 a British firm, The General Electric Co., Ltd., approached both Austrian and German firms (which were then at law with regard to their patents) with a view to securing the patent rights of both for this country. The Germans were reluctant to sell, it being their intention not to license manufacturers in other countries, but to manufacture exclusively in Germany and to build up a large export trade. The Austraian syndicate, on the other hand, did not intend to manufacture, and were willing to dispose of the patent. The General Electric Co., Ltd., was eventually successful in acquiring the rights of the British patents for both processes, and forthwith erected a factory for the production of metal filament lamps in this country.

The next notable developments in the electric incandescent lamp were the production in the United States (by the General Electric Co., of New York) of the drawn tungsten wire filament lamp in 1909, and of the gas-filled lamp, popularly known as the half-watt lamp, in 1913. The British rights for these patents were acquired by the British Thomson-Houston Co., under their arrangements with the General Electric Co. (of New York), which has a majority interest in the British Thomson-Houston Co.

The gas-filled lamp, as invented in 1913, could be made only in the larger sizes, but in 1914 it was discovered that commercial lamps of lower sizes could be made if filled with argon instead of nitrogen. Up to that time, however, argon had had no commercial value, and its manufacture had not been developed. Repeated attempts to produce the gas on a commercial scale were made in this country during the early part of the war, but without success. Meanwhile a Dutch firm of repute, Messrs. Philips, of Eindhoven, had discovered a process, and were manufacturing argon-filled lamps in large quantities. Overtures were made to them by British manufacturers for the supply of the essential parts of an argon plant. The Dutch manufacturers were naturally not anxious to supply their British competitors with this machinery, but ultimately a contract, approved by the Board of Trade, was entered into, providing for the supply of an argon plant in consideration, *inter alia*, of the purchase of a large number of argon-filled lamps from the Dutch firm. After unforeseen delays the plant was received and erected at the lamp works of the General Electric Co., at Hammersmith, where it is now at work.

Prior to the war the annual output of incandescent electric lamps in this country is estimated to have been about 25,000,000, the corresponding figure for the United States being 110,000,000, for Germany 100,000,000, and for Holland 16,000,000. During the war the American output is stated to have increased by 60 per cent., and the British output by 20 per cent., while the manufacturers of Holland have gone rapidly ahead and acquired a considerable part of the foreign lamp trade of both Britain and Germany.

In 1913 electric incandescent lamps to the number of 3,300,000, having a value of £196,000, were imported into this country, while 3,700,000 lamps, valued at £192,000 were exported. During the war imports have on the average shown an increase and exports a decline. In 1919 the lamps imported totalled over 2,500,000, and those exported over 2,800,000, the f.o.b. value of the exported lamps being, however, only about two-thirds the c.i.f. value of the imports.

The consumption of lamps in the United Kingdom is now estimated at 30,000,000 per annum.

3. Under our terms of reference we are to inquire into the existence of any trust or trade combination in the electric lamp industry. We find that a trade combination does exist among electric lamp manufacturers in this country, and exercises a powerful influence over the conduct and development of the industry. The facts relevant to our inquiry concerning this combination we find to be as follows:—

The Tungsten Lamp Association was formed about seven years ago, its declared objects being to promote and protect the interests of manufacturers of, and dealers in, electric lamps in the United Kingdom; to conduct and assist in making experiments and research for the improvement of electric lamps, and to enter into agreements with members and wholesale and retail dealers relating to the manufacture, supply, and sale of electric lamps.

It has been explained to us that the success of the first metal-filament lamps, made in this country under acquired German and Austrian patents as already mentioned, encouraged other electrical concerns to make researches and take out patents for new inventions. It was considered that some of these patents overlapped, and costly litigation was threatened. Deeming co-operation preferable to conflict, The British Thomson-Houston Co., The General Electric Co., and, later, Messrs. Siemens, came together, primarily on patents, each agreeing to recognise the others' patents and to license the others for its own patents, and to interchange factory and laboratory experience. As a natural consequence, we are informed, a selling arrangement was entered into. These three, with the Ediswan Electric Co., formed themselves into the Tungsten Lamp Association. The Tungsten Lamp Association was incorporated in the Electric Lamp Manufacturers' Association of Great Britain, Ltd., in April, 1919, the declared objects of the latter association being the same as those of the original association. Various other firms have joined the Association at different times since its formation, and the complete membership is now as follows, the last three firms having joined during the war:—

The British Thomson-Houston Co., Ltd.
The General Electric Co., Ltd.
Siemens Bros., Ltd.
Ediswan Electric Co., Ltd.
Foster Engineering Co.
Stearn Electric Lamp Co., Ltd.
"Z" Electric Lamp Manufacturing Co.
British Westinghouse Electric & Manufacturing Co., Ltd. (now Metropolitan-Vickers Electrical Co., Ltd.).
Dick, Kerr & Co., Ltd. (Britannia Lamp & Accessories Co., Ltd.).
Pope's Electric Lamp Co., Ltd.

The electric lamp industry in this country may thus be regarded for our purpose as falling into two main divisions, namely, the firms in the Association and non-associated firms. The associated manufacturers of electric lamps in this country comprise the ten firms named above. The non-associated firms include:—

Cryselco Lamp Co., Ltd.
Crowther & Osborn, Ltd. (Sceando Lamp Co.).
Imperial United Lamp Co., Ltd.
Corona Lamp Works, Ltd.
Harlesden Lamp Co. (Stella Lamp Co.).
Maxim Lamp Works, Ltd.
Notable Lamp Co., Ltd.

Prior to the war the Association was responsible for about 85 per cent. of the total British output, whilst for last year its proportion is estimated to have been between 90 and 95 per cent.

4. Under our terms of reference we have further to inquire into the effects which the existence of a trade combination in the electric lamp industry, if proved, is having upon the prices of electric lamps.

The first fact to be recorded in this connection is that the Electric Lamp Manufacturers' Association has an arrangement whereby its members fix a common retail price for the various types and grades of lamps sold to the public, and give an agreed rate of discount to the factors and retailers who handle the lamps.

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The nature of this arrangement is as follows: A basic discount of 20 per cent. on retail selling prices is allowed to any approved trade retailer. The Association has further a sliding scale whereby any trader doing business in Association lamps to the amount of £70 or more per annum can receive a discount proportionate to his total annual purchases of lamps from all the associated firms, the rates being as follows:—

22 per cent. on £70	net value of purchases.
24 per cent. on £130	,,
25 per cent. on £330	,,
26 per cent. on £650	,,
27 per cent. on £1,000	,,
28 per cent. on £1,250	,,
30 per cent. on £1,550	,,
32 per cent. on £1,850	,,
34 per cent. on £3,000	,,
36 per cent. on £5,000	,,
37 per cent. on £11,500	,,
38 per cent. on £28,000	,,
39 per cent. on £55,000	,,

If a trader desires and is entitled to more than 20 per cent. discount under the above scale, he must apply to the Association for grading, which is granted conditional on his signing an agreement. If the trader's net purchases entitle him to a discount of from 22 per cent. to 28 per cent., he must sign the retailer's agreement, the main feature of which is that he agrees not to advertise, stock, or solicit orders for, lamps of other than Association makes. If the trader's net purchases entitle him to a discount of 30 per cent. or more, he must sign the factor's agreement, the main feature of which is that he agrees not to advertise, stock, solicit orders for, *or sell* lamps other than Association makes. Thus, the retailer under his agreement may sell non-Association lamps only if requested to do so, and must then obtain them specially for his customer. But the factor must not on any account sell non-Association lamps. Such factors are, in practice, agents for the associated firms, and it has been stated that their number is about 50.

The Association has a system whereby the whole of the manufacturers and factors are periodically informed of the discount grading of customers, besides which they have a register of approved 20 per cent. traders. It is a rule of the Association, and a stipulation in the factor's and retailer's agreements, that no trader shall be supplied at other than the discount advertised by the Association. In no case may a manufacturer or factor give more than 20 per cent. discount to any firm without the sanction of the Association.

A condition of sale of all Association lamps is that they shall be sold to the user at the prices fixed by the Association, and all distributors are compelled to insert the price maintenance clause as a condition of sale, as well as to withhold supplies from any purchaser infringing the sales terms of the Association.

Should a factor handle any other than Association lamps, or resell at discounts other than those prescribed by the Association, supplies may be withheld, and he may be put upon the "list prices net" register. Should a retailer on preferential discount stock, advertise, or solicit orders for other than Association lamps he may be down-graded to the basic discount of 20 per cent., or put upon the "list prices net" register. Should either sell to the using public at a price other than the price fixed by the Association, he may be put upon the "list prices net" register of firms who must not be given any discount whatever by any Association manufacturer or factor. Upon the "list prices net" register are placed not only firms who have sold at less than fixed prices, but also all agents for non-Association lamps, all non-Association lamp manufacturers, and various firms who are considered not to be *bona-fide* retailers, *e.g.*, firms who claim to be retailers in order to get lamps at trade discount for their own use. This "list prices net" register, which appears to be known in the trade as the "black list," contains the names of about 100 firms.

It will be seen that the prices of electric lamps to the public are completely controlled by the Association as regards between 90 per cent. and 95 per cent. of the home supply. We have now to state that a manufacturer of electric lamps who is not a member of the Association has the normal channels of the distributing trade in large part closed to him. A new firm of lamp manufacturers starting up in business and declining to join, or being refused admission to, the Association, would have to depend for the bulk of its sales on large consumers, such as Government departments, municipalities, stores, factories, theatres, hotels, collieries, or railway companies. If such a firm wished to sell to the general public it would have to rely almost entirely upon factors dealing only in non-Association lamps, or upon very small retailers, each of whose total purchases of lamps amount to less than £70 per annum.

The position of the non-Association manufacturer is likely to be even more difficult in the future than hitherto, by reason of the introduction of the half-watt lamp. No agent likes to admit to his customers that he cannot supply the "latest pattern" in any line of goods, but since the half-watt lamp is at present controlled under Association patents, any retailer who becomes an agent for a non-Association lamp cannot procure a half-watt lamp except at "list prices net," and if he is a retailer in a fairly large way of business, he cannot get the preferential discounts on the half-watt and other Association lamps unless he binds himself not to stock, advertise, or solicit orders for, any non-Association lamp. This is no more than a particular instance of a general principle. The lamps made by the leading Association manufacturers are widely advertised, and every substantial retailer must be called upon, by a large proportion of his customers, to supply such lamps, but as soon as his turnover in Association lamps reaches £70 per annum he has a strong cash inducement to give the cold shoulder to any lamp made by a non-Association firm. As regards the sale of lamps to the general public, the Association, for good or for ill, can exclude the non-Association manufacturer from all but the fringes of the distributing trade.

(To be continued.)

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

The "Easy-Fix" Conduit Fittings.

Every device by which the cost of installing electric wiring can be reduced is of value to the industry, and in this respect the conduit fittings introduced by the "Easy-Fix" Fittings Co., of 66, Victoria Street, S.W.1, offer distinct advantages. They are designed for use with switches, ceiling roses, and wall sockets, and dispense with wood blocks and their accompanying disadvantages, such as the necessity of cutting them to suit requirements, the loop of unprotected wire behind the block—where it may be in contact with a damp wall—

Fig. 1.—Through Outlet Box.

Fig. 2.—Ceiling Rose (Base).

Fig. 3.—Switch (Base).

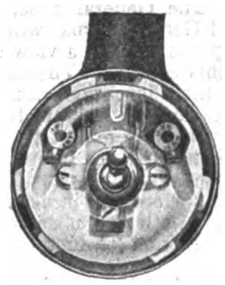

Fig. 4.—Switch Mounted.

Fig. 5.—Universal Outlet Box.

the difficulty of ensuring the earthing of the switch cover, &c. The attachment of accessories to conduit fittings by screws also gives rise to trouble, and offers scope for slovenly work. In the "Easy-Fix" system, as the name implies, all these difficulties are obviated. Fig. 1 shows a through outlet box, which, it will be seen, is provided with three internal lugs, which engage in slots formed on the wings of the special ceiling rose, fig. 2, or switch, fig. 3; the latter is securely fixed in place by screwing on the cover, which in the case of the switch is of metal, and thus earths the exposed metal parts to the conduit, without the use of a special earthing screw. Fig. 4 is a "ghost" view of the complete switch in place, showing the method of locking it to the box. Fig. 5 shows a "universal" type of outlet box, and other patterns are made, but only about half a dozen are required to cover all requirements. The ceiling roses and wall sockets are made in accordance with the British Engineering Standards Association's specification, and all the fittings are standardised as far as possible, the same boxes serving for roses, brackets, rigid pendants, switches, &c. They can be used with any wiring system, suitable devices being provided for the purpose where necessary, such as an earthing clamp inside the box for metal-sheathed wire. Those illustrated are castings,

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but a line of boxes is in preparation of pressed steel, embodying the same features, and covered with a white enamelled fibre ring which gives them a very neat apearance. By the use of the "Easy-Fix" system, it is claimed, a material economy is effected on the cost of every outlet.

A "Mazdalux" Ceiling Unit.

The British Thomson-Houston Co., Ltd., Mazda House, 77, Upper Thames Street, E.C.4, has recently introduced a very compact ceiling unit (fig. 6). This consists of a metal

Fig. 6.—"Mazdalux" Ceiling Unit.

reflector, lampholder and housing suitable for direct attachment to a ceiling. The upper part is cut away, as shown, to permit the entry of casing, conduit or wires.

The "Hoadley" Current Limiter.

Messrs. Drake & Gorham Wholesale, Ltd., 67, Long Acre, W.C.2, have sent us particulars of a current limiting device, which, although not new, has been greatly improved upon and re-designed. The main feature of the "Hoadley" limiter (fig. 7) is a coil (A), taking the main current, one end of which is connected to the circuit through terminal B, and the

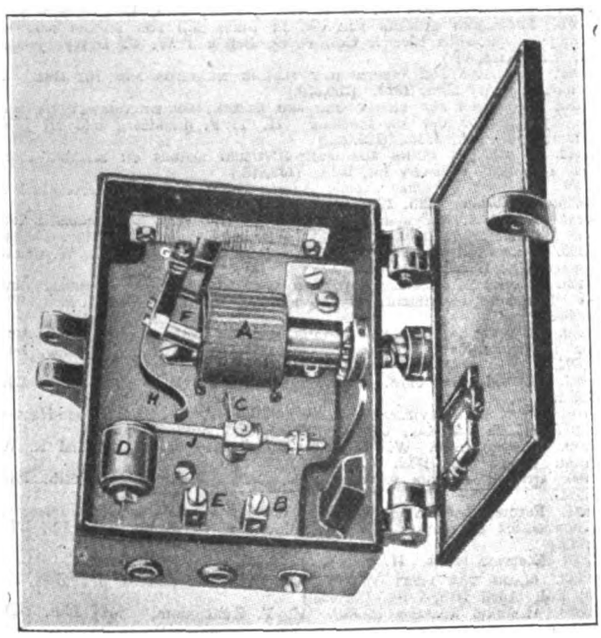

Fig. 7.—The "Hoadley" Current Limiter.

other end is connected through a tripping arrangement C and a mercury switch D to terminal E. Entering the coil is an armature F pivoted at G and bearing a striking piece H. When the current through the coil exceeds a predetermined limit the armature is drawn into the coil, and the striking piece trips the switch C which, being rigidly fixed, raises the bar J, breaking the circuit at the mercury cup. The armature is immediately released, but if the current is still excessive the circuit is again broken, and this action goes on until a lamp or lamps are switched off and the current is reduced.

A New British Motor.—The sole British agent for the motors described in the Electrical Review of March 19th under the above heading is the Enterprise Manufacturing Co., Ltd., Gun Street Electrical Works, Bishopsgate, E.1.

CORRESPONDENCE.

Letters received by us after 5 P.M. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Cost of Living in India.

It might interest those thinking of accepting a post in India to know something about the present cost of living from a woman who has spent some years out here. As to the value of the rupee, in spite of the favourable rate of exchange, viz., 2s. 9d. to 2s. 11d., the purchasing power of the rupee is actually down fifty per cent., taken all round.

In pre-war days a young single assistant engineer in an up-country station might reasonably expect to start on from Rs. 350 to Rs. 450 per mensem, with the usual free quarters, medical attendance, passage out and home, and six months' leave on full pay at the end of, say, five years' service.

In the present state of affairs, and possibly for many years to come, the above conditions would be quite inadequate if a young man hoped to put by a little for his efforts. In towns, housing and even hotel accommodation is very difficult to procure, the former running from Rs. 80 to Rs. 110 per month for flats, Rs. 150 and over for houses, and the latter from Rs. 175 to Rs. 225 per month for a single room.

To run your own small establishment on the most economical grounds, servants' wages alone cost approximately Rs. 100 per month; even in an hotel you would have to keep a boy and pay him Rs. 30 per month, besides various other tips, probably running to another Rs. 30, if you wished to get any attention.

The married man is at a still greater disadvantage, for a conveyance is an absolute necessity. A carriage, horse, and groom can be hired in towns for Rs. 120 per month; previously the price was Rs. 60.

If there is a child an ayah is a necessity—a further cost of Rs. 30.

If two shared a flat, or three or four formed a chummery, the messing bills would run to approximately Rs. 150 per head. Clothing is another serious problem, a drill suit costing from Rs. 20 to Rs. 30, and these are required in numbers, as the "dhobi" takes care they do not last you too long. A lounge suit costs Rs. 80 to Rs. 120. English boots are Rs. 35 per pair; country boots are not worth the purchase.

I think I have given sufficient general details above, which do not include gymkhana and club subscriptions, &c., and would summarise the minimum starting salaries as follows:—

(*a*) A single young mechanic, Rs. 450 per month.
(*b*) An assistant engineer (unmarried), Rs. 750 per month.
(*c*) No responsible position should be accepted under Rs. 1,000 per month.

It is understood that the usual free allowances will be given as stated previously; this is really a most essential clause in all agreements. An ordinary "box walla," or merchant's assistant in a merchant's office, will draw his Rs. 1,000 per month, plus allowances, and think himself badly off.

Western India.

February 25th, 1920.

[We are very much indebted to our correspondent for this excellent statement of living conditions in India.—Eds. Elec. Rev.]

Automatic Switching for Street Lamps.

It would be interesting to know if automatic clock switches have been found satisfactory for operating street lamps. These switches are now being developed to a considerable extent for working gas lamps, which leads to great economies, as lamplighters are not required and also because the lamps can be lighted and shut off at the correct times, whereas with lamplighters they must be put on long before dark and shut off after daylight to allow for the time that the lamplighter uses in going round.

Clock switches did not get a good name for electric lighting purposes in days gone by, but one would like to know if there have been improvements since.

C. Turnbull.

Electricity Works, North Shields.
March 19th, 1920.

Wages in Kinemas and in the Electrical Industry.

In an article of mine, "Electricity and Kinematography," which you published in your issue of Sept. 5th, 1919, I briefly dealt with the status of the kinema operator. It is interesting to note that his position has now become more definite and recognised, and that he has attained unto a wage which would bring joy to many a hard-working shift engineer or technologist. Electricity, as I pointed out in the article, plays an important part in picture projection, and it is insisted (and rightly) that a chief operator must have had at least two years' experience.

But even two years in an operating-box can hardly be taken as a thorough claim to electrical competence, though it certainly gives plenty of time for an operator to get "the hang" of his equipment—and practice, it is said, makes perfect. As

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I have pointed out elsewhere, we have in kinematography an outstanding example of co-operating electrical appliances and methods which function so well as to require little or no skilled attention. Still, in view of the nature of projection work, it is necessary to ensure at least a modicum of technical skill on the part of the operator.

Not very long ago a kinema operator was lauded in the Press because he was said to have saved the situation, and innumerable lives, when a fire occurred in the operating-box. The plain fact of the matter was that no fire should have taken place at all; with a skilled (or should I say experienced) operator-electrician, the risk of a fire outbreak is so remote as to be negligible.

I call to mind the chief operator of a kinema in a Midland town who proudly demonstrated his knowledge of Ohm's Law ("Ho-hem's Lorr," as he termed it!). "Now," he explained, "with one amp. and one volt you get a resistance of one ohm. You can't deny that. In my 'box' the juice is 70 amps. at 70 volts, so that, by my reckoning, gives a resistance of 70 ohms." A logical and plausible argument.

This man was considered a good chief operator, and he is but one of many who, knowing little or nothing of the theoretical side of their electrical work, yet manage to "carry on" quite well in practice (thanks to efficient and safe electrical design). Now this raises an important issue: If, with a superficial technical knowledge and a job which does not demand skill of a high order, a kinema operator can claim the respectable wage of £5 per week, isn't it time the electrical industry woke up to the fact that many of its highly-skilled workers are receiving shamefully low pay in comparison? Of course, the kinema operator has realised the deadly power of *combination*. Yet his work, after all, is only for entertainment purposes (admittedly useful), while the electrical industry is playing a most important and ever broadening part in the *productive* life of the community. *Verbum sap.*

G. E. Moore.

London, N., *March 22nd*, 1920.

NEW PATENTS APPLIED FOR, 1920.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. Sefton-Jones, O'Dell and Stephens, Chartered Patent Agents, 285, High Holborn, London, W.C.1.

6,939. "Electric valve or lamp relay and intervalve transformer." G. A. Mathieu. March 8th.
6,946. "Sparking plugs." F. A. L. Johnson. March 8th.
6,971. "Sparking plug." G. C. Lazenby. March 8th.
6,974. "Wireless telegraphy or telephony." O. Thornycroft. March 8th.
6,977. "Subscribers' instruments for telephone systems." E. A. Petithory and Siemens Bros. & Co. March 8th.
6,980. "Electric heaters." H. W. Sullivan. March 8th.
6,988. "Telephone transmitters." Miessner Inventions Corporation. March 8th. (United States, March 12th, 1919.)
6,990. "Sound-reproducers for talking-machines, telephones, &c." E. Paterson. March 8th.
6,998. "Electro-therapeutic plates." S. Porter. March 8th.
7,003. "Detection signals." E. E. and S. P. Marsh. March 8th.
7,004. "Thermal circuit closer." H. Fairbrother (H. Sieben). March 8th.
7,020. "Electric heater." P. J. H. Bernard. March 8th.
7,023. "Storage electric batteries." W. E. Holland and L. J. Pearson. March 8th. (United States, September 5th, 1919.)
7,024. "Storage electric batteries and separators for elements thereof." W. E. Holland and J. M. Skinner. March 8th. (United States, May 17th, 1919.)
7,038. "Electric circuit breakers, &c." J. Hall. March 8th.
7,039. "Time-lag devices." J. Hall. March 8th.
7,046. "Remagnetising device." G. A. Foehl. March 8th. (United States, March 20th, 1918.)
7,069. "Telegraph printing systems." Automatic Telephone Manufacturing Co., H. H. Harrison and S. R. Smith. March 9th.
7,084. "Key and receiving gear for wireless telegraphy." J. Swinbourne. March 9th.
7,092. "Method of using electric lamps to illuminate heated, &c., chambers." A. W. Bridges. March 9th.
7,099. "Detachable sparking plug." L. Wells. March 9th.
7,106. "Junction box for electric wiring systems." J. C. White. March 9th.
7,109. "Device for packing and carrying Marconi bulbs." A. Astley. March 9th.
7,140. "Electric targets." P. Elphick. March 9th.
7,142. "Systems of electric ship propulsion." British Thomson-Houston Co. (General Electric Co., U.S.A.). March 9th.
7,147. "Electric storage batteries or accumulators." G. R. N. Minchin and The Pritchett and Gold and Electrical Power Storage Co. March 9th.
7,160. "Miners' safety, &c., electric hand lamps." G. Oldham, J. Oldham, O. Oldham, and Oldham & Son. March 9th.
7,163. "Automatic switch for electric heating appliances." B. G. C. Stephens. March 9th.
7,176. "Electron-releasing devices." J. E. Lilienfield. March 9th. (Germany, December 12th, 1919.)
7,199. "Guiding devices for trolleys of electric tramway, &c., vehicles." R. N. Bradley and A. E. Millington. March 10th.
7,210. "Electric heaters." W. Marples. March 10th.
7,224. "Cord-grips for electric lamp holders." V. Hope. March 10th.
7,235. "Magneto-electric ignition apparatus." H. G. C. Fairweather (Aktiebolaget Svenska Elektromagneter). March 10th.
7,255. "Electric-starting apparatus." H. G. Andre. March 10th.
7,256. "Thermionic tubes for wireless transmission systems." S. Brydon, A. G. T. Cusins, S. Johnson and J. H. Whittaker-Swinton. March 10th.
7,266. "Reflectors for lamps, &c." Benjamin Electric, Ltd., and G. Campbell. March 10th.
7,289. "Deflagration apparatus for testing the electrostatic rigidity of insulating materials." A. R. Matthis. March 10th.
7,286. "Telephone fittings." M. H. Spencer. March 10th.
7,342. "Electrically-operated illuminated advertising, &c., signs." A. S. Ellerton. March 11th.
7,346. "Circuit interrupters." British Thomson-Houston Co. (General Electric Co., U.S.A.). March 11th.
7,348. "Electric switches." British Thomson-Houston Co. (General Electric Co., U.S.A.). March 11th.
7,359. "Grill for gas and electric cooking stove." H. H. Beach. March 11th.
7,363. "Generation, transmission, or distribution of electricity." Ferranti, Ltd., W. H. Hanstock, H. Hawkins and A. H. Higgs. March 11th.
7,365. "Safety device for electric generators." Siemens-Schuckertwerke. March 11th. (Germany, October 23rd, 1918.)
7,377. "Aerials for wireless signalling." T. L. Eckersley. March 11th.
7,378. "Electrodes for electric welding." J. H. Paterson and Premier Electric Welding Co. March 11th.
7,386. "Storage battery locomotives." Manchia Storage Battery Locomotive Co. March 11th. (United States, August 31st, 1918.)
7,401. "Sparking plugs." J. E. Barrow. March 12th.
7,431. "Device for winding armature coils." J. A. Edley. March 12th.
7,452. "Electric-signalling apparatus." J. L. Major and F. S. S. Wade. March 12th.
7,454. "Electric relays." M. D. Dimitrievitch. March 12th.
7,457. "Method of carrying or storing electric-light bulbs." A. Astley. March 12th.
7,488. "Telephone receivers." M. Barrasford. March 12th.
7,490. "Electric signalling systems." F. G. Bell, W. C. Davey and Sterling Telephone & Electric Co. March 12th.
7,503. "Electric signals." P. H. Purcmjee. March 12th.
7,504. "Producing low-frequency varying current or voltage by thermionic valve circuits." W. A. Appleton, S. H. Long and A. K. Macrorie. March 12th.
7,517. "Ignition devices for internal-combustion engines, &c." D. R. Dobson and W. Pickard. March 13th.
7,523. "Switches for electric signalling systems." R. Blunt and H. F. Mitchell. March 13th.
7,542. "Switch and fuse contacts." Callender's Cable & Construction Co. and J. F. Watson. March 13th.
7,544. "Electric starting and regulating switches." C. J. Margerison and F. J. Shenton & Co. March 13th.
7,561. "Systems of electric motor control." British Thomson-Houston Co. (General Electric Co., U.S.A.). March 13th.
7,573. "Galvanometers." J. Riddle and Telegraph Construction & Maintenance Co. March 13th.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1914.

11,857 Indicating arrangements for electricity supply systems. A. J. J. Marguetond and R. F. J. D. Du Rousset. May 12th, 1914.

1916.

16,862 Connection for electric leads. P. Clerget and Soc. Clerget Blin, et Cie. November 24th, 1916. (138,940.)

1919.

276. Electric switch for use with burglar alarms. G. Nissen. January 4th, 1919. (138,957.)
1,259. Arrangement for indicating or utilising vibratory movements of amplitudes insufficient to effect the opening or closing of an electric circuit or to give a visual indication. Automatic Telephone Manufacturing Co. and S. R. Smith. January 17th, 1919. (138,966.)
1,271. Electro-plating. C. A. Bolton. January 17th, 1919. (138,967.)
1,470. Signalling systems for use in mines and for similar purposes. Sterling Telephone & Electric Co., F. G. Bell and W. C. Davey. January 20th, 1919. (138,968.)
1,682. Apparatus for electrically testing magnetos and the like. A. Howlett. January 23rd, 1919. (138,970.)
2,283. Apparatus for discovering and determining electrically the location of veins of ore or mineral. H. T. F. Lundberg and H. J. H. Nathorst. July 8th, 1918. (129,621.)
2,542. Supporting means for light-diffusing shades on electric lamps. C. H. Kitching. February 1st, 1919. (138,980.)
3,407. Electric switches. Cable Accessories Co., F. H. Reeves and A. Crawford. February 12th, 1919. (138,987.)
4,244. Automatic or semi-automatic telephone systems. Automatic Telephone Manufacturing Co. and H. M. Friendly. February 20th, 1919. (139,000.)
4,386. Electric storage batteries. London Battery Co. and E. W. Clarke. February 21st, 1919. (139,001.)
4,459. Electrical signalling systems such as are used in mines. Automatic Telephone Manufacturing Co. and H. Green. February 22nd, 1919. (139,003.)
4,460. Electrical signalling systems such as are used in mines. Automatic Telephone Manufacturing Co. and H. Green. February 22nd, 1919. (139,004.)
5,929. Electric switches. Benjamin Electric, Ltd. July 3rd, 1918. (129,254.)
6,864. Protective devices for electric circuits. British Thomson-Houston Co. (General Electric Co., U.S.A.). March 19th, 1919. (139,032.)
7,288. Electromotor. W. R. Sykes Interlocking Signal Co. and R. W. Tarrant. March 24th, 1919. (139,038.)
7,830. Quartz mercury vapour lamps. H. George. April 24th, 1918. (125,944.)
8,601. Electrical relays or contact-makers for mine signalling apparatus and for other purposes. J. R. L. Allott and E. Dean. April 5th, 1919. (139,005.)
9,205. Electric fuses. H. J. Abbott. April 11th, 1919. (139,061.)
10,220. Means for ventilating dynamo-electric machines. W. Holt and Brolt, Ltd. April 24th, 1919. (139,066.)
12,589. Electric welding tongs. H. F. Kuntzmann. May 19th, 1919 (139,078.)
13,998. Covers to electric switches, bell pushes, wall plugs, sockets and the like. J. A. Bower. June 2nd, 1919. (139,085.)
14,062. Electric heaters for ironing, cooking, heating, and like apparatus. P. P. Meunier. June 4th, 1918. (127,826.)
14,110. Electric switches. A. P. Rutherford. June 4th, 1919. (139,087.)
17,427. Electric lighters. B. L. Dechelle. July 12th, 1918. (129,653.)
18,301. Automatic or semi-automatic telephone systems. Automatic Telephone Manufacturing Co. November 4th, 1918. (134,812.)
20,116. Thermostats. W. J. Mellersh-Jackson (Cutler-Hammer Manufacturing Co.). January 21st, 1919. (Divided application on 1,571/19.) (139,111.)
23,811. Device for testing a person's steadiness of hand and accuracy of aim. Riebe-Kugellager-und Werkzeugfabrik Ges. (in liquidation). November 6th, 1918. (134,821.)
24,856. Electric plug coupling. O. Kessler and W. P. Hammond. October 10th, 1919. (139,128.)
24,927. Electrical driving means for phonographs or the like. J. Russ and F. J. Russ. September 1st, 1917. (133,715.)
29,404. Electric switches. V. E. Joyce and Park Royal Engineering Works. May 28th, 1919. (Divided application on 13,453/19.) (139,135.)
29,447. Audible and visual signals as used for mining-shaft signals and the like. W. O. Vicary. November 26th, 1919. (139,136.)
30,970. Automatic telephone systems. D. S. Hulfish. December 8th, 1917. (Divided application on 121,471.) (136,817.)

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THE TRANSPORT PROBLEM.

DURING last week several important events took place bearing directly upon the transport problem, both as it affects London and as it affects the whole country. It is gratifying to observe that this question is now receiving the attention that is its due, but which it never could gain until it was forced upon the notice of the public by touching their most sensitive spot—their pockets. We have previously remarked that the average man is reluctant to pay for transport service; hence the demand of the London Railway Companies for power to increase their charges, backed up with proofs that otherwise they cannot continue solvent, has brought the facts home to him with unpleasant emphasis. As Sir Eric Geddes said in his presidential address to the new-born Institute of Transport last week: "The State is faced with this: Under pre-war conditions of revenue, no one single transportation agency can continue to exist. And yet their healthy existence and development are vital to the State. And at long last the public are coming to understand this." "The interests of the community and the interests of the transport agencies are one."

Sir Eric dealt with the subject of transport in relation to the State, and showed that State control was indispensable though he avoided any direct discussion of the policy of State ownership; State control, however, necessarily involves a national guarantee that private capital shall receive a fair return, while it demands that the transport service shall be improved to the utmost, and that devastating disputes with Labour shall not occur. In order to provide the information required for these purposes, he laid great stress on the necessity of securing accurate comparative statistics and data from the operating companies, and foreshadowed legislation to that end. One passage in his address seems rather ominous—namely, that in which he invites the new Institute to act as "umpire" in the battle between alternating and direct current, in connection with the impending "great extensions of the application of electricity to railway traction." From past experience, we know only too well the harmful results of a "battle" of this kind, and we sincerely trust that every effort will be made to arrive at a definite decision without embarking on a protracted controversy.

We fear that the appointment of a Transport Advisory Committee last week to consider whether and what regulations should be made for the electrification of railways in respect of interchange of traffic, uniformity of system, &c., bears only too close a resemblance to the inauguration of the contemplated battle. These Committees! We know them well. They possess unlimited powers and possibilities of delaying progress; they meet once a month, and take a year to collect evidence, and another year to make up their minds—and then their advice is not adopted. We must make an exception, however, in the case of the Advisory Committee on London Traffic, which published its

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Report also last week. This Committee, under the guidance of a man of "push and go," has accomplished its task with comparative celerity, and has arrived at no uncertain decision. Its recommendations are admirable—above all, that which calls for the appointment of a supreme traffic authority for London, consisting of three members, giving their whole time to their work, and invested with the necessary powers by the Ministry of Transport. These are the fundamental conditions which must be fulfilled to secure results, and to secure them quickly. Voluntary unpaid Committees, of which we have so many that hardly anyone has escaped being put on one or other, are ineffective and futile so far as administration is concerned; if control is necessary, let it be in the hands of a whole-time body of the least possible number of men, with full authority. Then we shall get things done. There is nc work so inefficient as work that is not paid for. The exceptions only prove this rule.

The need for a supreme authority for London traffic has been so often pointed out by Commissions of Inquiry, and we have so consistently endorsed the demand, that we need say little further on this point; we hope that Sir Eric Geddes, who has already shown a willingness to be guided by advice, will lose no time before he calls this authority into being.

In the meantime, the case of the London Electric Railways brooks no delay; it cannot wait for the Authority, and Parliament is, therefore, dealing with it. We are pleased to see that the House of Commons has bowed before the facts, and that the opposition of the London M.P.'s to the Bill has been withdrawn. As Mr. J. H. Thomas most rightly pointed out, here was a case where employers and employed were in absolute concord—and promptly people declared that it was an unholy alliance against the public! The prospect before the Whitley Councils would be poor indeed if this were the general attitude towards their conciliation schemes.

Another Committee?

Yes! Another Committee—as though we had not had enough already! And what do we want to know now? Answer: How to increase production! To help us to increase our production of manufactured goods, let us then first increase our production of Government-appointed Committees. The exact terms of reference shall be these: "To consider and advise as to the best means of securing the greatest possible production consistent with the permanent well-being of industry and of the employers and the workpeople engaged therein." We have had discussions and conferences, committees and leagues, and what not, for the promotion of industrial harmony, but they have not brought an end to industrial unrest, which is the root-cause of low production. We have had elaborate movements in favour of Whitley Committees, which we thought would prevent disaffection by removing the causes thereof before they had time to develop. Yet these and Industrial Courts are found to be insufficient. We have had agitations for nationalisation engineered by those who contend that if we remove the obnoxious system of private ownership and let men work for the State, every man will feel in honour bound to give his best for the common good. But to many this is so thoroughly proved to be fallacious that they see in nationalisation a sure and certain measure for reducing, rather than increasing, production. We have had investigations of co-partnership proposals, but again and again they have been treated with scorn and derision. The nearest we have got to anything which appears to be a practical proposal for securing increased output is payment by results. Many men are making a good thing for themselves along such lines, and we doubt whether this new Committee will offer any better recommendation. An awakened conscience throughout the nation, securing to Capital and Labour alike a fair and reasonable share in the results of their efforts and abilities, would alone accomplish much; education regarding economic and industrial questions might remove ignorance which confirms men in the belief that they are doing well by their fellows in not working too hard, but education may fail to awaken a conscience. Let us have a committee therefore, take evidence, make recommendations, and hope that somebody will read the evidence and follow out the recommendations. We will save Old England's industries then by just one more committee. If it should happen that we do not succeed, we shall at least have one more and better way open—we can appoint yet another! By that time—.

The German Transmarine Electricity Works.

One of the greatest oversea undertakings established by German financial interests is now proposed to be transferred to foreign ownership. We refer to the German Transmarine Electricity Co., of Berlin, which owns extensive supply works at Buenos Ayres, and is also concerned with supply works and tramways in other parts of South America. The development of the company's activity in pre-war years was such that a sum of from 15,000,000 marks to 30,000,000 marks in gold was required almost every year to keep pace with the progress made. Owing, however, to the depreciation of German currency, it is considered that it would be impossible, even if it were desirable in the national interest, to raise such large amounts in the German market for foreign investments in the future. Under these circumstances, the situation of the German Transmarine Electricity Co. (D.U.E.G.) would remain stationary unless a way out of the difficulty were found which would permit of the future development of the undertaking.

According to reports in circulation in Germany, various foreign interests have sought to obtain possession of the company's undertaking in recent months, but the suggestions made in this respect failed to meet with the approval of the directors. Now, however, it is stated that a provisional arrangement, which has the prospect of becoming definite, has been entered into with a Spanish-international group which is to form a company, to be domiciled in Madrid, to take over the German company's assets in exchange for interest-bearing bonds and A shares in the Spanish currency. It is proposed, for instance, to allot for each German ordinary share interest bonds for 1,500 pesetas and 500 pesetas in A shares. The bonds are to receive out of the profits of the undertaking interest of up to 6 per cent., with cumulative rights for five years; whilst on the A shares will devolve one-half of the profits realised in excess of 6 per cent., and the other half will be retained by the Spanish company. The latter will provide the funds for the redemption of the preference shares in the Germany company at the price of 150 per cent., and of the loans issued by the latter, and will also raise the considerable amount of fresh capital which will be required for the future development of the undertaking.

The prospective transfer of the undertaking to foreign control is regretted in German industrial circles, although it is considered desirable to obtain securities which have a market abroad, and could be of advantage in the provision of foreign exchange. As far as the capital is concerned, the ordinary shares amounted to 120,000,000 marks, and they were recently quoted in Switzerland at 60 per cent. of their nominal value. The preference shares total 30,000,000 marks, and are redeemable at 110 per cent., whereas the Spanish offer comprises purchase at the price of 150 per cent., so that the holders of these shares stand to gain the most. In addition, the loan capital of the German company exceeds 105,000,000 marks. The holders of ordinary shares who have received no dividend since the end of 1916 will be sacrificing one-half of their prospects of profits by accepting 6 per cent. bonds, but, on the other hand, they have the right to 50 per cent. of the surplus remaining after the payment of the 6 per cent. It appears that at least one-third of the ordinary capital has been purchased in recent months for foreign account, chiefly Switzerland, and Swiss interests have sought to secure control over the undertaking, but the offers made are said to have been less favourable to the Germans than those put forward by the Spanish group, as above mentioned.

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IMPROVISATION: AND SOME ACTIVE-SERVICE REMINISCENCES.

By G. E. MOORE.

In primitive life the faculty of invention or improvisation may be found in its essential. Pre-historic man discovered, by some process of reasoning or bitter experience, that a stone could be extemporised into an effective weapon. And he also found that the stone could be used as a tool. By subsequent expedients, through many years, the stone evolved into a much more efficient weapon or tool—until eventually it became the medium for still more effective substitutes.

The so-called *lodestone* is a particularly good example of a natural object being utilised with practically no modification. Some "heathen Chinee" of an inventor was not slow to realise its utility.

In the case of the simple stone an ordinary object was utilised first in its natural state, and later modified and improved. And looking back on the evolution of the stone, and, indeed, that of industry, all succeeding steps appear as a series of expedients, of improvisations, of progressive modifications—all impelled and stimulated by human wants and ambitions.

The impromptu-spirit does not seem to be encouraged very much in young folk nowadays. Ready-made toy devices of all kinds are on the market; although these are certainly an aid to ingenuity they can hardly be so effective as regards latent inventiveness, pride in achievement, and teaching any principles involved. The writer remembers some of his own early and rather pathetic experiments with extemporised odds and ends. Do boys still try to make frictional electric machines out of old whisky bottles, and wait under arc-lamp standards to beg carbon stumps for their home-made tomato-tin cells?

Jules Verne always credited his heroes with an extraordinary and unfailing skill in improvising. In the present epidemic of novels and film-dramas of the uninhabited island type, neither heroes nor heroines set about the provision of, say, a generating station and electric lighting, heating, and other devices out of "nothing." But perhaps that sort of stuff would be unacceptable. Surely this points to a general lack of electrical knowledge and of the handyman ability?

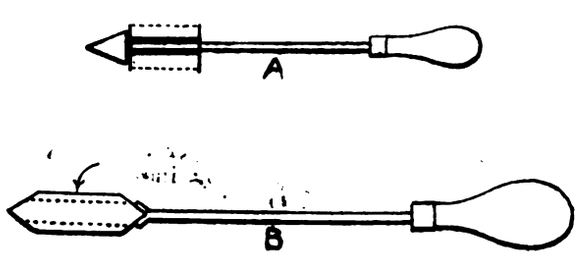

Fig. 1.

The great war was the cause of what may be termed a wave of improvisation. Britain was in many particulars utterly transformed. In the case of the Expeditionary Forces the need for improvising was of a much more pressing and primal nature—indeed, in many ways, life at the Front constituted the biggest lapse into the simple life ever experienced. The work of field companies of the Royal Engineers called for a considerable amount of improvisation, but apart from that there was a general incentive towards extemporising.

Was not the dug-out but an impromptu form of dwelling? And in the first gas attack in 1915, was it not a fortunate expedient thought of and acted on, on the spur of the moment, which saved the situation?

There is no doubt that during the first stages of the war the need for improvising was felt far more by our Army than that of the enemy, in view of the latter's thorough preparedness. Fortunately, "Tommy," whether of the old or new type, was not found wanting—look at the uses to which the "tin hat" was put, the biscuit-tin huts, and so forth. A book, or many books, could be written on this aspect of the war alone.

Many a linesman cursed that failing of the infantry (and especially the Portuguese), which oft-times meant that "'Dis' on such-and-such a line" was caused by somebody purloining a length of wire. It was difficult to cut, and the steel strands hardly improved a knife, but it was very useful for all manner of things.

In the technical corps improvisation of a specialised form was called for. In many cases, tools and materials might be conspicuous by their absence or painfully insufficient, and great difficulty would often be experienced in obtaining stores. You might, for example, urgently require a certain substance, and you would accordingly indent for 1 lb. of it. After the inevitable circumlocution, either of two things might happen: You would receive nothing at all, or you might get 1 cwt. of the required substance.

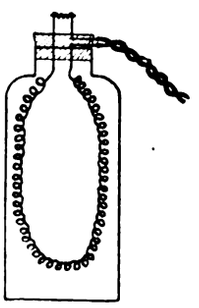

Fig. 2.

A few months ago the "Tucker microphone," a war invention, was examined by the Royal Commission on Awards to Inventors.* The idea underlying the microphone was not new; Dr. Eccles had made a hot-wire microphone before the war, and quite recently Prof. McGregor-Morris introduced an anemometer which depends on the same principle. The Tucker microphone was adapted to sound-ranging, and the experiments were carried out at the Front in the shell zone (research work which was noteworthy if only for that), the original microphones being crude but efficient improvisations of oil drums, hot-wires, and Wheatstone bridges.

The writer now proposes to describe a few "gadgets" more or less improvised on active service. It is to be regretted that many much more interesting electrical devices—examples of improvisation at the Front—must, on account of their military nature, remain unrecorded.

One instance the writer will always look back to with amusement. During several winter months he and a few others occupied a barn known as "Windy Manor"—*why* it was so named can be guessed! No candle could ever hope to survive many minutes on a windy night, and it was decided to light the barn electrically. A captured 12-volt accumulator (somewhat sulphated), some scraps of cable and bare wire, and one or two battered lampholders helped the "2-way intermediate" installation. The only lamps forthcoming were broken 100-v. metallic-filament ones. These were mended in the classic manner, and those which were persuaded to give a respectable light on 12 volts were retained. Even these flickered sometimes! Later, it was difficult to get volunteers to carry the accumulator to and from the generating station (a portable Austin set), which was a considerable distance away.

In instrument repair work a considerable amount of

* Elec. Rev., August 1st, 1919.

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soldering of a fine nature was necessary, and the writer was asked to convert a light "iron" for electrical heating. A rough bobbin of metal was fitted on the stalk (fig. 1, A), and on this, with suitable layers of thin mica, the heating element was wound. The wire was of an alloy similar to constantan, of 18 S.W.G. (.048 inch nowadays!), and attained dull red heat with a current of about 2½ amps. (A large-capacity battery of Edison cells, 12 volts, was available.) Over the windings a layer of asbestos engine packing was placed. The heating wires were joined to flexible leads. Time taken to heat up, 3 minutes.

Crude though the iron was, it remained in almost daily use for over nine months, and it was still on active service when the armistice was declared. All ranks, including technical officers and visiting "brass-hats," regarded the little electric iron with an astonishment that was both laughable and flattering. One or two officers, who ought to have known better, were very sceptical concerning the conversion.

Later, another iron, and a much larger one, were also converted; in the latter the heating wires were laid in two specially-cut linear slots in the copper bit (fig. 1, B). Naturally, this method is the most efficient, inasmuch as the heat is produced where it is wanted, and conduction troubles are obviated. The iron in question took about 75 watts, and heated up in 4½ minutes.

Like the other smaller irons it never required a new heating element (fortunately!), and was in demand for several months. Sometimes it was left "on" for several hours by careless users. One such occasion was memorable. A coat was flung over the unnoticed iron,

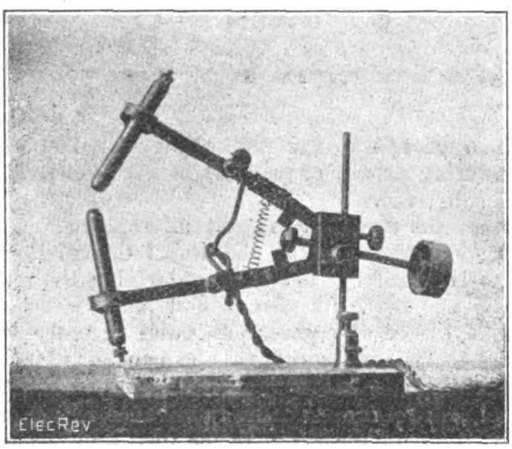

Fig. 3.

and when the owner returned two hours later he was puzzled to find that his coat had vanished. A prolonged search made him no wiser. Suddenly he noticed that the iron was covered with black ashes, and when he had recovered a sooty cigarette-case from these he realised what had happened.

These irons were by no means works of art, but they served their purpose very well. In connection with them the writer came to the same conclusions as Mr. C. Turnbull, who has recently contended in these columns that the bits and stalks of electric soldering irons should be in one piece.*

Another heater device was in the form of a "cigar-lighter" (fig. 2)—pipes and cigarettes not being barred. This was a mere luxury, of course, but in view of the match scarcity, very welcome. Thin resistance wire served as the heater, and in series with it was a length of thicker wire. The latter was placed inside a bottle, and the heater on the stopper. On the 12-volt circuit the lighter took about one ampere.

One day an officer of high rank appeared on the scene; during his *tour d'inspection* he found himself minus matches, and the cigar-lighter was handed to him. The astonishment with which he examined and applied the weird thing was very diverting, and it is certain that he regarded the lighter as probably the outstanding feature of his visit.

A surprising amount of heat was given out by the series resistance, and the cigar-lighter was more in demand for cold hands than it was for its legitimate purpose. This unexpected quality led to its disappearance, for it was afterwards found being used to warm the bed of a "billet." This is a startling example of improvisation—not every cigar-lighter can be turned into a bed-warmer at will.

Soon after the armistice a general slackening-off of work took place in those units which did not advance into Germany. It was decided by the writer and a friend that local concerts should be blessed with a lime-light equipment. Current was available, but very little else.

The most awkward proposition was the arc-lamp. With a few tools, odd terminals, scraps of metal, &c., and an enormous expenditure of energy, the handsome-looking apparatus shown in fig. 3 came into being. The makers were able to verify the dictum (attributed to Edison) that invention equals 10 per cent. inspiration plus 90 per cent. *perspiration*!

A petrol tin was then adapted to house the arc-lamp. A large convex lens was fortunately forthcoming, and the whole was fitted on a disused theodolite stand. There now remained the provision of a series resistance, as the pressure was in the region of 150 volts, and a "water rheostat" was made. Two more petrol tins were requisitioned, opened up, fitted in a wooden container, insulated with cleats, and given a couple of adjustable tin electrodes. An ammeter and D.P. switch—both of which had seen much service "up the line"—were fitted on the container. The electrolyte was salt solution—salt by kind permission of the battalion cook! The petrol tins could be put in parallel or series.

The *début* of the limelight set was not altogether a triumph. The carbons, on account of their origin (scrapped dry cells), spluttered abominably, and the arc wandered in a most irritating fashion. The water rheostat, too, required watching and adjustment owing to temperature rise; that, and the antics of the arc, meant a neglected stage—with an interesting innovation in stagecraft as a result: artistes had to follow the "lime."

These were not the only worries. The supply failed periodically—and the generating station (such as it was) was half-a-mile away. The electrician there undoubtedly felt neglected as regards the concert, and he had already shown animosity towards the arc-lamp. With a species of technical cunning which roused one's grudging admiration he had inserted a 5-amp. fuse in the circuit (the arc-lamp took 8 or 9 amps.), and every time the fuse blew he simply inserted another of the same size.

The arc-lamp distinguished itself for the last time at a lecture by Capt. R. W. James on the Shackleton Expedition, in which he was scientist. The arc-lamp was used inside a projection lantern, and for over an hour its behaviour left nothing to be desired. Then it became obvious that the tension of the spring was nil again, so the lower arm had to be moved up at intervals with a handy file. The lecturer's description of how the shore party extemporised a hut out of their boat was grimly appreciated by the lantern operator—between the shocks and burns.

The arc-lamp is now demobilised and on the reserve.

During the uneventful days which followed the armistice the writer and a friend essayed the construction of a simple wireless receiving set. This was a delightful example of improvisation. The inductance was made up of heavy gauge copper wire wound on a cardboard tea canister which had contained beef dripping (and hence was well insulated!). Tappings were led to a row of drawing-pins on a candle-waxed base. Connection was made by U-shaped brass clips.

A variable condenser was made from a dissected biscuit box and scraps of mica, a sandwich construction

* Elec. Rev., September 5th, 1919.

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allowing one set of plates to be slid in or out. An electrolytic detector was easily extemporised, but it was later deposed by one of the crystal type. A broken Isenthal rheostat (a casualty of April, 1918) served as potentiometer. A brave attempt was made to construct a receiver, but eventually one had to be borrowed. Porcelain cleats and odd bits of ebonite acted as insulators throughout.

The erection of the aerial was by no means easy. It was composed of two 150-ft. antennæ, 3 ft. apart. After a vast number of attempts one end was eventually hauled up to the bend of a tree about 50 ft. above *terra firma*.

The other tree was lower, and was in a farmyard. An enormous amount of slime covered and lay under the tree, and whoever reached the top would do so at imminent risk of falling into the pond. But these dangers were as nothing compared to the opposition raised by the twenty-five fowls which inhabited the tree. According to the farmer, these feathered opponents of scientific progress served only one useful purpose in life; they woke him punctually at 5 o'clock every morning.

Strategy won the day. The erection of the aerial was concluded during the fowls' absence at *déjeuner*. A couple of Army pattern biscuit-tins in the pond formed a good "earth."

Other "gadgets" of the billet included electric lighting, a special device which would heat supper o' nights in readiness for the author's return, and an electric réveillé. This for a time took the form of a phonograph which at a predetermined hour began to play a *rousing* military air. Once it started five hours too soon, and after that a simple electric bell was installed. This was worked from the kitchen of the farm, and there a "je suis levé" message would illuminate by way of a reply.

All these little devices were held in great awe by the simple French villagers. When showing any visitors around the farm the programme of the "patron" would be as follows: The cows, the horses, the pigs, the wires which tapped "les messages de l'air," a peep into the room of "les ingénieurs anglais," the garden and orchard, and the electric réveillé. The latter was generally tested two or three times, much to the annoyance of the said engineers.

One day the farmer approached the writer regarding a little favour. Apparently the various "gadgets" had stimulated his mind, for he said that whilst he considered the horse far superior to any engine for farm work, he was not averse to electrical illumination, and would the writer rig up a dynamo and lights which would never cost anything and continue to work as long as he lived.

The author was very sorry—it was a great misfortune, but he was afraid his knowledge of improvisation was unable to meet the case.

ELECTRICITY IN THE WESTERN WAR ZONE.

By Major T. RICH, O.B.E.

(*Concluded from page* 392.)

Pre-war Systems of Supply.

Three-phase supply at 50 periods is very usual throughout France, both for transmission and L.T. distribution. In one area to the north of Paris 2-phase energy is supplied; in Paris and in the south, odd periodicities are to be found. Single-phase is employed in some areas, for instance Paris Plage and Berck Plage. In a number of places, such as Boulogne, Amiens, and Rouen, where the supply is of long standing, D.C. is used in the original distributing area, and 3-phase H.T. and L.T. energy supplied in outer areas or for long lines. The use of step-up and step-down motor-generators for the supply of new areas with light and power, which is a frequent feature in England, is avoided by the direct supply of 3-phase energy through transformers.

The usual voltage for lamps varies from 110 to 125, the latter in very few places, and 190 to 220 for power. In textile mills, where the power consumption is high, and separate transformer stations are usual, a pressure for motors of 440 volts across phases is often adopted.

Current according to French regulations is divided into two categories, up to 600 volts to earth D.C., and 150 volts to earth A.C., and the second category above these voltages. As the lower category carries with it various advantages regarding first cost, lamps on A.C. at 110 up to 125 volts are very usual. In some areas 220/220 volts D.C. is to be found, but in most of the smaller stations having D.C. 110/110 volts is used. By far the largest proportion of the lamps sold in France are for the lower voltages. French practice is very similar to American with regard to lamp voltages on 3-phase or single-phase circuits. From the point of view of safety, price of lamps, life and fragility of lamps, effect of lighting per watt, and the cost of installation, this voltage has still many points in its favour, the introduction of metallic lamps making the cost of copper in house circuits less than before. Improvements in transformers have reduced the increase in losses with small distributed sub-stations. Factory owners are beginning to use 3-phase energy much more than D.C., the latter being used mainly where existing plant has to be extended. There are very few classes of work for which 3-phase motors cannot be used, and it is probable that before long variable-speed commutator motors will be available for all classes of work.

In many areas power is purchased in bulk by distributing companies, in which the parent company often has a share holding. In the neighbourhood of St. Quentin an agricultural co-operative society purchased power in bulk and distributed it to a number of villages and small towns; as agricultural societies are rarely wealthy, this fact shows what can be done with reasonable capital expenditure and fair conditions. With regard to overhead H.T. mains, it is noticeable that where electricity supply is controlled by financial interests owning cable factories, there is often a greater tendency to use cables than when the supply company is independent. Difficulties of post-war finance will probably modify this tendency.

French High-pressure Voltages.

Up to the outbreak of war there was little standardisation of H.T. voltages, and it must be said that provided the periodicity is the same, standardisation in this direction has not the same value as it has, perhaps, in other sections of electrical work, owing to the ease of interchange. Some of the older systems were at 3,000 volts, for instance Dunkerque and the outer suburbs of Dieppe, other systems at 5,000 volts, such as Calais, Boulogne, Havre, and part of the area around Bethune and Arras, Douai, Cambrai, and near Rheims. Rouen was supplied at 5,500 volts, Charleroi at 6,000 volts, and Roubaix, Tourcoing, part of the Lille area, Ostend, Malines, Dieppe district, and a number of areas in the south at 10,000 volts, with 10,500 volts at Valenciennes and Maubeuge.

The pressure of 15,000 volts is very popular throughout the north-east and east of France. It is about the highest voltage which can be adopted for village distribution, with comparatively inexpensive sub-stations

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and apparatus; as noted elsewhere, the Germans supplied a number of 2-K.V.A. single-phase and 3- and 5-K.V.A. 3-phase transformers for this voltage to the western front. This voltage has been adopted for general reconstruction work in the north-east for places where there are no underground cables *in situ* which will stand such a pressure. The same voltage was used before the war considerably in Belgium both for overhead and underground lines. It might be pointed out that the Germans used this voltage for practically all their new independent distribution systems from Laon and Charleville to the Belgian coast.

Among the E.H.T. voltages used in east and north-east France the following are to be found: 30,000, 45,000, 65,000, and 90,000; and 110,000 will probably be used for some of the new main trunk lines. Continental engineers are very much amused when they hear that anything over about 3,000 volts is termed E.H.T. in the United Kingdom; the continued use of such a term at home frightens local authorities and damages our reputation abroad. An extensive system of trunk lines at 45,000 volts was erected before the war by the Compagnie Electrique du Nord and its allies, starting from Pont-à-Vendin near Lens, where a by-product power station was situated, and passing Douai and St. Quentin, it linked up to a turbine steam station at Beauter on the Oise, a route distance of 80 or 90 miles, with branches to Laon, Soissons, Noyon, Compiègne, and with further links under construction towards Paris and the west. The overhead mains of this company were carried in the northern section mostly on lattice posts along a canal, and on the southern section along the roadways by armoured concrete posts. It is interesting to note that, except when there were direct hits, armoured concrete posts and structures stood up during the war against shell fire and explosion remarkably well. This company sold energy in bulk to several local distributing companies, the distributing voltage being 15,000 in most cases. The Germans after their advance in 1914 occupied practically the whole of the area served by this company, took over the power stations, and found their system of mains so useful that a pressure of 45,000 volts was adopted for the main military trunk lines for the northern section. The Société Béthunoise, and the Artésienne Co. adopted the same pressure for their trunk mains in the area occupied during the war by the British.

An extensive series of 30,000-volt lines exists to the east of Paris in the area between Rheims, St. Dizier, and the Briey Basin. In the Vosges area there is a system at 65,000 volts running north and south, connected near Belfort to a colliery station burning a somewhat low-grade coal, and to a Franco-Swiss water-power station. Up to the present there have been few if any E.H.T. systems in Belgium.

Power Stations in France.

The largest power stations are to be found in the colliery and industrial areas between Calais, Roubaix, and Jeumont. Practically all supply 3-phase energy generated usually at 5,000 or 10,000 volts. Three stations were in the suburbs at Lille, one at Croix Wasquehal to the north-east with 35,000 KW. installed; part of this plant was removed by the Germans and part damaged; at Usine Lomme, 20,000 KW., most of the plant was removed, and the turbine house blown up; at Sequedin, 20,000 KW., the plant was either removed or damaged. There are four power stations in the colliery area Pont-à-Vendin, Henin-Lietard (mainly colliery supply), Bully-Grenay, and Bruay, with several private colliery and other power stations. Other stations are at Valenciennes and Jeumont; the latter belong to the financial group which is controlled by Baron Empain, and owns the largest electric manufacturing works in the north of France, and also large works at Charleroi, and about half the electric power stations in Belgium. In the coastal sector there are power stations at Dunkerque, Calais, Boulogne, Amiens, Havre, and Cherbourg, with several smaller stations elsewhere and small local water-mill installations giving public supply.

In the newer stations steam turbines are usually installed, although auxiliary supply is in some cases given by blast-furnace gas engines. The stations are in most cases alongside rivers, but at Wasquehal cooling towers are used. The Germans with the aid of their customary patent-mongering bluff, had almost a monopoly of cooling-tower building in France before the war. On the whole, steam turbine-driven auxiliaries seem to be favoured. A number of chimneys were seen made with armoured concrete formed blocks, with vertical key reinforcement. On the Continent steam turbine floors are usually kept higher above the condenser floors than in the United Kingdom. Some very complete conveyor plant was installed in some cases.

Due to a large extent to the clear atmosphere, and partly perhaps to the painting, tiles, or light steelwork, power stations have not usually that dingy effect so often noticed in England. Owing partly to the original necessities of the glass industry, the use of very wide spans of 100 ft. or more, with north lights, is not unusual in Flanders for factories; in some cases the roofs are non-combustible, with two layers of interlocking tiles and no woodwork. The cross girders are usually worked into the frame carrying the north lights.

Power Stations and Systems in Belgium.

In general the power stations in the area occupied by the British troops or adjacent areas do not differ greatly from those in France. A certain number of the companies supply 42-period, 3-phase energy. Owing to the density of some of the areas supplied, the narrow and winding roads in many parts, and local prejudice, there is much less overhead line than in France; although, owing to the necessity for economy in expenditure, according to information received, there will probably be a great increase in overhead line in the future. The L.T. distribution is in many places 3-phase. A power station at Ostend supplied power and light along most of the coast by means of cables. The Germans used energy from this station and from stations at Bruges and Zeebrugge for lighting dug-outs, batteries, and depots all along the coast.

Electricity on Board Ship. — Several motor-driven oil tankers without sails are on order, one being under construction, for the Standard Oil Co., of California, at the yard of the Union Construction Co., Oakland, California. The engines installed will comprise two 550-B.H.P. sets, running at 165 R.P.M., the speed of the vessels being 11 knots. In most motor oil tankers, the auxiliary machinery, which has to be fairly high-powered on account of the fuel pumps required for pumping out the cargo, is steam-driven, but in this vessel the electric drive is adopted throughout. The power is supplied by two 150-B.H.P. ordinary stationary Diesel engines of the Dow Diesel type, manufactured by an American firm with a licence for the construction of the Willans and Robinson Diesel engine as built at Rugby. These engines, which are of the three-cylinder type, are each coupled to a 100-KW. generator at 250 volts. The electrically-operated auxiliary plant includes the two cooling water pumps, two lubricating oil pumps, one of which is a spare, an auxiliary air compressor for the supply of manœuvring air at a pressure of 50 lb. per sq. in., a three-stage turbine pump used for fire and bilge purposes, and a two-stage turbine pump for sanitary purposes. The employment of turbine pumps for this purpose is interesting, as the plunger pumps are more common. In addition, there is a centrifugal fresh-water pump, whilst there are four oil pumps, all electrically operated, these being used for discharging the cargo. The lighting on the ship is at 125 volts, and a small booster is fitted to provide for this. Even the heating is carried out by electricity, special electric heaters being used, whilst the cooking is all effected by electric power, the equipment being furnished by the Edison Electric Appliance Co. On deck there are four cargo winches, driven by 15-H.P. motors, and two capstans, driven by 10-H.P. motors, besides an anchor windlass, coupled to a 25-H.P. electric motor, and the steering gear is of the hydro-electric type. The only steam that is used is for steaming out the cargo tanks, and for this purpose a small donkey boiler is fitted, which may also be used as an evaporator. The only auxiliary plant in the engine-room, apart from the main Diesel-driven generators, is a 16-H.P. Skandia emergency set driving a 7-KW., 250-volt generator. With all these novelties, the vessel is obviously one of considerable interest, in spite of the fact that it is relatively small.—*Motor Ship and Motor Boat.*

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THE POULSEN ARC IN WIRELESS TELEGRAPHY.

Much has been heard of the Poulsen system in general terms during the last 10 years—but very little in the form of precise details, and the development of other and newer methods of generating continuous waves, such as the high-frequency alternator and the vacuum valve, has further tended to promote the impression that the arc as a generator is passing into the class of things that have been. This, however, is far from the truth, as we shall show below. Not only is the Poulsen system very much alive, and maintaining communication to-day over the longest ranges ever attempted on a commercial scale—it is also being installed for long-distance communication in high-power stations in this country and abroad, as well as in numerous stations and ships for shorter ranges.

It will be remembered that at the Parliamentary inquiry regarding the contract for the Imperial Wireless Chain in 1913, the Poulsen system was put forward as a practicable alternative to the Marconi system, largely on the strength of the establishment of communication between San Francisco and Honolulu, but the evidence available regarding the results obtained was meagre and unconvincing. That was, at the time, the longest range in commercial operation (2,100 miles), and the installation was carried out by the Federal Telegraph Co., U.S.A., of which Mr. C. F. Elwell was the chief engineer. In order to make clear the course of events, a brief outline of the history of the system and Mr. Elwell's connection with it is necessary.

Mr. Elwell, an Australian by birth, received his scientific training at the Stanford University, California, where he graduated as B.A. in Engineering in 1907, and E.E. (Electrical Engineer) in 1908. He specialised in the subject of wireless telegraphy, and in 1909 he visited Denmark, and studied the Poulsen system, eventually purchasing the U.S.A. patent rights. Returning to America, he founded the Poulsen Wireless Telegraph and Telephone Co., of which he was managing director and engineer; later this concern was merged in the Federal Telegraph Co., with Mr. Elwell as chief engineer until 1913, when he became chief engineer to the Universal Radio Syndicate, a company with an option on the Poulsen arc patents for the rest of the world, except the United States. This company went into liquidation, and in 1915 Mr. Elwell commenced business on his own account and carried out a large amount of work during the war. Throughout his career he has been closely identified with the Poulsen system, and has developed the arc generator from a capacity of 30 kw. to 400 kw., having built and installed 11 machines of 200 to 400 kw. during the war, and having

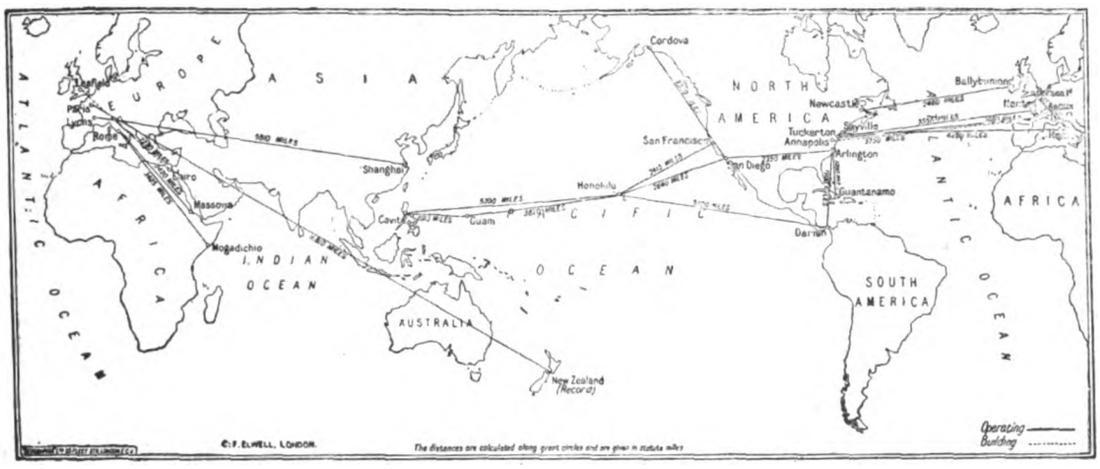

Fig. 1.—Map showing some Long-distance Poulsen Transmissions.

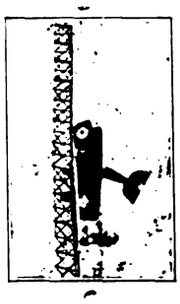

Fig. 2.—Flying-boat in Collision with Elwell wooden mast at Horsea Island Naval Station.

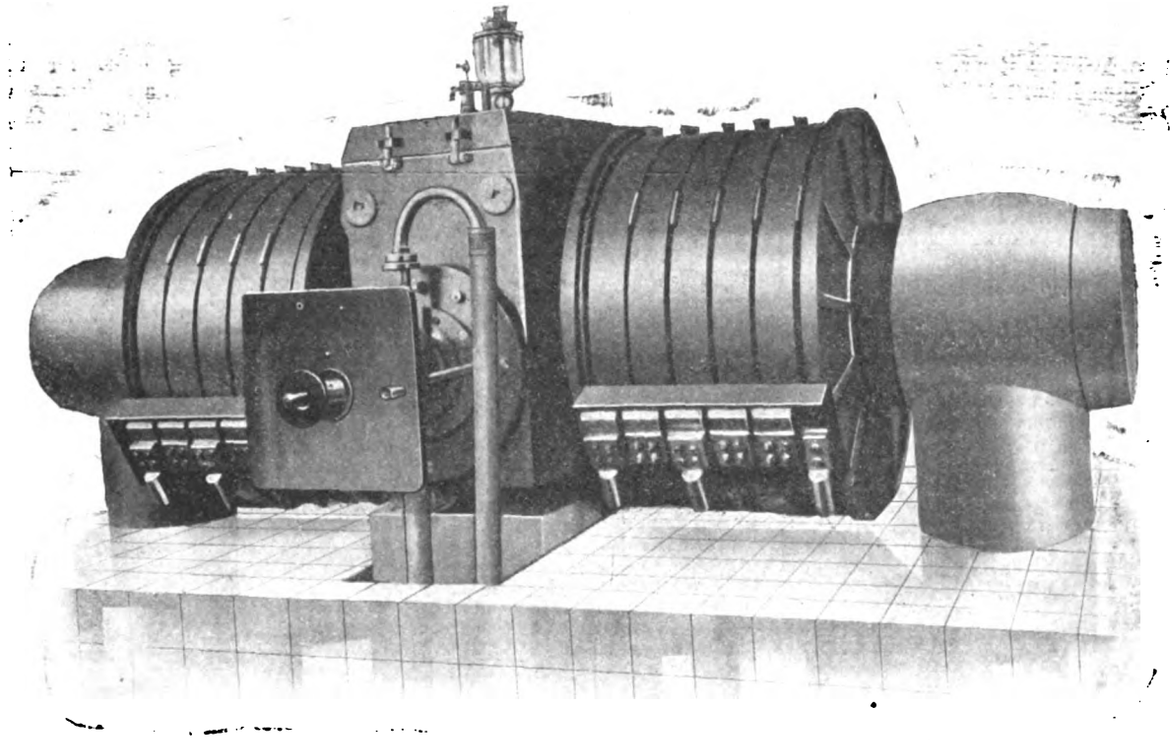

Fig. 3.—Elwell-Poulsen 350-kw. Arc-generator at Lyons.

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designed and built in all about 500 masts of various lengths up to 711 ft. Of the total of 20,000 KW. of arc generators now in use, about half have been designed and built by the present organisation, and most of the remainder by the ompany which he organised. Amongst the installations esigned and built by Mr. Elwell are the stations, including

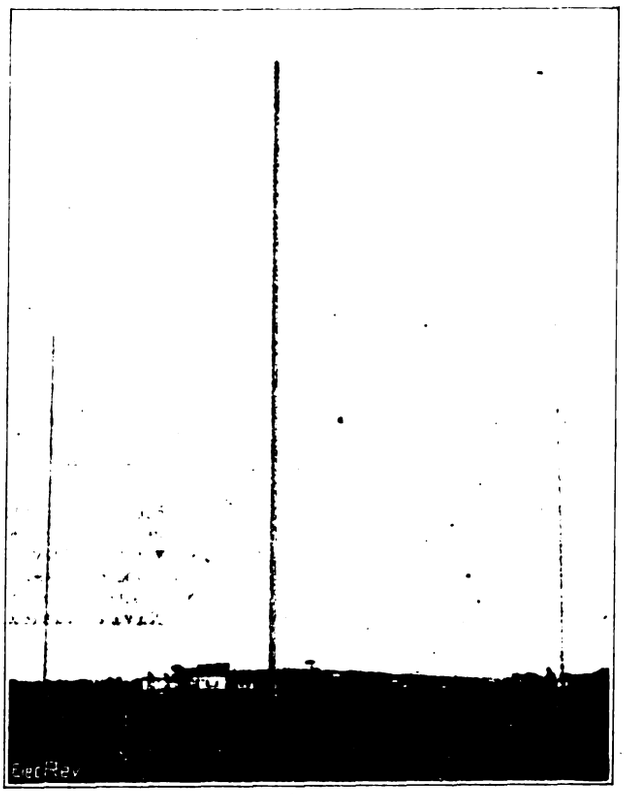

FIG. 4.—ELWELL 711-FT. WOODEN MASTS AT ROME.

masts and apparatus, at Honolulu and San Francisco, communicating over a range of 2,100 miles; the station at Horsea Island, Portsmouth, with a range to the Dardanelles; and the station at Rome, working to the United States. He also designed, built and installed apparatus at Lyons and Nantes, communicating with the United States, at the

It is interesting to note that Mr. Elwell's masts are al of the wooden lattice type, the three at Rome which w illustrate being 714 ft. high, while two at San Francisc and Honolulu are 606 ft. in height. The three Horse masts are 440 ft. high, and one of these successfully with stood the impact of a large flying boat (fig. 2).

The accompanying map (fig. 1) shows some of the long-distance transmissions over which commercial service is maintained with the Poulsen arc generator, minor routes

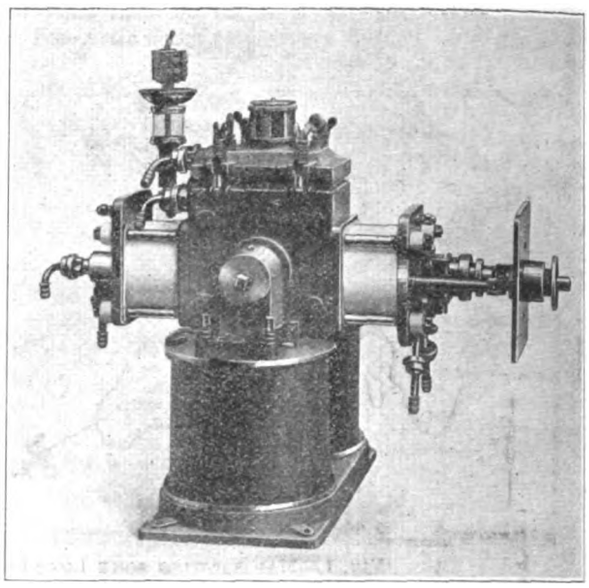

FIG. 6.—ELWELL 10-KW. ARC GENERATOR.

having been omitted for the sake of clearness. The Paris-New Zealand range is a "freak" record, but the rest are in continuous operation, and we may draw attention to the transmission from Lyons to Shanghai of 5,810 miles over-land (also to Japan), and Cavite-Honolulu-Darien, tw stretches over 5,200 miles. A 5-KW. Elwell generator has been heard at a distance of 3,500 miles—of course, a "freak." A station now being built for the French Government is to be equipped with a Poulsen arc-generator rated at 1,000 KW., by the Federal Telegraph Co., U.S.A.

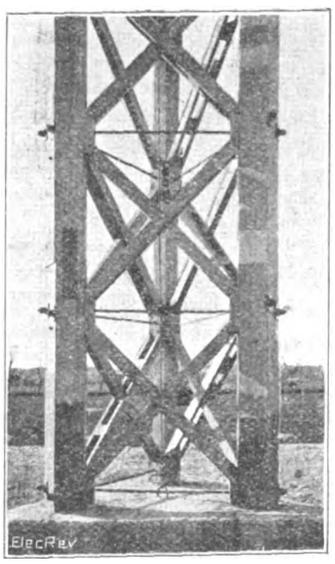

FIG. 5.—DETAIL OF MAST CONSTRUCTION.

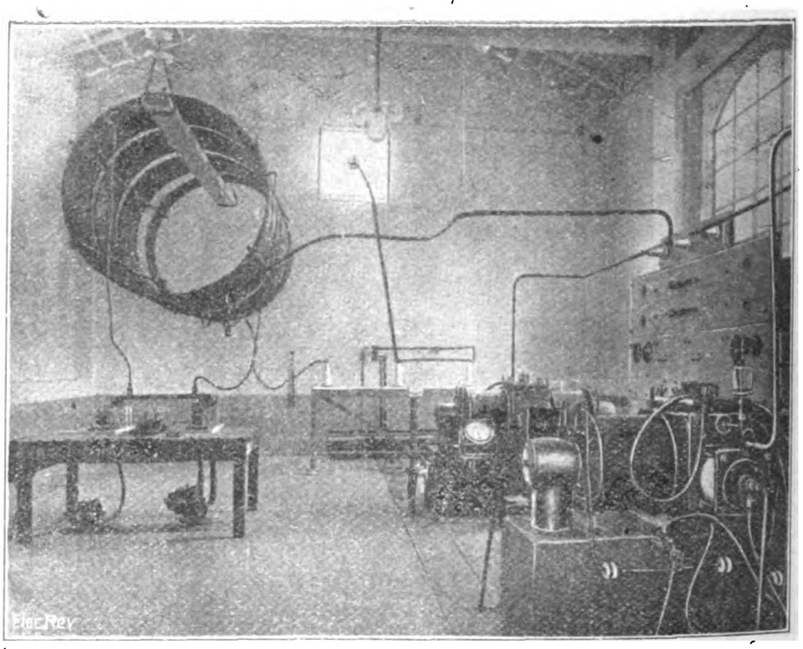

FIG. 7.—INTERIOR OF THE STATION AT ROME.

Eiffel Tower communicating with Bucarest, and at Salonica, communicating with Paris, as well as many smaller sets, including 13 25-KW. sets for the British Admiralty, and many sets installed in the British Colonies. He is now building the arc apparatus for the first two stations of the Imperial Chain to the order of the British Post Office Department.

For the help of readers who are not familiar with the Poulsen system, we may mention that it depends upon the formation of an arc between a copper anode and a carbon cathode in a chamber filled with hydrocarbon gas; powerful electromagnets maintain an intense magnetic field at right angles to the arc, and the cathode is slowly

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rotated to keep the length of the arc constant. An oscillating circuit consisting of capacity, the antenna, and inductance is connected in series with the arc, as shown in the diagram of connections, fig. 11, and in this circuit powerful undamped oscillations are set up, radiating from the antenna a continuous stream of undamped waves. In order to send signals, a key is used which short-circuits a few turns of the sending inductance, and thus alters the wave-length by about 1 per cent. Tuning, with continuous waves, is so sharp that the receiving apparatus only responds to the latter wave-length, and is not affected by the slightly different wave-length radiated when the sending key is open. As the frequency of the waves is far above the limits of audition, the heterodyne method of receiving is employed, by exciting the receiving aerial at a frequency differing slightly from that of the signalling waves, thus producing beats at a frequency which can be heard in a telephone-receiver, and which can be adjusted at pleasure to suit the operator's choice.

Very heavy high-frequency currents can be obtained in the antenna with the arc-generator, about 50 per cent. of the power put into the arc being delivered to the antenna. The arc chambers in all but the smallest sizes have to be water-cooled, as well as the copper anode, and provision is made for introducing either coal-gas or a hydrocarbon liquid (by drops) into the chamber. Fig. 3 shows a set installed at the transmitting station at Lyons, which is similar to, but of more modern design than, those which were installed at Rome for communication with America and the Italian Colonies in Africa, when urgently required during the war; the arc-chamber—a double-walled gunmetal casting—occupies the centre, with the magnet coils on either side; the yoke of the huge magnet, of which the ends are visible, is for the most part concealed in the foundation block. At the front of the arc chamber are seen the device for striking the arc, and the water-pipes. This set is rated at 350 kw.; the generator at Rome (fig. 7) is rated at 200 kw. (250 amperes at 800 volts), weighs 3·75 tons, and is provided in duplicate. In the case of these large sets, remote control with contactor switches is employed: the control board consists of five marble panels, two for each arc-generator and a change-over panel. The series resistance used for starting the arc is cut out by five contactors controlled by a master switch. The cooling water supply for the arc-generator is electrically interlocked with the D.C. supply, and in the latest patterns the whole of the processes of starting up are carried out with a controller, which ensures the operations being performed in the correct sequence. The sending inductance at Rome has a value of 2,500 microhenries, and consists of a spiral of 1½-in. copper tubing suspended on insulators. Choke coils, necessary for the protection of the dynamo, have each an inductance of 5,000 m.h., and are wound with flat copper strip; we may mention that the high-frequency currents behave in a manner which would astonish the engineer accustomed only to ordinary alternating currents, for small capacities are open doors to them, and unless expert care is employed to confine them strictly to their lawful circuits they make their appearance in most unexpected places, "play the devil" with insulation, and provide unpleasant (though not dangerous) traps for the unwary operator.

A motor-generator consisting of a three-phase motor coupled to a 350-ampere, 750-volt dynamo provides the current for the arc circuit.

The distance over which good communication was desired at Rome was 4,200 miles, necessitating a lofty aerial

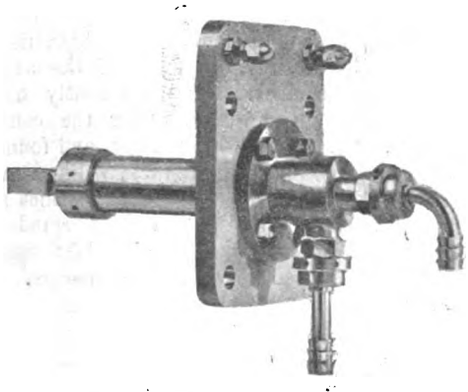


Fig. 8.—Water-cooled Anode.

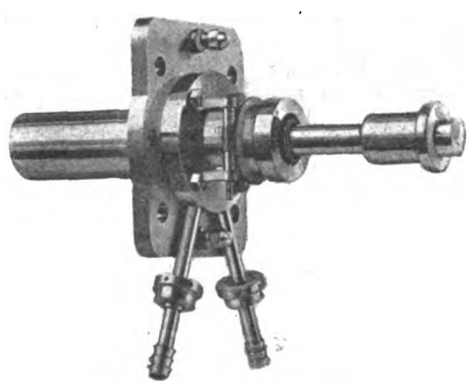


Fig. 9.—Water cooled Cathode.

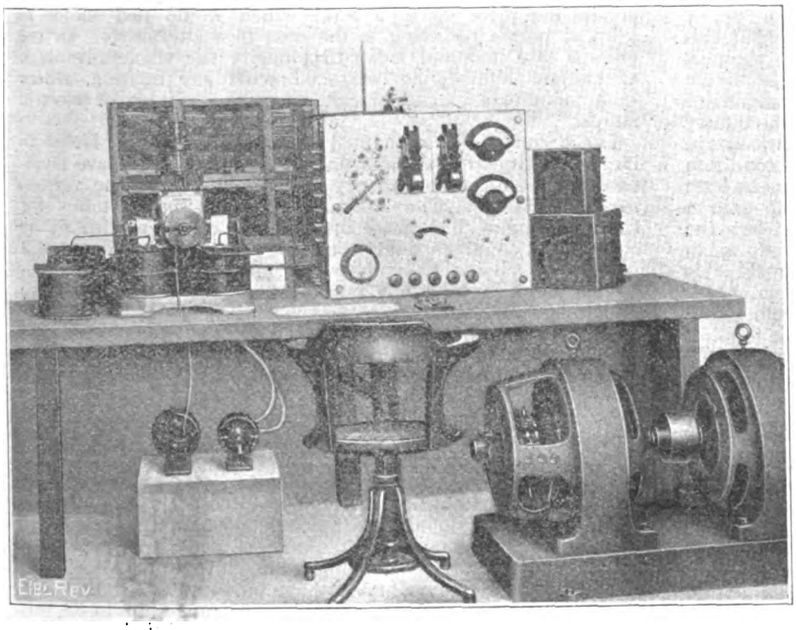
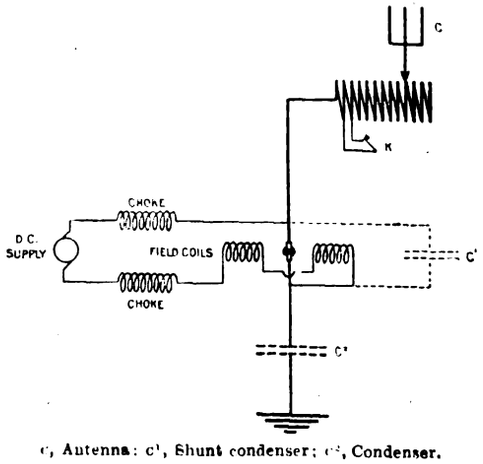


Fig. 10.—Complete 5-kw. Elwell-Poulsen Installation.



C, Antenna; C', Shunt condenser; C², Condenser.

Fig. 11.—Diagram of Connections.

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Owing to the scarcity of steel, of which 300 tons would have been required, it was decided to construct the masts of pitch-pine, the quantity of timber needed being 105,000 board feet. The horizontal component of the antenna pull was 22,000 lb., and the maximum stress allowed in the wood was 1,000 lb./sq. in. The masts were built in 11 sections, supported by 11 sets of three guys at 120°. The section of the bottom columns was 12·6 × 16 in., and of the top 12·6 × 7·1 in. The three masts are shown in fig. 4, and a detail of the foot of a mast is given in fig. 5.

The masts were placed at the corners of an equilateral triangle with sides of 984 ft., and the triangular antenna had a capacity of 0·011 mfd. The counterpoise consisted of buried copper wires extending over an area greater than that of the antenna, and supplemented by wells leading down to the ground water.

Fig. 7 shows the interior of the station at Rome, with the arc generators and switchgear on the right, and the sending inductance and electromagnetic keys on the left. The high-frequency lead passes up to a sheet of glass in the wall of the building, at the centre of which is mounted a large porcelain insulator, through which the cable is taken to the antenna.

The Elwell-Poulsen arc equipments range from 2 KW. to 400 KW., in 13 standard sizes, of which the 5-KW. set is the most widely used—some 800 stations having been equipped; up to 25 or 30 KW. the apparatus can be installed, with all accessories, in an ordinary room. We illustrate in fig. 6 a 10-KW. generator, with which continuous communication can be maintained over a range of 700 miles. Figs. 8 and 9 show the water-cooled anode and cathode for this size, and fig. 10 a complete 10-KW. installation.

Improvements are constantly being introduced, and the speed of transmission has been raised to 100 words per minute by automatic operation. Amongst the stations at work or building with Poulsen arc-generators of 100 KW. and upwards, some 24 in number, in addition to those mentioned above, are those at Bordeaux, Cairo, Cordova, Leafield, and Newcastle, and about eight in the United States. Mr. Elwell's headquarters are in Paris, but his arc-generators and other apparatus are all made in England, mostly at his works in London—where, by the way, the whole of the male staff and employés are ex-service men. We recently had the pleasure of going over the works, under the courteous tutelage of Mr. B. Mittell, London manager, and found the visit exceedingly interesting, the products being in a class by themselves. All parts are made to gauge, so that spares can be supplied at any time, and a high standard of workmanship is maintained, while only the best materials can be successfully employed in work of this nature.

REPORT ON THE ELECTRIC LAMP INDUSTRY.

(*Continued from page* 414.)

6. The evidence we have heard goes to show that in the existing state of the lamp market the retail prices fixed by the Association become the standard retail prices for all lamps, whether manufactured by Association or non-Association firms. Whilst non-Association manufacturers allow greater discounts to the middleman, their lamps are bought by the general public at the same prices as Association lamps. We have sought to ascertain why non-Association agents serving the general public do not seek to increase their trade by selling at less than the Association prices. It has been explained to us that at the moment they can sell, at prices fixed by the Association, all the lamps they can obtain, and would find no advantage in selling to the public at a lower price—in fact the public would doubt the quality of a lamp offered below the recognised Association price.

The unanimity of the witnesses to whom we have put this question forces us to the conclusion that there is no prospect of the prices fixed by the Association for lamps sold to the general public being subjected to any effective competitive check (so far as non-Association lamps made in this country are concerned) until such time as the supply of electric lamps considerably exceeds the demand. If and when that condition obtains some non-associated makers or large retailers, or both working in conjunction, might make an attempt to gain a wider market by cutting the Association list price; but the hazard would be great, and the inducement to conform to Association list prices is so strong that we consider there is no great probability of the Association's list prices being seriously influenced by the fear of competition from home manufacturers in any foreseeable future.

Nor would foreign lamps, even assuming open ports, easily find their way through the normal distributive channels, for it is to be noted that the agreements under which the vast majority of distributors handle Association lamps are directed against imported lamps (except such as may be imported by the Association) equally with non-Association lamps manufactured at home. In one respect potential competition from abroad is more formidable than home competition. American, Dutch, and perhaps German manufacturers, in that they have far greater financial backing or may be able to produce at far lower cost, might have an inducement and a power to challenge the Association monopoly in Great Britain to better purpose than any non-associated home manufacturers; but from evidence laid before us we incline to the view that an international agreement between the British, American, and Dutch electric lamp combines might forestall any threatened battle royal between the respective national groups.

We are therefore of opinion that, apart from some public accountancy of costs, prices, and profits, supplemented by power of control should necessity arise, the determination of what is a "reasonable price" for electric lamps sold to the general public will rest with the Electric Lamp Manufacturers' Association. We do not suggest that the Association would necessarily pursue a policy of inflated prices and inordinate profits, but wish merely to point out that if they decided to do so there would be no effective check in the shape of competition.

It was put to us that the fear lest the Electric Lamp Manufacturers' Association should use its monopoly powers to exact unreasonably high prices was unfounded, in that the electric lamp is in competition with the incandescent gas light, and that the result of raising prices above a certain level would be the displacement of electric lighting in favour of gas lighting. We agree that this consideration must influence to some extent the price of electric lamps, but we would remark that the price at which electric lamps are sold ought to depend either upon competition between independent lamp manufacturers or upon the gross cost of production of the lamp, and not upon the comparative cost of gas and electric lighting. If the latter proposition were generally accepted it would mean that any Association of manufacturers having an effective monopoly of a given product instead of selling that product to the public at a competitive price, could increase the price up to a level which would just suffice to prevent people resorting to the next best alternative. In the present case it would mean that nearly the whole advantage of electric lighting as compared with gas lighting, where such advantage exists, would go to the makers of electric lamps.

Large consumers, as named in paragraph 5, buy lamps in large quantities for use and not for sale, and some have facilities for testing the efficiency and durability of the various makes of lamps. The Association makes special terms for such customers, but those are too big and powerful to be constrained by any exclusive dealing agreement, and are in a position to choose freely between Association and non-Association lamps. One non-associated maker from whom we have taken evidence (there may be others) has abandoned the attempt to supply the general public, and confines himself to these large users. Here competition is free, and the maker who can offer the best value, in terms of price and quality, can get the order. We consider it noteworthy that in many cases non-associated makers are able to secure orders from these large users in competition with firms in the Association.

7. Non-associated firms which look to supply the householder with lamps are compelled to offer the factor and retailer larger discounts than would be given by Association makers—this in order to give them some inducement to forgo the preferential discounts offered by the Association, or to compensate them for the handicap of being unable to obtain Association lamps on trade terms. We have already stated that the discounts given by the associated firms range up to 39 per cent., but we also learn that during the period April, 1914, to June, 1916, the discounts given by associated firms were raised by 7½ per cent. on drawn-wire lamps and by 10 per cent. on squirted-filament lamps, making a total maximum discount of 46½ per cent. and 49 per cent. respectively. There are more than ample discounts, but instances have been cited to us of non-associated firms giving discounts as high as 60 per cent. It should be understood that those maximum discounts are given only to the largest factors, who usually sell lamps wholesale to the smaller retailers, and that the factor in reselling the lamps to the retailer retains only the difference between his factor's discount and the discount which he allows to the retailer. But making every allowance for this, we are convinced that the discounts given in the electric lamp trade are larger than is necessary, the more so in that most electric lamps are widely advertised "pro-

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prietary articles," and as such should carry minimum discounts. It is a trade custom to economise on discounts what is spent in advertising. In the electric lamp trade lavish allowances are made on both scores.

The manufacturer, we understand, accepts responsibility for the lamps reaching the trader in sound condition; thus the trader, by examining his consignment on arrival secures himself from loss by fault or breakage. Subsequent deterioration or breakage can be provided against by proper storage facilities. By economies in the cost of distribution alone, apart from any reduction in the manufacturers' prices, it should be possible to reduce the price of lamps to the public by 6d. each.

The fixed-price policy, however, precludes any such economies being made in respect of distributors' margins. Such competition as there still is between associated and non-associated firms works out—under present conditions—as a competition not in price to the public, but in discount to the trade. The fixed-price policy is supported by its promoters and advocates on the ground that it gives the small man the same chance of selling lamps as the large man. It does, but it gives the large man much bigger profits than the small, and prevents the public from obtaining electric lamps at any lower price than will enable the smallest and most inefficient retailer to make a comfortable profit on their sale. We have no desire to see the small shop submerged by the big store, and would be disposed to approve any arrangement whereby they were placed on the same footing as regards the price of their purchases. The policy followed by the Association does not place them on any such footing of equality. It is generous to the small retailer but lavish to the large retailer. Certain other combinations and consolidations producing proprietary articles at fixed retail prices have found it practicable to give a flat rate of discount to all retailers, large or small, and we consider that the Electric Lamp Manufacturers' Association will have fallen short of its declared aspirations to sell the best lamp in the largest quantity at the lowest price unless and until it puts its discount policy upon that basis.

We have next sought to ascertain the prices obtained for standard vacuum lamps by Association and non-Association manufacturers from the trade or from large users. We have already referred to the maximum discounts of 49 per cent. and 60 per cent. respectively, given to the largest factors or users, in some cases at certain periods. These figures serve to show that lamps bought by the public at 3s. have in those cases been sold, presumably at a profit, by the manufacturers to the trade or to large users at approximately 1s. 6d. and 1s. 3d. But these are not wholly representative figures, in that the *average* discount given is something less than the *maximum* discount. Our inquiries as to the *average* price received by manufacturers over the whole range of their sales have adduced information which we cannot verify, and which does not lend itself to presentation in a form permitting of unquestionable deductions. We must, therefore, be content to record that we have been furnished with information indicating that the average price received for standard vacuum type lamps, with drawn-wire filaments, by four of the largest Association firms, was 1s. 8½d. in 1913, and 2s. 2d. in 1919, and that from another quarter we have received evidence which is embodied in the following table:—

Standard Vacuum Wire-filament Lamps.

Period 1912.—	Low volt (20-60 watt).	High volt (30-60 watt).
	s. d.	s. d.
Price to British consumer	2 6	3 0
Association price to ungraded retailer	2 0	2 4¾
Association price to large factor ...	1 6¼	1 10
Non-Association price to large factor...	9	1 1
Period September, 1913, to April, 1917.—		
Price to British consumer	2 2	2 6
Association price to ungraded retailer	1 8¾	2 1½
Association price to large factor ...	1 4	1 7½
Non-Association price to large factor...	8	11¾
Non-Association price for export ...	6	
Period April, 1917, to December, 1917.—		
Price to British consumer	2 6	3 0
Association price to ungraded retailer	2 0	2 4¾
Association price to large factor ...	1 6¼	1 10
Non-Association price to large factor...	10¼	1 2
Period December, 1917, to present day.—		
Price to British consumer	3 0	3 6
Association price to ungraded retailer	2 4¾	2 9½
Association price to large factor ...	1 10	2 1½
Non-Association price to large factor ..	1 7¼	1 10¾
Association price to large factor for export	1 4¾	1 7½

It has been submitted to us, in criticism of these figures, that they refer to purchases or quotations on very large quantities, and cannot be taken as representative of the average prices received from the trade, either by Association or non-Association manufacturers, and that the price to the retailer and factor was lower from April, 1914, to June, 1916, by virtue of the additional discounts given during that period. We have taken account of these objections, but are satisfied as to the substantial reliability of the figures given above.

We have further been supplied by a large corporation, which has for many years past bought electric lamps in considerable quantities, with particulars of prices quoted by the Association group and by five non-associated firms during the past six years. The discounts from standard prices have been deducted to show the net price per lamp quoted to the corporation. The price to the consumer in the several years is also shown:—

Comparison of Net Prices Quoted to a Corporation for Standard Vacuum Wire-filament Lamps.

High Volt (25 and 50 c.p.).

	Association. Retail price list.	Association. Net price quoted.	Non-Association. A.	B.	C.	D.	E.
1914 ...	2/8	1/7·48	1/3·75	1/2	1/4	—	—
1915 ...	2/8	1/9·76	1/3	1/2	1/4	—	—
1916 ...	2/8	1/6·94	1/3	1/1·6	1/4	—	—
1917 ...	3/-	1/5·52	1/3	1/1·8	1/1	—	—
1918 ...	3/6	2/6·24	—	2/1·2	—	—	—
1919 ...	3/6	2/3·46	—	2/1	2/1	1/11	1/11½
Jan. 1920	3/6	2/3·46	—	2/1	1/11·8	1/11	2/1

Low Volt (16, 25, and 32 c.p.).

	Association. Retail price list.	Association. Net price quoted.	Non-Association. A.	B.	C.	D.	E.
1914 ...	2/2	1/4·64	1/-	1/-	1/3·6	—	—
1915 ...	2/2	1/5·7	1/-	1/-	1/1	—	—
1916 ...	2/2	1/3·37	1/-	0/11·05	1/1	—	—
1917 ...	2/6	1/2·28	1/-	0/11·05	0/10·5	—	—
1918 ...	3/-	2/1·2	—	1/9·6	—	—	—
1919 ...	3/-	1/11·68	—	1/9½	1/9	—	—
Jan. 1920	3/-	1/11·68	—	1/9½	1/9	1/9	1/7·44

The discrepancies between these prices and the minimum figures given in the preceding table are accounted for by the difference in the volume of purchases by a corporation, though large, as compared with those of a factor, and the consequent differences in discounts allowed. From the two tables we draw the following inferences:—

(*a*) That non-Association firms, although their output is in general smaller than that of the Association firms, are able to sell lamps at a lower price than Association firms, and still make a satisfactory profit on their manufacture.

(*b*) That because of the standard price policy the public was compelled to pay the same price for non-Association and Association lamps, the whole price-advantage of the former (which to the factor was 9½d. in 1912 and 2¾d. in recent years) being denied to the householder.

We desire also to call attention to the following points:—

(*c*) That in 1912 lamps bought by the British householder at 2s. 6d. were sold by the manufacturers (presumably at a manufacturing profit) to large factors at 9d.

(*d*) That between September, 1913, and April, 1917, lamps bought by the British householder at 2s. 2d. were sold by the manufacturers (presumably at a manufacturing profit) at 6d. for export.

(*e*) That at the present time lamps bought by the British householder at 3s. are sold by the manufacturers (presumably at a manufacturing profit) at 1s. 4¾d. for export.

Since the beginning of the war the price to the public of the standard vacuum lamp has been increased by about 26 per cent. As the general retail price level of necessaries has risen during the same period by 125 per cent., it follows that the price of electric lamps has been advanced much less than the price of commodities generally. Two considerations are to be taken into account here: one is that immoderate profits were being made on the manufacture of electric lamps in the period immediately preceding the war. A reduction in the price of lamps was already overdue, and, we are told, was projected at that time. The other is that in consequence of improvements in the technique of manufacture, economies in the cost of production had become possible, and the price of lamps was simultaneously falling in some other countries. But allowing in full for these considerations it must be agreed that had the price of lamps been uncontrolled by any Association, or had the Association so desired, a much higher retail price could have easily been obtained. In this connection it is important to remember that the prices fixed by the Association are maximum as well as minimum, and it is just as much a breach of agreement to sell lamps above the fixed price as to sell below it. We are satisfied that during some periods of the war, in view of the limitations of imports the Association had a stabilising influence on electric lamp prices in the United Kingdom. Our unqualified testimony thereto does not prevent our recognising that just as the Association in periods of scarcity prevented prices rising as much as they otherwise might have done, it could equally effectively in time of plenty prevent them from falling as far as they ought.

8. We have endeavoured to ascertain the production cost of electric lamps as delivered from the factory, and to arrive at the profit made by lamp manufacturers either per lamp or as a percentage upon capital sunk in the business. Owing to the fact that the leading lamp manufacturers in the Association are large concerns producing electrical apparatus of all kinds, lamps being but one minor item in their total output, we cannot determine from their balance sheets what rate of profit is made upon that section of the business which is devoted to lamp manufacture. We have, however, sought

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information as to the actual costs of manufacture of electric lamps, and figures have been given to us by representatives of associated and non-associated firms from which we learn that the present-day average factory cost of lamps which are sold to the public at 3s. and 3s. 6d. varies from 9d. to 1s. 4d. per lamp, according to factory, process, and material used. The Electric Lamp Manufacturers' Association has furnished us with figures, which we summarise as follows:—

Four Association Firms.

(Standard Vacuum Type Lamp with drawn-wire Filaments.)

	1913. (pence)	1919. (pence)
Labour cost	1.9	4.0
Materials cost	3.6	9.9
Overhead factory charges	1.9	2.2
Selling charges	3.7	5.1
Total factory and selling costs	11.1	21.2
Average price received by manufacturers	20.6	25.9
Manufacturers' average profit per lamp ...	9.5	4.7

We have not thought it necessary to check these figures by requiring an independent cost-accountancy of the books and records of these firms. From them one matter to which we have already called attention—the inordinate profits enjoyed by lamp manufacturers in the years immediately prior to the war may be clearly seen. In the year 1913 four manufacturers made on the average 9½d. profit on lamps which cost just over 11d. to produce and sell, a profit of over 86 per cent. on gross cost. Last year the costs of producing and selling appear to have risen comparatively more than the price received, and the profit, according to these figures, was then only 4¾d. on a lamp costing 1s. 9¼d. to produce and sell.

We remark, however, that according to the first table in paragraph 7, at least one Association firm quoted prices of 1s. 4¾d. and 1s. 7¾d. in 1919 for lamps for export, which is lower than the production cost given in the table immediately above. Even on those figures we think it desirable to point out that lamps sold at 3s. and 3s. 6d. cost only 1s. 4d. to manufacture and that the remaining 1s. 8d. or 2s. 2d. was absorbed in selling expenses incurred by the makers and in margins absorbed by the distributing trade. We think it worth while to record, moreover, that three non-Association manufacturers have given us figures which indicate that their cost of material rose only 100 per cent. in the period covered by the Association's statement.

We are disposed to conclude that, taking associated and non-associated firms together, the manufacturers' average margin of selling price over factory cost may be taken as being about 1s. per lamp. Some part of this must be earmarked for advertising, selling expenses, research, patent fees or royalties, and reserves against patent litigation; the rest is profit. We consider that the 5d. per lamp allowed by the Association for selling charges as shown above is more than is necessary in view of the fact that the bulk of their sales are to the trade.

(*To be concluded.*)

CORRESPONDENCE.

Letters received by us after 5 P.M. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Electricians v. Plumbers.

I thought it might interest your readers and the trade generally to know that Burnley and district E.T.U. members are taking the same stand as Blackburn, viz.: "No installation erected by plumbers or non-unionists will be coupled to Corporation mains." A notice in the local Press from next Saturday's issue will be inserted warning electrical contractors, users, and prospective users of electricity of these instructions to our members who are plumber-jointers for Burnley Corporation. It is about time the scandal of every Tom, Dick, and Harry doing electric installation work was put a stop to. The rule comes into force May 1st, 1919.

In this district electrical contractors are as common as chip and tripe shops, and some of the work—well! ——

Albert J. Cutler.

Padiham.
March 22nd, 1920.

Situations Vacant.

I should like to express my feelings with "Pro Bono Publico," as to the prevailing custom of box numbers; if firms do not wish to give their full name, you certainly, Sir, ought to insist on an indication letter being inserted so that applicants do not have to write you on every occasion they insert an advertisement. One firm I know of (not a thousand miles from Euston Road), are always inserting advertisements, and are still looking for their superman. Also, why do you allow duplicate advertisements as in this week's issue—Box 9495-6 from the same firm?

If you can see your way to give us employés some consideration we shall be greatly obliged.

S. E. Brown.

Wallsend.
March 23rd, 1920.

[Advertisers in the Press purchase space in which they can put what they please, provided that they do not thereby cause injury to others by libel, fraud, &c. Indications such as our correspondent suggests would involve an interference with this privilege. Our advertising department undertakes to withhold letters if the writers name firms to whom they are not to be forwarded.—Eds. Elec. Rev.]

In the last issue of the Review I note, and quite endorse, the remarks of "Pro Bono Publico" re "Situations Vacant."

All applicants for jobs, advertised under box numbers, may take it for granted that there is something very fishy, or in more vulgar language, stinks, when the advertiser does not put his name to the advertisement.

I would advise all engineers to treat such advertisements as they would a mad dog, viz., leave them alone, and let the advertiser stew in his own juice.

J. E. Ellis,
Borough Electrical Engineer.

Morley.
March 22nd, 1920.

University College, London, War Memorial.

We trust you will give us the hospitality of your columns to call the attention of former students of University College and University College Hospital, London, to the memorial we are endeavouring to raise to college and hospital men who fell in the war. Owing to the many changes that have taken place during and since the war, our address-list is not complete. It will be of great assistance to us if all members of the College who have not already received our appeal will send postcards with their names and addresses and dates of student years to the hon. secretary. We shall then be very glad to send them full particulars of our war memorial scheme. We hope we may rely on the support of all students, past and present.

Lawrence Solomon, Hon. Secretary.
Gregory Foster, Chairman.
G. Blacker, Vice-Chairman.

University College, London.
March 25th, 1920.

NOTES FROM CANADA.

(From Our Special Correspondent.)

Canada has before her to-day a question of very great importance in the form of the proposal to canalise the St. Lawrence River from Montreal to Kingston, where Lake Ontario becomes the river, a distance of some 170 miles, about 70 of which is the international portion of the river, the remainder being entirely in Canadian territory.

This subject is being considered at present by the International Joint Commission, before which a series of public hearings is to be held during the next few months in various localities likely to be directly concerned in this matter; one such hearing was held in Buffalo recently.

Being an international problem, the Governments of both this country and the United States are naturally interested in it.

It may be said that the proposal is to build several dams at suitable points on this great river so as to turn it into a canal which will enable ocean-going steamers to come right up into the great lakes, in this way such vessels could go straight from ports in other countries right into the heart of the Dominion, even so far as the Twin Cities, Port Arthur and Fort William, at the extreme end of Lake Superior. Montreal is the present terminus for ocean steamers.

So much for navigation. In addition the proposal includes the development of about 2,000,000 h.p., as it is stated that approximately this amount could be made available if the scheme be properly carried out so as to take care of both navigation and power.

The Commission referred to above has been charged by the two Governments concerned with the duty of hearing arguments for and against this great scheme, and there is every indication that there will be a real fight between the opposing interests. On the one side are Ontario and the great grain-growing Provinces of the West, together with the Western States bordering the southern shores of the Great Lakes, and on the other are the City of Montreal, New York State, the great railway interests on both sides of the international boundary and the powerful coal companies located in those parts of the United States which supply Canada with a large part of her coal.

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To anyone over here the reasons for the contending views held by the people of the various Provinces and States, and by the several bodies named, are readily apparent, but some little explanation seems necessary for the benefit of readers at home.

Ontario will benefit both from increased shipping facilities for existing and possible future ports, and from the immense amount of power, over 1,000,000 H.P., that would be her share of the total available; the increase in general trade, in population, and in industrial activity, that would result if such a scheme can be carried to a successful commercial conclusion, is almost beyond calculation.

The Western Provinces and the Western States are deeply interested because of the readiness with which the immense grain produce of those regions could be transported to other lands at rates much lower than is possible now with rail transportation and double handling. The Canadian Provinces are further concerned because such navigational facilities as would be afforded would enable coal to be delivered cheaply from Nova Scotia to many lake ports, thus rendering the Dominion far less dependent on United States supplies, and incidentally benefiting Nova Scotia, too, by providing a large new market for her coal.

Montreal is opposed to the project because she fears that her importance as a port is almost certain to be considerably diminished; New York State is opposed to it because a great deal of the grain from the West is shipped along the barge canal in that State, and the people there are afraid that they will lose a large portion of the existing traffic along this canal. The railway companies naturally feel that a very large and profitable traffic may almost disappear from their lines, while the coal companies realise that their shipments to Canada will be very greatly reduced.

To a very large portion of Eastern Canada the coal problem is a very serious one, as Ontario and Quebec are practically without any supplies of their own, and at present Ontario is wholly dependent on the United States. Already that country is beginning to inquire for how much longer she can afford to ship coal into Canada, and the period appears to be not much more than a century; a large part of the population of Ontario is, therefore, absolutely at the mercy of the United States for its very existence, and unless means of getting coal at reasonable rates from Nova Scotia are provided (as by some such scheme as that referred to above) it is difficult to see how Ontario can, say, 25 years from now, supply fuel to any considerable population, such as 40 or 50 million people, because it is unlikely, even if the United States does not actually reduce her exports of coal to this country, that that country will allow any great increase in such exportations to take place, hence people in Ontario who could not obtain sufficient supplies of fuel in the winter would either have to seek a warmer clime, or go to a region where the fuel supplies were ample—or perish.

With reference to the proposed power development which forms an essential part of this great St. Lawrence scheme, it has been roughly estimated that the sale of power will pay for the entire undertaking, both as regards navigation and power. That during the next few years it will be possible to dispose of so large a quantity of electrical energy as two million H.P. is hardly to be doubted, in view of the ever increasing demands for power that are being made each year on this continent.

TRANSFORMERS FOR ELECTRIC FURNACES.

At Birmingham, on February 25th, Mr. J. L. Thompson's paper (an abstract of which appeared in our issue of January 30th last) was read and discussed before the South Midland Centre of the I.E.E.

Major A. M. Taylor pointed out that nowhere in the paper was the use of three-phase transformers contemplated. Presumably the difficulties in their construction were too great to be faced, but surely from the central station engineer's point of view, a considerable amount of unbalancing of the mains was introduced thereby. The author had brought out very clearly the losses introduced in the core clamping plates, and inferred that the core transformer was on that account not so good as the shell transformer. This leakage flux could probably be considerably reduced if the coils were subdivided into narrower and deeper coils, thus giving the leakage paths further to travel. This would also get over the difficulty of the secondary coils sharing the load unequally when certain of the primary coils were cut out of circuit. No doubt the difficulty was that a certain amount of reactance was wanted in the transformer, but such reactance could be obtained separately outside the transformer, and it would seem as though this would be the best arrangement.

Mr. M. Kahn thought the paper gave a very instructive comparison of the core and shell types of transformers as applied to furnace work. There were advantages and disadvantages in either type, which counterbalanced one another more or less, although it appeared that the shell type was easier to build and arrange than the core type. A very important consideration in connection with the choice of the type from the user's point of view, on this particular class of transformer, was the question of repairs. If a coil of a shell type transformer broke down, the whole core had to be rebuilt, whilst in the core type only the top yoke had to be removed. This advantage might decide the question, particularly on the smaller sizes, where some of the considerations set out in the paper, for example, the influence of the connections between coils and the bringing out of the leads, did not offer great difficulties on either type of transformer. With transformers of small outputs it was possible to avoid connections between various sections of L.T. coils in parallel by arranging the L.T. winding in the form of a wide copper sheet which extended over the whole length of core, and was wrapped round the iron in a spiral. It was essential with this construction to avoid uneven distribution of the flux by arranging the tappings in the middle of the core, otherwise considerable losses would occur in the copper sheet.

Mr. H. S. Holbrook said that with transformers and boosters arranged in the manner shown by the author, it appeared that the hot oil rising from the transformer would tend to overheat the booster windings.

Mr. F. Forrest thought it most essential that all large oil-cooled transformers should be provided by the manufacturer with an indicating thermometer or temperature detector, and that such an instrument seemed especially necessary in the case of transformers for furnace work which were subjected to severe shore circuits. These thermometers should be included whether they were called for or not by the purchaser, and it was the manufacturer's business to indicate to the buyer how essential it was that he should know the working temperature of the transformer windings.

Mr. W. Perry said the author had given a well-balanced comparison between the shell and core types of transformer for furnace work. By using a two-legged rectangular core mounted horizontally in the tank, the L.T. leads could be made of practically the same length, and without joints, as in the case of the shell type, the ventilating ducts between the coils would be in the same direction as the natural flow of oil, and could be insulated on the same method as the shell type. There would also be plenty of room to bring up the H.T. leads without congestion. There was the further advantage that the economic proportions of copper and iron could be reasonably obtained, also a butt joint in the core could easily be used to facilitate repairs. With regard to the H.T. terminals, he was of opinion that they should be brought through corrugated porcelains, and that in exceptionally dirty conditions they should have at least one petticoat to obviate the possibility of a flashover. With regard to the different power factors at different periods of the run, he said that between the melting period and the molten period there was a difference of 16.5 per cent. in the reactance of the circuit, which difference must originate in the bath. Was it correct, therefore, to assume that it was due to the molten steel having lost its magnetic properties. Most transformer manufacturers would agree with the author's conclusions that the most reliable transformer was one without any tappings on the H.T. side. Current control could be obtained on the L.T. side by the use of variable chokers, which were made similar to transformers. A fine wire winding of equal ampere turns to the main current winding was used, and shorted or opened automatically by a standard contactor. The choker would be of a rating of about 20 per cent. of the output of the main transformer, and would be somewhat expensive, but very reliable.

The Ministry of Transport.—A supplementary vote for £181,061 for salaries and expenses of the above Ministry for the half-year ending March 31st, was passed by the House of Commons on March 10th. Of the total, the salary list accounts for no less than £171,861, or at the rate of £343,722 per annum. The following figures show, according to the daily Press, how the staff has grown: December, 1919, 449; March, 1920, 774, an increase of 325. The list of the salaries paid to its leading members is said to be as under: Transport Minister (Sir E. Geddes), £5,000; chairman of the Rates Advisory Committee, £5,000; secretary and solicitor, £3,750; assistant secretary and solicitor, £1,500; parliamentary secretary, £1,500; director-general of civil engineering, £3,000; deputy-director ditto, £2,500; three chief engineers (each), £2,000; director-general of traffic, £3,000; three directors (each), £1,200; director-general of mechanical engineering, £2,500; two directors (each), £1,200; consulting mechanical engineer, £2,500; director-general of finance, £2,500; secretary, £1,200; director-general of roads, £2,300; chief engineer, £1,500; assistant secretary, £1,200; director-general of transport, Ireland, £2,100; two subordinate directors (each), £1,200; director-general of public safety, £2,000; secretary, £1,200; director-general of development, £2,070; secretary, £1,200; commissioner of light railways, £1,000. Twenty-eight officials receive an average of over £2,000 a year. The railway companies have been drawn on considerably for the Minister's staff. Last December there were 55 members of the staff who had previously been in the service of the railways, and 14 who were formerly employed by local authorities. It should be noted that the above figures do not include the salaries of the Electricity Commissioners nor the expenses of their department.

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BUSINESS NOTES.

An Offer from Algeria.—Mr. P. H. Debelfort, the chief engineer of the Mascara (Algeria) electricity works, informs us that he is willing to act as an intermediary between English producers and French customers in Algeria.

Transit of Goods for the Serb, Croat and Slovene State.—The Department of Overseas Trade understands that the Roumanian Government has given instructions to allow the free transit of all goods destined for the Serb, Croat and Slovene State which arrive at Danubian ports. It is, however, essential that the ship's manifests, bills of lading, &c., as well as the packages themselves, should be clearly marked "Transit pour la Serbio," as otherwise they are liable to detention by the Roumanian Customs Authorities at the port of arrival.

Socials.—The Ipswich staff of the Electrical Department of Messrs. Mann, Egerton & Co., Ltd., held a Bohemian concert on Saturday evening, March 20th. Over 100 members of the staff and friends were present at the Great White Horse, where the event was held. Mr. C. Lill, the manager of the department, presided, and he was supported in the vice-chair by Mr. A. Fisher. During the war—from 1914 to the Armistice—the company was engaged building aeroplanes and carrying out electrical installations at many important aerodromes. Since the Armistice, the return to pre-war work has been occupying everybody's attention; that work consists chiefly of country house lighting and factory equipments. The social gatherings, such as that alluded to above, are being arranged with the hope of creating a good spirit between the technical, clerical and "working" staffs.

A whist drive and dance organised by the Electrical Trades Union in Blackpool Tower was attended by considerably over 1,000 people. The prizes for the whist drive were presented by the Mayoress (Mrs. E. H. Howe).

Book Notices.—Scientific Paper, No. 364, of the U.S. Bureau of Standards, "Relation of Voltage of Dry Cells to Hydrogen-Ion Concentration." Washington: Government Printing Office. Price 5 cents. Report of Investigations into Voltage Variation and Polarisation of Dry Cells.

"The Practical Engineer Electrical Pocket-Book and Diary, 1920." (592 pp.). London: The Technical Publishing Co., Ltd. Price, cloth, 1s. 6d. net; best binding, 2s. net. This edition, the twenty-first, has been thoroughly revised and brought up to date, and many additional tables and notes have been introduced. The Electric Furnaces and Pyrometry sections have been entirely re-written.

"Studies in Elementary Physics." By E. Blake. Pp. vi + 176, 43 figs. Price 5s. net. "Wireless Transmission of Photographs." By M. J. Martin. Second edition. pp. xv + 140, 77 figs. Price 5s. net. "Wireless Telegraphy and Telephony." By H. M. Dowsett. Pp. xxix + 331, figs. 305. Price 9s. net. London: The Wireless Press, Ltd.

Liquidations and Dissolutions.—Kendall & Gent, Ltd.—Winding up voluntarily for reconstruction purposes. Liquidator, Mr. T. W. Wright, 13, St. Ann St., Manchester. Meeting of creditors, April 9th, at Manchester. Claims must be sent to the liquidator by April 23rd.

Britannia Lamp and Accessories Co., Ltd.—Winding up voluntarily. Liquidator, Mr. R. L. Tayler, 24, Coleman Street, E.C. 2. Meeting of creditors, April 6th.

Electric Train Lighting Syndicate, Ltd.—Winding up voluntarily. Messrs. Day & Yewdall, solicitors, 4, Central Bank Chambers, Leeds.

Tong, Nutter & Sons, electrical engineers, manufacturers, and merchants 41, The Side, Newcastle-on-Tyne.—Mr. A. S. Tong and Mr. P. Nutter have dissolved partnership. Mr. P. Nutter will attend to debts and continue the business.

Auction Sale.—By direction of the Disposal Board, Ministry of Munitions, Messrs. J. J. Greaves & Sons will sell by auction, on April 28th, at the Cyclops Works of Messrs. Cammell, Laird & Co., Sheffield, machinery and plant, including electric overhead travelling cranes, centrifugal pumps, electric motors, electrical fittings, office fittings, &c. Full particulars are given in our advertisement pages to day.

Bankruptcy Proceedings.—F. Mitchell (F. Mitchell and Co.), electrical engineer, Manchester.—Application for debtor's discharge will be heard at Manchester on April 27th.

W. H. Howard (Holborn Electrical Co.), electrical engineer, 5, Featherstone Buildings, Holborn, W.C., and Finsbury Park.—Discharge suspended for two years from February 27th, 1920.

Catalogues and Lists.—Messrs. Drake & Gorham Wholesale, Ltd., 67, Long Acre, W.C. 2.—Illustrated Pamphlet, No. 284, the "Xcel" electric utility cooker. Other agents for this British product are: Messrs. Siemens Bros., Down & Davies, the Electrical Supplies, Berry's Electric Co., and the Sun Electrical Co.

The Consolidated Pneumatic Tool Co., Ltd., Egyptian House, 170, Piccadilly, W. 1.—Catalogue No. 41. A comprehensive list of pneumatic tools covering drills, hammers, portable mine-hoists, &c., and giving illustrations and complete details.

Trade Announcements.—Mr. Fernand Espir announces that, as from January 1st, 1920, he has taken into partnership his son, Mr. H. Espir, and his brother, Mr. J. Espir, the style of the firm remaining unchanged.

Messrs. Percy Huddleston & Co.'s London telephone number has been changed to "Clerkenwell 1094."

Messrs. Connolly's Blackley, Ltd., have removed their London sales office to 46 and 47, Finsbury Square, E.C. 3. Mr. O. H. Bishop will continue in charge. New telephone number, "London Wall 7188."

Electric Motor Prices.—At a sale of engineering plant and machinery under the direction of the Disposal Board, Ministry of Munitions, at La Bassée Shell Factory, Glasgow, among the best prices realised were—A 40-B.H.P. electric motor, £205; and two 7-B.H.P. electric motors, £103 each.

Copper Prices.—Messrs. F. Smith & Co. report (March 29th):—Electrolytic bars, sheets, wire rods, H.C. wire, no change.

Messrs. James & Shakespeare report (March 29th):—Copper bars (best selected), sheet and rod, £166, a decrease of £2: English pig lead, £43, £3 reduction on last week's prices.

Strike.—On Friday last 350 workers at the Enfield Ellswan Cable Works downed tools.

German Transmarine Electricity Works.—With reference to the leaderette on this subject, appearing on an earlier page of this issue, the *Daily Mail* Madrid correspondent says:—"The Deutsche Ubersee Elektrizitäts Gesellschaft, with big interests in South America, especially Buenos Ayres and Santiago, is turning itself into a Spanish concern. The German company has a nominal capital (each share of 1,000 marks) of 260,000,000 marks [at par £13,000,000]. This is to be converted into Spanish capital (each share being of 500 pesetas) of 300,000,000 pesetas (at present rate £15,000,000). Other German companies are following suit."

Electric Welding Demonstration.—On Saturday last, the A 1 Manufacturing Co., of Sunbridge Road, Bradford, gave a demonstration of the capabilities of some of their welding appliances. Particulars will appear in our next issue.

Train Lighting.—We learn that the 100 new suburban railway carriages, which are now being built for the New South Wales Government Railways in Sydney, are to be fitted with Stone's system of electric lighting, comprising Liliput dynamos, Pegoud switches and accumulators.

For Sale.—Aberystwyth Town Council invites tenders for a 125-H.P. Daimler petrol engine. For particulars see this issue.

Applications for British Trade Marks.—Appended is a summary of the recent applications for British trademarks in connection with productions associated with the electrical industries:—

Treva. No. 397,128. Class 8. Electrical contacts, terminals, parts, fittings, lamps, fusible cut-outs, sparking plugs, and switches. No. 397,129. Class 14. Electrical fittings made of precious metals or imitations thereof. No. 397,130. Class 16. Electrical insulators, parts, and fittings, made of porcelain or earthenware. No. 397,131. Class 20. Electrical detonators and fuses (explosive). No. 397,132. Class 40. Electrical insulators, parts, and fittings, made of ebonite or like substances manufactured from india-rubber or gutta-percha. No. 397,133. Class 50. Electrical insulating materials, parts, and fittings of wood, bone, ivory, or other substances. Trevelyan & Co., 155, Bracebridge Street, Birmingham. November 12th, 1919.

The giant that lives in a box (lettering combined with two different designs), Nos. 398,178 and 398,179. Class 8. Electric accumulators and parts thereof. The Chloride Electrical Storage Co., Ltd., Clifton Junction, near Manchester.

Philco. No. 398,928. Class 40. Goods manufactured from india-rubber and gutta-percha. Philadelphia Storage Battery Co., Philadelphia, U.S.A., December 30th, 1919.

Fyrac. No. 398,471. Class 13. All goods in Class 13. National Spark Plug Co., 214-216, East State Street, Rockford, Ill., U.S.A., December 16th, 1919.

Faem. No. 397,689. Class 17. Electric and pneumatic bell systems, &c. Mercantile Engineers & Founders, Ltd., 224, St. Vincent Street, Glasgow, November 27th, 1919.

Electrol. No. 399,046. Class 1. A chemical compound serving as an electrolyte, and a charging compound for use in connection with electric batteries. Henry Edmunds, Parliament Mansions, Victoria Street, Westminster, S.W., January 2nd, 1920.

Hermetic. No. 384,723. Class 50. Vulcanised fibre, electrical insulating tapes, &c. The Self Sealing Rubber Co., Ltd., Hermetic Works, Ryland Street, Birmingham, August 13th, 1918.

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P.N. (initial letters embodied in design). No. 390,006. Class 6. Electric generators and parts of same, &c. The Pyle-National Co., 1334, Kostner Avenue, Chicago, U.S.A., April 9th, 1919.

A.E.G. (letters combined with design). No. 356,202. Class 8. Electric cables, batteries, induction coils, resistances, switchboards, and meters. Allgemeine Electricitats Gesellschaft, 2-4, Friedrich Karl Ufer, Berlin, Germany, November 8th, 1913.

Walger (lettering combined with design). No. 389,905. Class 40. Connection insulators, and insulating preparations. Edwin Arthur Walshaw, Glasgow Road, Bolton, Ont., Canada, April 7th, 1919.

Hardite. No. 398,730. Class 50. Compositions used for electrical insulation purposes and battery cases, bases for electrical apparatus, &c. Frederick James Harden, 41, Norroy Road, Putney, S.W., December 22nd, 1919.

Spondite. No. 391,819. Class 50. Electric insulating materials, &c. British Cellulose & Chemical Manufacturing Co., Ltd., 8, Waterloo Place, London, S.W., May 30th, 1919.

Spondonite. No. 391,817. Class 50. Electrical insulating materials. The British Cellulose & Chemical Manufacturing Co., Ltd., 8, Waterloo Place, London, S.W., May 30th, 1919.

R.M.R. (initial letters embodied in design). No. 398,597. Class 5. Wire and metals used in the manufacture of radio telegraphic and electrical goods. No. 398,599. Class 13. Radio telegraphic and electrical goods of metal. No. 398,600. Class 16. Radio telegraphic and electrical goods of porcelain or earthenware. No. 398,601. Class 41. Radio telegraphic and electrical goods, being articles of furniture. No. 398,602. Goods made of wood or other material covered by Class 50 for use in radio telegraphy and electrical work. R. M. Radio, Ltd., 5, Chancery Lane, London, W.C., December 19th, 1919.

Trade with Argentina.—The Buenos Ayres correspondent of the *Chamber of Commerce Journal* says: "Provided only that the goods can be obtained, British importers in Argentina at the present moment are on velvet. Not only is there a benefit, which at the time of writing works out at about 40 per cent., on exchange, but there is also an unquestionable preference for British goods, a preference that is readily translated into pounds, shillings and pence. Argentine buyers to-day are willing to pay more for a proved British article than for new and untried goods from elsewhere, and this preference is particularly marked against many United States products. Both official departments and private buyers agree in this matter, and, while it is not right to say that the United States are losing their trade in this part of the world, it is no exaggeration to declare that they have lost, and are still losing, many golden opportunities."

Later the writer says: "American sellers of harvesting machinery were perhaps the first to see that it was not enough to dispose of a machine; it must also be kept running. To this end they had always available a number of capable men who could be sent anywhere at a moment's notice and who understood the job they were on blindfold. It is evident that this apparently unremunerative addition to selling charges is beneficial to the main interests of any big business which adopts it, and one or two of the large Argentine importing houses have adopted something similar on their own account, without, however, getting much support in the past from British manufacturers of machinery, either tools or plant. Its general adoption has, therefore, everything to recommend it, and when combined with co-operative salesmanship, it will unquestionably do much to push British export in one of its most valuable lines. Every smooth-running British machine is in itself a piece of propaganda, and when the man in charge of it is convinced of its virtues, and knows, moreover, that in any case of unforeseen difficulty or breakdown he is able to obtain speedy and expert assistance, its introduction paves the way for further purchases in the same quarter. It may not be out of place to point out that Germany had already begun to adopt similar tactics in regard to electrical plant and flour-milling machinery before the war; and with very satisfactory results, as may be gathered by conversation with any chief mechanic or engineer in charge of the various mills and electric light stations about the Republic, even when he does not happen to be of German birth or descent, as so frequently is the case."

LIGHTING AND POWER NOTES.

Accrington. — INDUSTRIAL SUPPLY. — Regarding the application of Messrs. Howard & Bullough, textile machinists, for an increased supply of power to their Charter Street Works, Accrington Electricity Committee has agreed upon a basis of charging for additional supply. The estimated cost of the necessary high-tension cable, switchgear, &c., is £2,000.

Aldershot. — EXTENSIONS. — The proposal to spend £21,550 on extensions led to criticism by members of the Council, who stated that the local private undertaking showed a profit of £1,017 during last year, while the municipal works showed a deficit of over £1,000. The proposed extensions include turbo-generators (£11,000), boilers (£3,500), and buildings (£6,500).

Alfreton. — ELECTRICITY SUPPLY. — The Notts. and Derbyshire Power Co. has notified the local Town and Trade Association that it is willing to extend its mains from Ripley if sufficient revenue is assured. The cost of laying the mains would be from £1,000 to £1,200, and the company would expect a yearly revenue of £1,000. The comparative cost of electricity is half the present cost of gas, and the Association is supporting the scheme.

Beachley.—TIDAL POWER.—The cost of the scheme to erect a bridge over the Severn and a dam to harness the 40-ft. tide for the purpose of generating electricity, is stated to be between £8,000,000 and £9,000,000. The *Evening News* says the project is expected to be completed in about five years.

Birmingham.—NEW POWER STATION.—Owing to the slow delivery of steel-work for the construction of the new power station at Nechells, the building will not be ready for the reception of the plant in the estimated time. It was originally hoped to have the station running by October, but there seems every probability of another shortage of power during next winter.

Blackburn.—PROPOSED LINKING-UP.—The Corporation, in conjunction with Preston Corporation, is negotiating with the Electricity Commissioners upon the question of laying a main between the two undertakings.

Bolton.—EXTENSIONS.—The Electricity Committee has approved a scheme of extensions to the Back-o'-th'-Bank power station. The first stages are expected to cost £140,000, and the ultimate total expenditure will be £250,000.

Bradford.—NEW PLANT.—A much-needed addition to the present plant, a 10,000-KW. turbo-generator, which has been on order for a considerable time, is expected to be installed at the Valley Road station within the next three months.

Canada.—WATER POWER.—The *Electrical News*, of Toronto, publishes some interesting information regarding the utilisation of Canadian water power for the generation of electricity. It is stated that, of an estimated available H.P. of 18,832,000, a total of nearly 2,400,000 H.P. is being developed. The Ontario Hydro-Electric Commission's undertaking at Chippawa (Niagara Falls) is to have an initial capacity of 200,000 H.P., with future extensions to bring it up to 500,000 H.P. The Government plants at Shawinigan and Grand Mere are to be raised from 330,000 to 600,000 H.P.

Continental.—AUSTRIA.—The *Economic Review* learns from a Continental source that the American Westinghouse Co. and other American industrial groups are considering the exploitation of the water power of the Austrian Alps.

FRANCE.—The movement for the centralisation of the supply of electric energy in the Paris district has extended to the South-west of France. Various companies in the Lyons district have formed themselves into a company to supply electricity to Lyons and St. Etienne. The scheme consists in gradually replacing the present fuel stations by water power, and the linking-up of the South-east networks will enable the company to utilise the St. Etienne coalfield when reinforcement is needed. At the moment, 10 companies, producers or consumers of electricity, constitute the group: the Gaz et Electricité de Lyon; the Société Hydroélectrique de Lyon; the Société des Forges et Aciéries Paul Girod; the Société Lyonnaise des Forces Motrices de Jonage; the Société des Forces Motrices de la Tarentaise; the Société pour la Création et l'Utilisation des Forces Motrices de la Haute-Isère; the Société Force et Lumière; the Energie Electrique de la Loire et du Centre, &c. The energy distributed in the Lyons and St. Etienne district will total at the outset about 100,000 H.P., requiring some hundreds of tons of coal daily, and is insufficient for the needs of the district. Consequently, further calls on the Alps and on the Central Plateau will have to be made. The Truyère central station alone is able to supply 100,000 H.P. The first steps of the new company will be the setting-up of three 120,000-volt three-phase lines—one linking Lyons with Albertville; the second, Lyons to Bourg Saint-Maurice; the third, Lyons to a point to be fixed in the Tarantaise. The cost of each of these lines is estimated at 30,000,000 francs. The lines will converge on the same central station at Lyons, from whence power will be distributed. Application for sanction to the scheme on the ground of public utility is about to be made, and as the complementary generating works are under way, realisation of the scheme within two years at the latest is expected. The city of Lyons will be the chief consumer; the public lighting there is still by gas, and the demands for electric current for private lighting, heating, and motive power are beyond the existing three big companies' means to supply. Moreover, the Paris-Lyons-Mediterranean Railway, which has begun the electrification of the Cirloz-Modane line, and foresees that of the Lyons-Geneva and other mountain railways, will be an important consumer.—*L'Electricité*.

Owing to a dispute in the electrical industry of Verviers, the town and about 40 communes have been deprived of electric lighting and tramway services.

Chorley.—ELECTRICITY SUPPLY.—The Town Clerk has reported regarding the obligation of the Lancashire Electric Power Co. to supply electricity in the borough under the Provisional Order of 1914, that the mains are still eight miles away, and a supply from any other existing authority does not at present appear practicable. It is proposed to discuss the whole matter with the Electricity Commissioners with a view to formulating a scheme.

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Devonshire.—Joint Electricity Authority.—At a recent conference of representatives of municipal authorities, a deputation, consisting of delegates from Plymouth, Exeter, Torquay, and Barnstaple, was appointed to meet the Electricity Commissioners to discuss the formation of a Joint Electricity Authority for the county.

Dundee.—Delay in Extensions.—The progress of extensions to the electricity works is being held up by the difficulty in obtaining structural steel work.

Gold Coast.—Electricity Supply.—A Bill to make provision for the supply by private enterprise of electricity for lighting and other purposes has been introduced in the Gold Coast Legislative Council.—*West Africa.*

Hull.—Coal Shortage.—A deputation recently waited upon the Coal Controller to point out the great loss and inconvenience being caused by the shortage of fuel. It was stated that many large works had to be closed down at 4 o'clock in the afternoon, as it was impossible to supply them with power.

Lancaster.—Outbreak of Fire.—A fire recently occurred at the switchboard in the electricity works. Although it was soon extinguished the plant was temporarily put out of action.

Liverpool.—Mains Extensions.—The extension of over 50 cables has been approved, including a high-tension main to a factory at Aintree, at an estimated cost of £4,370, involving the erection of a sub-station costing £2,000. An extension from Longmoor Lane to Tazakerley will cost £8,100, and the sub-station £2,000.

Price Increase.—The charge for electricity for lighting purposes is to be increased by 25 per cent., as from January 1st.

Repayment of Costs.—The Tramways and Electric Power and Lighting Committee has decided to have a list compiled of the firms which have applied for the return of the amounts paid by them for the extension of mains, showing the cost of the work, the amount paid by these consumers, the amount proposed to be refunded, and the amount paid, or payable, in respect of the consumption of electrical energy by such firms, and the period of consumption. The list will be considered by the Committee at the next meeting.

London.—Hammersmith.—The original proposals for electricity extensions were submitted to the Electricity Commissioners, who recommended a much more comprehensive scheme to meet not only the needs of the borough, but also those of neighbouring undertakings. It is therefore proposed to install two 8,000 to 10,000-kw. turbo-generating sets at an estimated cost of £124,000, and three additional boilers, costing £45,000. Structural alterations to the boiler house will cost approximately £5,000.

Electricity Supply.—The Special Committee of the London County Council on London Electricity Supply has reported that, as the result of conferences with representatives of local authorities, it is clear that no satisfactory proposals can be put before the Electricity Commissioners without a general outline scheme dealing with the technical aspects of the subject. Mr J. H. Rider, of the firm of Messrs. Preece, Cardew & Rider, has, therefore, been engaged to investigate the matter and report thereon.

Lynton.—Price Increase.—The Electric Lighting Co. has increased the price of electricity for heating to 2½d. per unit up to 100 units per quarter, and for larger quantities to a flat rate of 1½d.

Nigeria.—Hydro-Electric Plant.—Messrs. Vickers are constructing a hydro-electric plant on the Kwall Falls of the N'Gel River for the Northern Nigeria Tin Mines. The power is obtained from a series of small falls over a length of 1½ miles, which give a difference in level of 700 ft. The plant capacity is to be 1,500 kw., and power will be conveyed at a pressure of 22,000 volts to the mines (a distance of 15 miles), where it will be stepped down to a working pressure of 525 volts.

Plymouth.—Proposed Price Increase.—The Electricity and Street Lighting Committee recommends an increase of the charges for electricity for lighting by 1d. per unit, and for power by 5 per cent.

Skegness.—Proposed Electricity Supply.—Messrs. Handcock, Dykes & Trotter have prepared a scheme for the installation of electrical plant, &c., at an estimated cost of £19,580, including £2,240 for land and buildings. Before further steps are taken estimates are to be secured from other experts.

Worksop.—Proposed Extensions.—The electrical engineer recommends large extensions and additions to meet the consumers' increased demands. The proposals include the adoption of three-phase generation and a temporary bulk supply from the Manton Colliery, of the Wigan Coal and Iron Co., at a capital cost of £7,500, in order to meet consumers' demands. The matter has been referred to a Committee for consideration and report.

TRAMWAY AND RAILWAY NOTES.

Blackburn.—Increased Receipts.—The receipts of the Corporation tramways department for the past financial year amount to £116,964, an increase of £25,221 over 1919, and of £39,495 in 1918.

Burnley.—Wages.—Tramway employés on March 26th received the difference between their actual earnings for the last two weeks and their wages for the regulation 48 hours' week, in consequence of the Sunday stoppage through coal shortage.

The new tramway queue system came into force on March 27th, and all the unloading and embarking places in the Centre are now being labelled with indicators.

Continental.—Russia.—The municipal authorities of Petrograd have been empowered by the Executive Committee of the Soviet to introduce a system of free travel on the tramways.—*Economic Review.*

Exeter.—Additional Plant.—The city electrical engineer has been instructed to make inquiries regarding the purchase of a second-hand turbo-alternator of from 300 to 500-kw. capacity to augment the supply of power to the tramways.

Haslingden.—Fare Increase.—The Town Council has received the permission of the Ministry of Transport to increase all tramway fares on the borough routes by 50 per cent.

Ilford.—Railless Trolleys.—To meet the increased demand for transport facilities likely to follow the erection of thousands of new houses in the district, the Council is considering the advisability of commencing a system of railless trolley routes as the cheapest and most flexible form of transport.

Industrial Court Award.—Men and women employed in railway shops and generating stations are to receive an advance in wages of 1½d. an hour or 6s. a week, according to the system of payment in vogue. Piecework rates are advanced 15 per cent. These were the terms of an award made by the Industrial Court on March 24th.

Leigh (Lancs.).—Parliamentary Bill.—The Private Bill Committee of the House of Commons has informed the Corporation that its approval will be given to the Bill seeking powers to establish a motor omnibus service, if a clause is inserted preventing the Corporation competing with the South Lancashire Tramways Co. on the latter's existing routes.

London.—Underground Railway Fares.—As a result of representations by London M.P.'s, the "Tube-fares Bill" has been amended in two respects. First, it is agreed by the promoters that an increase in fares shall be made only to cover working expenses, efficient management, renewals, and a reasonable return upon capital; and, secondly, that workmen's return fares between any two stations shall not exceed the charge for the single journey, with a minimum fare of 3d.

Owing to the delay in paying arrears in respect of wage increases, the employés of the London Underground Railways threatened a strike at Easter, but the men have reconsidered their decision.

Traffic Authority.—The Committee appointed to advise the Minister of Transport on the London traffic problem, under the chairmanship of Mr. Kennedy Jones, M.P., has recommended, *inter alia*, the formation of a permanent authority, consisting of three members, to deal with all questions affecting traffic in the London area. The primary duties of such an authority would be to make a preliminary examination of all transport Bills, to examine schemes for traffic improvement, to study housing and town-planning schemes from the point of view of transport, to prepare a general development plan to which all new schemes should conform, and to consider all legislation proposed dealing with traffic and transport.

Railless Trolley Cars.—The London County Council intends to carry out experiments with railless trolley cars, as the cost of laying tracks has become unremunerative.

A tramway strike, to begin on April 4th, is threatened throughout the country, says the daily Press, "owing to the failure of the workers' side of the Joint Industrial Council for the tramway industry to induce the Council to grant a 44s. weekly increase on pre-war rates." This would mean a 10s. weekly increase on present wages. The resolution to tender notices was passed by the Transport Workers' Federation, and seven days' notice, ending at midnight on April 3rd, has been given by the tramways section of the United Vehicle Workers, who are affiliated with the Federation. The application for an increase was made on February 26th: the tramway authorities generally declared their inability to pay the increase demanded, but offered 2s. 6d., which was rejected.

Sunderland.—Year's Working.—The report of the directors of the Sunderland District Tramways for the year ended October 31st last states that after paying expenses and providing for depreciation, there was a balance for disposal of £24,385, including £1,195 brought forward from the previous year. From this was deducted £7,100 interest on the prior lien bonds and first mortgage debentures, £500 for sinking fund instalment, £8,000 for transfer to general reserve account, leaving a balance of £8,785. From this the directors proposed to pay dividends of 5 per cent. (less income-tax) on the first income bonds, the second income bonds, and the preference share capital. The sum of £1,208 was left to be carried forward. The traffic receipts have shown a substantial increase, but the working expenses have again been considerably higher.

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TELEGRAPH AND TELEPHONE NOTES.

A New Exchange.—A new telephone exchange, to be known as Clerkenwell, was opened in Ironmonger Row, E.C. 1, on Saturday last. About 800 subscribers were transferred to the new exchange at 2 o'clock on Saturday afternoon. They were to be taken mainly from the London Wall, Holborn, Central, and City areas. A further 500 will be transferred on April 10th. The new exchange will serve the northern portion of the City, and by the end of the year it will have a capacity of 10,000 lines. The apparatus is of the manual type. A feature of the exchange will be an operating school accommodating 130 students. This makes London's seventy-fourth exchange, and by the end of the year three others will have been opened. At present there are about 155,000 subscribers in the London district, and others are being added at the rate of about 1,000 per week. Approximately 60,000 new subscribers have been connected since the armistice, and there are still half that number waiting for instruments.

Engineers for Dutch Colonies.—According to the *Schweiz. Bauzeitung*, of March 6th, the Dutch Government requires a fairly large number of electrical engineers for the Telegraph, Telephone, and Postal Services in the Dutch East Indies. As it is not possible to cover requirements in Holland, the Government wishes to engage young Swiss engineers holding the diploma of a technical college. In order to give applicants some idea of the conditions and duties of their employment, the (Dutch) Government arranged for a Colonial official, Herr Dom van Rombeck, Chief of the "Dutch East Indies Labour Department" at the Hague, to give a public lecture in Zurich, on March 8th, on the conditions in the Dutch East Indies, and in connection therewith to receive applications.

Why the Dutch Government should go to Switzerland for electrical engineers is not clear. Is not the war over yet? We have never heard that Swiss engineers have shown any special aptitude for telegraphy and telephony, subjects in which the British have always held their own.

Holland.—Owing to cable congestion between England and Holland, the Netherlands Chamber of Commerce in London has asked the Marconi Co. to report on the possibility of instituting a wireless telephone service. A licence would be necessary from each of the Governments concerned.

Italy.—Successful wireless telephonic conversation was carried on, last week, between Chelmsford (England) and Rome. According to Marconi officials, wireless conversation has been received clearly up to distances of 1,200 miles. Conversation has also been heard from a ship's station at a distance of 1,500 miles, but this was very faint.

Japan.—The estimates for wireless expansion in the Japanese Budget for the coming year do not, according to *Eastern Engineering*, cover the overhauling of the Funabashi Station, which must soon be taken in hand, but only provide for the replacement of the transmitting and receiving outfits. The apparatus is of the old German one-mast type. This is one of the three stations belonging to the Japanese Navy, the others being Hozan (Formosa), and the station at Sosebo, now in course of construction. The Navy will probably present a supplementary estimate to cover the construction and repair programme considered necessary.

Portugal.—The strike of telephone workers ended last week, and work was resumed.

Post Office Loss.—A White Paper issued on March 22nd, deals with the accounts of the Postal, Telegraph, and Telephone Services for the year ended March 31st, 1919, and shows deficit on both the telegraph and telephone departments. The net receipts of the two departments, including £5,456,573 put down as the value of services performed for other departments without remuneration, amounted to £16,193,289, while the expenditure aggregated £18,279,998. The ultimate result being a deficit on the telegraphs of £685,139, an increase of £128,809, and on the telephones a deficit of £36,261, against a net surplus of £355,468 in 1917-18. On the other hand, the postal services showed a surplus of £8,168,956, an increase on that of the previous year of £1,320,671.

Wireless Telephony.—Marconi's Wireless Telegraph Co. carried out successful demonstrations last week at Chelmsford in directing an aeroplane by means of wireless telephony.

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the Electrical Review *in which the "Official Notice" appeared.)*

OPEN.

Australia.—Melbourne.—April 12th. City Council. Two 2,000-kw. rotary converters; H.T. switchgear, 6,600 v.; D.C. switchgear, 600 v. (January 30th.)

Perth.—May 3rd. Postmaster-General's Department. Insulators, bolts, brackets, &c. Schedule 673. (See this issue.)

April 14th. Postmaster-General's Department. Telegraph and telephone instruments and parts. Schedule 671. (See this issue.)

Bedwellty.—April 12th. Urban District Council. Electric wiring, fittings, &c. at Pengam and Aberbargoed. (March 26th.)

Belgium.—April 7th. The municipal authorities of Ixelles, Brussels. Supply of a quantity of armoured cable for low-tension distribution mains. Specifications may be obtained from the Maison Communale, Ixelles, for two francs.

April 6th. Municipal authorities of Chassepierre (Province of Luxenbourg). Tenders for a central electric lighting station in the town.

April 13th. Municipal authorities of Wevelghem. Supply and installation of a transformer sub-station of 150-kw. capacity. Particulars from and tenders to the Salle Communale, Wevelghem, Belgium.

Canterbury.—April 19th. Electricity Department. One 1,000-kw. three-phase turbo-alternator, surface condensing plant, two rotary converters, superheater, &c. (March 26th.)

Darlington.—April 19th. Electricity Department. One water-tube boiler. (See this issue.)

Edinburgh.—April 26th. Electricity Supply Department. E.H.T. paper-insulated lead-covered cables. (See this issue.)

Eastbourne.—April 16th. Electricity Department. Supply and erection of one water cooling tower. (March 26th.)

Great Yarmouth.—April 16th. Electricity Department. One 2,000-kw. turbo-alternator, one 750-kw. rotary converter and transformer, and one 750-kw. frequency changer. (March 19th.)

Lincoln.—April 8th. Electricity Department. Pipework, and motor-generator and switchgear for St. Swithin's power station. (March 5th.)

London.—Shoreditch.—Electricity Supply Department. Water-tube boiler, 5,000-kw. turbo-alternator, E.H.T. and D.C. switchgear. (March 19th.)

Margate.—April 15th. Town Council. Electric light installation, pavilion and winter gardens. Mr. J. E. Saxby, Manager.

Peterborough.—Electricity Department. 1,000-kw. turbo-alternator with condenser and pipe work, switchgear, 500-kw. rotary converter, superheaters, induced draught fan, two sets forced draught furnaces, foundations and builders' work, and H.T. cables. (March 19th.)

South Africa.—April 24th. Oudtshoorn Municipality. Time for receipt of tenders extended from March 24th to April 24th.

Tasmania.—Launceston.—June 7th. City Council. One 1,000-k.v.a. hydro turbo-alternator, with switchgear. City Electrical Engineer, Town Hall, Launceston.

CLOSED.

Accrington.—Electricity Committee. Accepted:—
Alterations to crane, £330.—J. Spencer & Co.

Australia.—Sydney.—City Council. Accepted.

4 miles 7/16 H.D. bare-copper cable	1s. 7½d. lb.	W. G. Watson & Co., Ltd.
8 miles 7/14 " " "	1s. 8½d. lb.	F. S. Lee.
4 miles 19/16 " " "	£430	F. S. Lee.
20 miles 7/18 " " "	1s. 9½d. lb.	F. S. Lee.
8 miles 7/14 " " "	£468	W. Adams, Ltd.
10 miles 7/20 double-braided aerial cable	£195	Lawrence & Hansen Elec. Co., Ltd.

Two sets of front headers with water boxes for economisers; one set of back headers with water box, £2,437, Babcock & Wilcox, Ltd.

9,000 yd. ·15 sq. in. three-core 5,000 v. lead-covered H.T. cable, £6,884; 5,000 yd. ·1 sq. in. three-core 10,000 v. lead-covered H.T. cable, £3,562; 10,000 yd. ·15 sq. in. three-core 10,000 v. lead-covered H.T. cable, £8,896, Siemens Bros., Ltd. *Tenders.*

London.—Stepney.—Electricity Committee. Accepted:

3,000 tons West Cannock nuts, 41s. 4d. per ton; 2,000 tons ditto, 2 in. nutty slack, 36s. 10d. ton; 1,000 tons Tamworth, 1½ in. nutty slack, 37s. 6d. ton.

Switchgear for Whitechapel and Mile End sub-stations:—

A. Reyrolle & Co.	**£7,761**	Sub-station type (recommended).
Ditto (alternative)	8,086	
General Electric Co., Ltd.	7,785	
Bertram Thomas	8,026	
Switchgear & Cowans	8,026	
Park Royal Engineering Works, Ltd.	9,158	
Brit. Thomson-Houston Co., Ltd.	9,646	
New Switchgear Construction Co., Ltd.	9,910	
Edison Swan Electric Co., Ltd.	incomplete	

24 steel tubular electric standards for street lighting, £342, British Mannesman Tube Co., Ltd. (Accepted.)

Additional supply 2¼ miles of feeder cable, for the Limehouse and Whitechapel stations, £4,349. Henley's Telegraph Works Co., Ltd. (Accepted.)

House service cable:—

Henley's Telegraph Works Co., Ltd. (recom.)	**£385**
British Insulated and Helsby Cables, Ltd.	390
W. T. Glover & Co., Ltd.	442

¼ mile of earthenware pipes, and ½ mile of troughs and covers.

Sutton & Co. (recom.)	**£215**
Siemens Bros. & Co., Ltd.	238
Henley's Telegraph Works Co., Ltd.	264

St. Pancras.—Highways, Sewers and Public Works Committee. Recommended:—

Mossay & Co., Ltd.—Two 3½-ton "Orwell" electric motor wagons, with interchangeable cylindrical water-tank bodies, £1,613 each, including extras.

Lacre Motor Car Co., Ltd.—Two motor road-sweeping machines, £650 each.

FORTHCOMING EVENTS.

Association of Engineering and Shipbuilding Draughtsmen.—Thursday, April 8th. At the University, Liverpool. At 7.30 p.m. Lecture on "Design of a 40-ton Titan Crane," by Messrs. P. A. Arbeny and H. W. Mellor. At the Grammar School, Chesterfield. At 7.30 p.m. Lecture on "The Destructive Distillation of Coal," by Mr. E. Nicholson.

Institution of Electrical Engineers (Western Centre).—Monday, April 12th. At the South Wales Institute of Engineers, Cardiff. At 7 p.m. Lecture on "Thermionic Valves," by Prof. E. Bacon.

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NOTES.

New Fire-Damp Indicator.—A new fire-damp indicator, the invention of an English electrical engineer, is said to have passed all tests, and should, in conjunction with the electric lamp, materially contribute to the safety of life in mines. According to the *Sheffield Independent* the instrument only occupies a space of 2 in. by 2 in., and weighs less than 8 oz. It is strongly made, and is unaffected by complete immersion in water; it can be incorporated in any electric lamp. The device, it is claimed, is capable of recording the percentage of fire-damp present in the atmosphere down to a quarter of 1 per cent.

Japanning Ovens.—A recent issue of the *American Machinist* contains some useful information regarding electrically-heated japanning ovens. The system described is that adopted by an American typewriter manufacturing company, and consists of a battery of six ovens, four of which are 7 ft. 5 in. high, 7 ft. 1 in. deep and 6 ft. 2 in. wide, while the other two are slightly smaller. The heating load of each oven is 27 KW. The heating units are compact, and as their maximum temperature is relatively low (400° F.) risk of burning out and causing fires or explosions is reduced to a negligible point. During their life of four years, these ovens have proved eminently satisfactory, and the fuel cost compares very favourably with gas-heated ovens, which circumstance, combined with the fact that the capacity of the electric oven is considerably above that of the other type, proves without doubt the soundness of employing electricity for this class of work. Figures given in the article show that the electric oven has a capacity of 300 frames, against 180 in the case of the gas oven, and while the fuel cost per day in the case of the latter is $5·78, that of the former is only $1·62, and a year's working shows a total saving of $360.

White Horses.—(Lines suggested by recent proposals.)

Chafing and rearing they start away,
Scared by the touch of a human hand,
Scattering foam in a cloud of spray;
Wild-eyed and panting, they will not stand.

They have been free since the world began,
Heedless of snaffle or curb or rein,
Galloping far from the homes of man,
Prancing and tossing each flowing mane.

Can they be broken, these dashing steeds,
Restless and strong as the wild North wind?
Will cunning Science to meet new needs
Harness the tides to assist mankind?

LESLIE M. OYLER.

London Underground Railway Speeds.—We are indebted to the *Tramway and Railway Journal* for the accompanying interesting table showing the average speeds of trains over the distances, and with the number of station stops mentioned. There has been an appreciable improvement on the routes on which "hurry-up" men have been provided. It will be noted that the average speed is in inverse proportion to the number of stops per mile. With regard to the lower speed on the City and South London Railway, the stops are exceptionally numerous, and it has to be remembered that the trains are hauled by electric locomotives instead of being equipped and driven on the multiple-unit system. On all the other lines the rate of acceleration on leaving each station is very high, and the pull up on stopping is sharp. When steam locomotives were used on the District Railway, the average train speed was 13·65 miles an hour.

—	Distance. Miles.	Station stops.	Time. Minutes.	Average speed. Miles per hour.
Mansion House to Ealing	10·9	9	27	24·2
Mansion House to Ealing	10·9	16	34	19·3
Elephant and Castle to Watford ..	20·8	26	62	20·13
Hammersmith to Finsbury Park ..	8·9	14	30	17·78
Charing Cross to Golder's Green ..	6·1	11	21	17·47
Charing Cross to Golder's Green (theatre)	6·1	4	16	22·84
Charing Cross to Highgate	4·4	11	17	15·55
Charing Cross to Highgate (theatre)	4·4	8	12	22·15
Liverpool Street to Wood Lane ..	6·8	13	24	17·0
Clapham Common to Euston ..	7·3	13	32	13·69

Decimal Coinage.—The Report of the Royal Commission on Decimal Coinage, of which Lord Emmott is chairman, was issued on Wednesday, last week. It emphasises the necessity of retaining the pound in any event, and states that the pound and mil system is the only one which complies with this condition; but it finds that the disadvantages of effecting the change outweigh the benefits to be gained, and decides against making any change. A minority report takes the opposite view, advocating the pound-mil system, and another minority report recommends a dollar system.

Appointments Vacant.—Charge engineer (£110 to £130 + 20 per cent. + £120), mains assistant (£110 to £130 + 20 per cent. + £120), for the Corporation of Portsmouth Electricity Supply Department; assistant engineer (£60), assistant mains engineer (£450), for the Edinburgh Corporation Electricity Works; switchboard attendant (85s. 6d.), for the Borough of Burnley Electric Lighting Department; shift engineer (£245) for the Eccles Corporation Electricity Works. See our advertisement pages to-day.

Electrically-propelled Canoe.—CORRECTION.—In connection with our article on the recent Olympia Motor-Boat Exhibition, which appeared in our issue of March 19th, wherein particulars were given of an electrically-propelled canoe, our attention has been called to the passage reading: "The motor and accumulators are concealed under the deck, the latter comprising 32 two-volt, 122-ampere Chloride 'Exide' cells in ebonite cases," and we would point out that the paragraph should have read: "The motor and accumulators are concealed under the deck, the latter consisting of 38 two-volt accumulators. The capacity of the battery at 20-ampere discharge rate, 122-ampere hours . . . ."

The Testing of Turbine Steels.—At a meeting of the North-East Coast Institution of Engineers and Shipbuilders, on March 19th, a paper entitled "Turbine Steels: a Research into their Mechanical Properties" was read by Dr. W. H. Hatfield, it being the joint work of that gentleman, of the Brown-Firth Research Laboratories, Sheffield, and of Mr. H. M. Duncan, B.Sc., of Messrs. C. A. Parsons's research laboratory, Newcastle. The research was instituted by the writers of the paper and Mr. A. D. C. Parsons, as a Sub-Committee of the British Electrical and Allied Manufacturers' Association, and was conducted with a view to determining what auxiliary tests might usefully be added to the specification in order to supplement the information obtained from existing mechanical tests. The tensile tests were carried out on a 50,000-kg. Olsen testing machine. The results generally suggested that commercial forgings were of moderately good quality steel, but that the qualities that could be induced in small masses were not obtainable, nor were they to be expected, in large masses. Turbine parts which had given satisfactory service as compared with those that had not, according to the results, suggested that design might be a factor of greater importance than the quality of the steel. As regards the indications of the various mechanical tests on the forgings and turbine parts investigated, in all cases the tensile tests gave a good indication of the quality of the material, though, perhaps, not sufficient for absolute reliance. The difference between ductility, longitudinally and transversely, was generally shown up in the figure for elongation or reduction of area, while the maximum stress reached indicated the conditions of hardness or stiffness. The Izod test, while useful for special cases where notches entered into design, was of little advantage in large turbine forgings—especially carbon-steel forgings—on account of its lack of sensitiveness. The test might, however, be usefully retained in some cases of nickel-chrome steel forgings as a check on heat treatment. The authors expressed the opinion that the Stanton test probably approached nearest to the conditions likely to be met with in practice where design or accident introduced undesirable features, such as sudden changes of cross-section, sharp right-angled corners, and the effect of a blow. The experimental work also enabled the compilers of the report to recommend the Sankey test for much more attention from engineers. Unfortunately the number of tests performed was not yet sufficient to enable them to fix definitely what value should be given by the test, and to specify sufficiently definitely the conditions.

American Copper Production Costs.—Following an examination of the books of the U.S.A. copper companies, the Federal Trade Commission finds, says the *Mining Review*, that the average costs of those companies that contribute 95 per cent. of the total output were as under in 1918:—

Department.	Cents per pound.	Pounds per long ton, approximate.	Per cent. of total cost.
Mining	6·94	£32 0	42·97
Depletion of ore*	0·72	3 6	4·45
Purchase of ore	0·51	2 6	3·19
Transportation of ore	0·83	3 16	5·18
Reduction of ore	5·89	27 4	36·44
Transportation of refinery ...	0·85	3 18	5·28
Refining	1·02	4 14	6·36
Administration	0·89	4 0	5·56
Selling expenses	0·18	0 16	1·16
Credits for gold and silver ...	1·71	7 18	10·59
Labour	5·30	£24 10	32·83
Materials	3·76	17 8	23·28
Overhead	2·14	9 18	13·27
Depreciation	0·94	4 6	5·85
Depletion*	0·72	3 6	4·45
Tolls	4·99	23 0	30·91
Credits	1·71	7 18	10·59

*Depletion of ore is a charge allowed by the Treasury Department when making out taxation forms.

Unprotected Wires—Company Fined.—At Spennymoor (Durham) on March 23rd, the Weardale Steel, Coal, and Coke Co., Ltd., was fined £50 for insufficient safeguard and protection of electric wires at its by-product ovens, Tudhoe Works, whereby George Copeland met his death on February 1st, by coming in contact with a live wire. It was stated that the body of Copeland was found at the doorway of the sulphate house, his hand clutching a live wire. The opinion was expressed that deceased had picked up the wire to put it on one side, as it had blown down across the doorway. William Shand, electrical engineer for the company, said the wire was put up in the ordinary way, and added that there was no cradle underneath. The wires had been in the same condition for 12 years, and no complaint had been made until the accident occurred.

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Electric Welding.—In reviewing developments in the electrical industry during 1919, Mr. J. Lister states in the *General Electric Review* that the rate of increase in the use of electric welding is indicated by the fact that in 1918 the number of welding outfits sold was more than double that of any preceding year, while 1919 in turn gave a further increase of 100 per cent. over 1918. A new D.C. welding outfit was produced which delivers current directly to the arc at the required pressure without the use of any form of ballast resistance or external regulating device. This result is obtained by means of a dual magnetic circuit, one section of which generates constant potential in part of the armature by means of a shunt field excited from this part of the armature winding, while the armature reaction and a differential series field cause a varying voltage in the other part of the armature winding. The constant potential is 30 volts, while the other component varies from plus 30 volts on open circuit to minus 30 volts on short circuit. The generator rating is 200 amperes, no exciter is required, and either A.C. or D.C. motor or belt-drive can be used. The outfit is self-contained, including a control panel, is compactly mounted so that it can be readily moved about, and weighs about 1,300 lb. A new automatic welding machine, for depositing metal varying in thickness from 25 mils to 0·25 in., was also developed for use, for instance, in increasing the diameter of a shaft by means of a self-feeding wire electrode, the shaft being rotated as in a lathe during the operation. The machine, fig. 1, consists of a pair

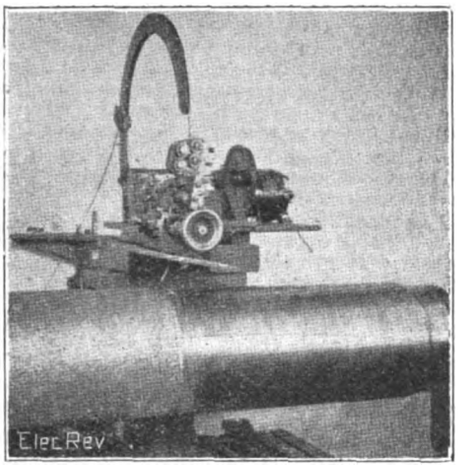

FIG. 1.—AN AUTOMATIC ELECTRIC WELDER.

of rolls which are driven at varying speeds by a D.C. shunt-wound motor. The rolls deliver the electrode wire to the working face, and when the arc is drawn, the field and armature of the motor are instantaneously influenced by the voltage across the arc and respond by increasing or decreasing the rate of feed of the wire, thereby regulating the length of the arc to the value for which the machine is adjusted. Above the feed rolls, wire straightening rolls are provided to ensure accurate feeding of the wire and the proper location of the arc. The machine may be operated from any D.C. welding circuit, and will use any size of electrode, up to its mechanical limits, with equal precision in operation, as neither of these factors enters into the question of the rate of feed control, which is governed solely by the voltage across the arc. The complete outfit is very compact, being 4 ft. long, 18 in. wide, and 6 in. high.

Automatic Sub-Stations.—Mr. John Lister's annual summary of developments in the electrical industry in the January issue of the *General Electric Review*, is always instructive and interesting. This year he has more to tell than ever before. On the subject of automatic generating and distributing stations, Mr. Lister says that the continued popularity of the automatic sub-station is shown in the increased orders for various types and sizes up to 2,000 KW., and 1,500 volts direct current. The largest set so far constructed is a 2,000-KW. synchronous motor-generator now being installed to supplement the power supply to the Michigan Central R.R. operating electric locomotives through the Detroit river tunnel. Automatic sub-station equipment was sold in Cuba, Australia, and New Zealand, and inquiries were received from other foreign countries. At the end of 1919 there were approximately 50 G.E. equipments in operation, and about 20 more being constructed or installed. The success of the automatic generating station at Cedar Rapids, Iowa, and the many railway sub-stations in service has encouraged development of others on automatic lines. An automatic hydro-electric generating station was developed for the Blue River Power Co., at Seward, Neb. This plant consists of a 240-K.V.A., 120-R.P.M., 60-cycle, 2,400-volt, water-wheel-driven generator, and three 80-K.V.A., 24,000/2,400-volt transformers, and is the first of several stations to be installed on this system. A second installation is for the Ontario Power Co., at Ontario, Cal., which consists of one 500-K.V.A., 60-cycle generator direct-connected to a Pelton water wheel. This station is not entirely automatic, but is controlled by pilot wires from a manually-operated station on the same stream. In case of necessity the station will shut down automatically. An automatic distributing station was developed for the Malden Electric Co., at Malden, Mass., and comprises a 3,000-K.V.A. transformer plant fed by a 22,000-volt line, with a second as a spare. It feeds three three-phase feeder circuits, and three single-phase feeder circuits which are controlled by automatic oil circuit-breakers with a "notching" relay. This relay will close a circuit breaker if it is tripped, and reclose it if it trips a second time within a brief period. If the short circuit has not cleared itself by this time, the circuit breaker trips a third time, and the circuit remains open until cleared and the switch closed by an operator.

The Kearney High-Speed Railway System.—*Modern Transport* is enabled to announce that the Ministry of Transport has called for a full-sized demonstration railway on the Kearney high-speed system. This decision is the outcome of a proposal made a year ago by Mr. Kearney for the linking of North and South Woolwich by means of a tube, on the Kearney system, under the river Thames. This scheme was examined in detail by the Corporations of Woolwich and East Ham, and endorsed by them, and we understand that it was also approved by the Ministry of Munitions, the War Office, the Royal Arsenal authorities, and the Great Eastern Railway Co. The test line is to be a surface railway incorporating all of the essential features of the Kearney Tube so far as gradients, curvature, and speed are concerned. A stretch of land has been retained near Brighton which fulfils all the necessary conditions. The line will commence on the western slope of Beacon Hill, and it will extend for a distance of just over half-a-mile towards Brighton. Starting on the level at Beacon Hill the line will descend by means of a gradient of 1 in 7 (as is proposed for the Woolwich Tube) until a depth of 120 ft. from the starting point is reached, corresponding with that portion of the Woolwich Tube which will be under the Thames. Then, after continuing on the level for about 500 ft., the line will ascend again by means of a gradient of 1 in 7 to a height approximately the same as at the starting point. For about 1,700 ft. from Beacon Hill the line will be run on a curve of 1 mile radius, so that it will be practically an open air duplicate of what is proposed for Woolwich. A speed of 60 miles an hour will be attained over the level section between the gradients, and the journey time from start to stop will be 1 minute. The car which is to be used in the test has already been built by the Brush Electrical Engineering Co., Ltd., of Loughborough, and will be ready shortly for delivery. It seats 44 persons, is equipped with two 35-H.P. electric motors, and has a streamline body. The four under wheels are each 3 ft., and the two guide wheels each 11 in. diameter. The weight (unloaded) is approximately 20 tons. Current at 500 volts will be generated by temporary plant at Greenway, and supplied to the car through an overhead wire suspended on the structure which supports the guide rail. The single ground rail, which takes the whole of the weight of the car, will be of the standard flat-bottom type weighing 75 lb. per yard.

Another American Turbine Failure.—Further particulars of the wreck of a large turbo-generator set in the Regina, U.S.A., power house, on January 8th, as briefly reported in our pages some weeks ago, are now to hand. The failure occurred at 7 in the morning, just after the day shift engineers had taken over the plant from the night crew. No warning of trouble was given, and that no casualties or serious damage to adjacent machinery occurred seems to have been a special dispensation of Providence. The damage is fully covered by the 12 months' guarantees of the makers.

The turbine in question, a 5,000-KW., 3,600-R.P.M., 2,300-volt, 60-cycle, 3-phase machine, was of the American General Electric Co.'s manufacture, and in this connection it is interesting to recall that three other machines by the same makers have failed in a similar manner within recent months. The accidents referred to were reported in our issues of April 12th, October 4th, and 25th, 1918.

Officials of the G.E. Co. are now inquiring into the cause of the wreck, which is said to have been due to weakness in one of the turbine wheels, a piece of which gave way and broke through the 2.5-in. casing, allowing the interior of the turbine to be scattered in all directions. When the casing gave way, the valve chamber was thrown aside, and the 9-in. diameter shaft and wheels, weighing some ten tons, was lifted from its bearings, travelled a distance of some 20 ft., and landed immediately behind the adjacent turbine set.

The wrecked turbine was only packed on its foundations in July last, being installed by the makers' representatives. It had five stages, the first with two running rows, and all the rest with one. The net weight of the turbo-generator, without condenser, was 125,000 lb., the price of the whole outfit erected being about $152,000. The makers' guarantees with 200 lb. gauge steam pressure, 2 in. absolute vacuum, and 100 deg. superheat, were: at half load 14.75; ¾ load 13.89; full load 13.68; and 1¼ load 13.89. The mean blade velocities and the mean wheel diameters were respectively as under:—

First wheel, 565 ft. per sec. and 3 ft. diam.
Second wheel, 785 ft. per sec. and 4 ft. 2 in. diam.
Third wheel, 793 ft. per sec. and 4 ft. 2.5 in. diam.
Fourth wheel, 801 ft. per sec. and 4 ft. 3 in. diam.
Fifth wheel, 816 ft. per sec. and 4 ft. 4 in. diam.

The accident places the undertaking in precisely the same by the G.E. Co. for the American Gas Co., which, however, after placing the order found that the machine would not be required, and, therefore, assigned its contract to the City of Regina. The machine was built, and others like it, but the makers found that in a similar machine weakness was suspected, the wheel of the present turbine was, therefore, dismantled and rebuilt to make assurance doubly sure (*sic.*).

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The accident places the undertaking in precisely the same position as it was a year ago, the capacity of the station being only about 500 KW. in excess of the demand, which reaches 4,000 KW. between 6 p.m. and midnight in the winter months. It is hoped, however, to have certain other plant, which has been in need of repairs for some time, in commission shortly; replacements for this plant, which were on order in England, are reported to have arrived in the States.

An Electrically-propelled Yacht.—The question of a suitable type of propelling plant for a large auxiliary sailing yacht needs careful consideration. Lightness, ease of control, and a minimum space occupied are necessary, combined with the least interference with the sailing qualities of the vessel. Many methods have been employed and various types of engines have been adopted, but probably the most original system, says the *Motor Ship and Motor Boat*, is that utilised in the auxiliary yacht *Elfay*. She is the only large yacht in which Diesel electric propulsion has been adopted, and the arrangement offers considerable advantages for the vessel concerned. The *Elfay* is 152 ft. overall, with a beam of 30 ft., and a draught of 21 ft. 2 in., the length on the water-line being 115 ft., and the gross tonnage 313 tons. In 1914, 1915, and 1916, before the auxiliary power was installed, she competed in a number of long-distance races, and was one of the most elaborately equipped yachts ever built in the United States. Last autumn it was decided to fit her out and install power to give a speed of 8 or 9 miles per hour under power alone. The Winton Engine Works, in conjunction with the Westinghouse Co., carried out the installation. These two firms are now combining for providing Diesel electric equipments for large ocean-going ships, as we recently announced. The electric generating machinery consists of a 125-H.P. Diesel engine of the ordinary four-cycle Winton type, being a six-cylinder machine running at 425 R.P.M., and as it drives a dynamo it is fitted with a sensitive governor for voltage regulation. This is essential, since the load varies considerably when, for instance, it is necessary to go astern. The generator is a 75 KW. set, and there is also a 9-KW. exciter machine, which is driven by means of a noiseless chain at 900 R.P.M., and is used for the excitation of both the propelling motor and the generator. This propelling motor is placed right aft, so that there is a very short propeller shaft. It is of 90 H.P. when running at 360 R.P.M., and drives a 42-in. diameter propeller with a pitch of 42-in., this giving the vessel a speed of about 8½ knots. The speed ahead or astern is varied by altering the strength of the field in the generator. In the stop position there is no field in the generator, but a full field in the motor, whilst in the full astern position there is a maximum field in both generator and motor. The advantage of this arrangement is that the main current is not controlled, but only a small portion of the exciter current, thus rendering the handling of the vessel very simple without complicated gear. The method of controlling the speed of the vessel is as follows: The engine is started up and the cam controller switch for building up the motor field from the exciter is then put in. Next, the main contact breaker between the cam controller and the motor is switched in, these operations being carried out by the engineer in the engine-room. The whole of the rest of the control is effected from the deck by means of a deck controller on a brass stand, about 3 ft. 6 in. high. The handle has a swing of about 20 in. By moving it one-half of the circle, full speed ahead is reached, and in the opposite direction, full speed astern. In intermediate positions, intermediate variations in speed are obtained. A switchboard is fixed in the deck house, on which instruments give the voltage of the generator, motor, and exciter, as well as the current and the speed of the motor and generator, this switchboard being duplicated in the engine room. Needless to say, the electrical drive gives excellent opportunities for the convenient operation of the auxiliaries. The winch forward for handling the anchor, and, in case of necessity, for hoisting the sails, is driven by a 10 H.P. electric motor. Amidships are two additional electric winches of 4 H.P. each, for hoisting and lowering the sails. The vessel is heated throughout by electricity, and all the cabins are electrically lighted and provided with fans. The auxiliaries include a one-ton ice machine, operated by a 7½-H.P. electric motor, a water pump, a bilge pump, and an oil pump, as well as a ¾ H.P. air compressor supplying fuel to the oil range in the galley. The auxiliary air compressor is driven by a 12½ H.P. electric motor. Electric current for these auxiliaries is provided by a 25 H.P. Quaille oil engine driving a 15 KW. generator, but this is purely an auxiliary and is used to charge a set of storage batteries when the vessel is lying in dock for any length of time. These storage batteries have a rated capacity of 60 amperes for five hours, this being sufficient for all the requirements of the boat, except the actual propulsion, for two complete days without recharging. The bunker capacity is 2,400 gallons of fuel oil, giving a cruising radius of 2,000 miles, with a consumption of 7½ gallons per hour. In addition, 360 gallons of lubricating oil are carried. The *Elfay* recently started on her maiden voyage to Cuba and Bermuda.

Electrostatic Effects on Airships.—Mixtures of hydrogen and air in proportions between certain limits may be exploded by a minute electric spark. Such conditions may obtain on or near an airship, and in this connection Prof. G. S. Fulcher's recent contribution to *Aviation* on electrostatic effects on airships is of interest. As a result of the electric field near the surface of the earth, 50 to 200 volts per metre, the difference of potential between points at different heights above the surface may be very great. The charges induced on a conducting balloon depend upon the electric field in the region before the arrival of the balloon and upon charges induced on nearby conductors because of the disturbing effect of the balloon; therefore, the sudden transference of a balloon from a region of high potential to one of low, will not change the charges on the balloon, provided the strength of the field is unchanged and the balloon is not brought near a conductor. The maximum field around an originally uncharged spherical balloon is three times the strength of the field into which it is brought, if no conductors are near, and that between such a balloon and the flat surface of the ground just before contact is made is five times the original field; protuberances projecting from the balloon will have a greater field immediately around them than that stated above, increasing with sharpness and the distance they project; but except during an electric storm, and when a balloon approaches a highly charged cloud, the field around any balloon due to charges induced on it will be too weak to cause sparks.

If the speed of an airship is sufficiently great, rubberised cotton fabrics become negatively charged, while rubberised silk fabrics become positively charged. The intensity increases with the speed, approximately as the sixteenth power. The effect depends on the solid and liquid particles held in suspension in the air; dust and water particles seem about equally effective; with ordinary air the effect is small for speeds below 60 M.P.H., but in the case of smoke or mist large effects may be obtained at 40 M.P.H. The effect is associated with impact rather than with skin friction. If the fabric and ropes are conducting, the only danger is that due to the rubber rings around the valve seat, which may become charged by outflowing gas and cause a spark to pass through the gas to the valve. A precaution would be to connect the valve and the seat by a wire. The difference of potential between it and the earth as it descends may be sufficient to cause a spark. To avoid danger the landing rope should be a fairly good conductor. If the balloon chances to be in the path of a lightning flash between earth and cloud, it will probably be destroyed; but since the electric capacity of the balloon is small, a spark between it and a cloud can be prevented by relieving the electric tension by means of discharging points located as far as possible from explosive mixtures of gases. A sharp point or crown of points made of non-corroding metal, projecting above the dorsal fin of the airship and connected by wire to the steel framework of the fins, would eliminate most if not all of the danger. The following recommendations are made: It is desirable that the outer surface of the balloon envelope should be conducting so that dangerous differences of potential between the various parts may be made impossible and so that the balloon may be rapidly discharged before landing. That the inner surface of the envelope should also be conducting to prevent dangerous differences of potential from being produced by the friction of one surface upon another during inflation. That, for similar reasons, the ropes suspending the car and especially the landing rope should also be conducting, and that the latter should be so well connected to the envelope and other parts of the airship as to ensure the rapid discharge of the airship before landing.

INSTITUTION NOTES.

Institution of Electrical Engineers.—NORTH MIDLAND CENTRE.—At a joint meeting with the Yorkshire Branch of the Association of Mining Electrical Engineers on March 20th, a lecture on "Electric Winders" was given by Mr. J. Kirkwood, showing comparisons between the principal systems. The lecture was illustrated by lantern slides. Mr. W. M. Selvey welcomed the members of the A.M.E.E., and Mr. Roslyn Holliday, President of the Yorkshire Branch, responded.

SCOTTISH CENTRE.—At a meeting in Edinburgh, the committee's nominations for office bearers were submitted as follows:—Chairman, Mr. J. E. Sayers; vice-chairmen, Messrs. E T. Goslin and Alex. Lindsay; hon. secretary, Mr. Joseph Taylor; assistant secretary, Mr. W. F. Mitchell (Edinburgh); chairman of Students' Section, Mr. F. A. Whysall (Greenock); members of committee, Messrs. H. Richardson (Dundee) and J. S. Nicholson (Glasgow).

Association of Mining Electrical Engineers.—At a luncheon given to prominent members of the mining industry by the North of England Branch at Newcastle, on March 20th, the speakers included Col. W. C. Blackett, Col. F. L. Simpson, Professors Henry Louis and W. M. Thornton, and Messrs. Mountain, Wilson, Ford and Severs. It was announced that the membership of the Association was now 1,275.

Edinburgh Electrical Society.—Through the kindness of Mr. John Macfee, district manager, Post Office Telephone Service, about 50 members of the Society were enabled to visit the Central Edinburgh Exchange on the evening of March 24th. The party was shown over the premises by Mr. Davies and other gentlemen connected with the engineering department. The next meeting takes place on April 7th, when short papers on everyday work will be read in competition for the Society's prize. The competition is open to all apprentices connected with the Society.

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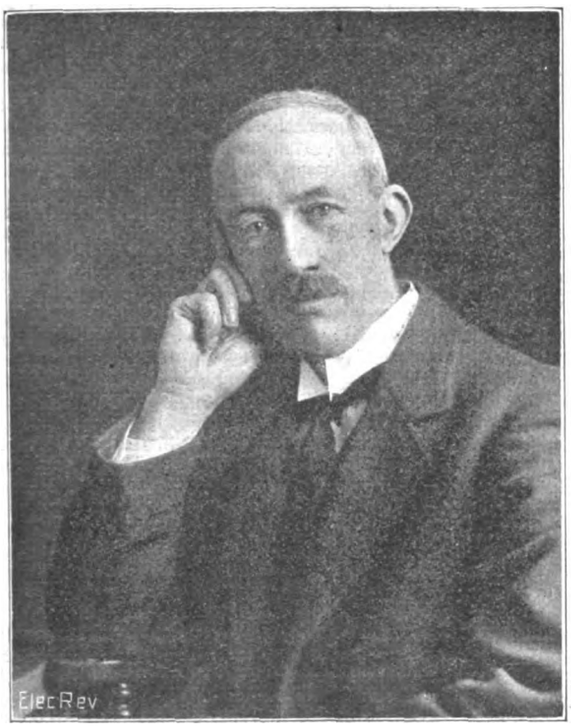
OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Mr. P. J. Pringle, general manager and chief engineer of the Electric Supply Co. of Victoria, Ltd., Australia, and his family, expect to arrive at London per the *Mantua* about the middle of April. His business address will be—The Electric Supply Co. of Victoria, Ltd., 255, Royal Liver Building, Liverpool.

Blackburn Corporation Tramways Committee has adjourned for a month the proposal to increase the salary of Mr. J. H. Cowell, the general manager, from £600 to £800 per year.

Last Friday, before leaving Carlisle electricity department to take up his appointment at Walsall, Mr. P. Wardle was presented with a dining room clock and a fountain pen. Mr. Chas. W. Salt, the city electrical engineer made the presentation.



[*Photo by*] R. B. Mitchell. [*Lafayette.*

Mr. Mitchell's appointment as general manager and engineer of the Glasgow Corporation's electricity department, foreshadowed in our issue of March 19th, was confirmed on Thursday last week, and we have pleasure in presenting his portrait herewith.

Mr. Councillor Grime has been elected to the Oldham Electricity Committee in place of Councillor Makin, deceased.

As from March 31st, Mr. Arnold B. Gridley has retired from Government service, after holding the position of Director of Electric Power Supply, and Electrical Adviser to the Ministry of Munitions during and subsequent to the war. After a lengthy holiday, he hopes to resume private business.

Will.—The late Mr. C. E. Groves, F.R.S., left £33,022 gross and £32,857 net personalty. On the death of certain legatees, £10,000 is to go to the Royal Institution for the Groves Endowment Fund for the promotion of scientific research.

NEW COMPANIES REGISTERED.

Gwynnes Engineering Co., Ltd. (165,547).—Registered March 22nd. Capital, £600,000 in £1 shares. There is also to be £300,000 7½ per cent. debenture stock, redeemable at 105 per cent. in December, 1939. £200,000 shares are to be offered to the public at par and all the debenture stock is to be offered at 95 per cent. Objects: To acquire (*a*) the business, stock and work in progress of Gwynnes, Ltd., (*b*) certain freehold, leasehold and copyhold property at Crisp Road, Hammersmith, and Church Wharf, Chiswick; (*c*) all the issued share capital of Adam Grimaldi & Co., of Albert Works, Vauxhall, S.W., who have been associated with Gwynnes, Ltd., in the development of the Albert car. The purchase price payable to Gwynnes, Ltd., is limited to £575,000 (£225,000 in cash and £350,000 in shares), nothing being payable for goodwill. General powers are taken to carry on business as manufacturers of pumps, pumping machinery, internal combustion, salvage, agricultural, electrical, marine, aero and general engineers, boiler makers, &c. The first directors are: Sir Byron Peters, K.B.E., M.I.Mech.E., Windlesham Moor, Windlesham; Jas. M. Dewar, M.I.N.A., M.I.Mech.E., Allington, Northwood, Middlesex; Nevile C. Gwynne, M.I.N.A., M.I.Mech.E., Vevendean, Oxshott, Surrey (managing director); J. G. Mair-Rumley, M.Inst.C.E., M.I.Mech.E., Hammonds, Udimore, Sussex; W. W. Wilkes, 16, Thurlestone Road, West Norwood, S.E.27, secretary. The trustees for the debenture stock holders may, so long as £175,000 of the debenture stock is outstanding, nominate one director. Qualification (except debenture stock director), £1,000. Remuneration, £500 each per annum (chairman £750). Solicitor: W. Harrison, 25, Bloomsbury Square, W.C. Registered office: Hammersmith Iron Works, Crisp Road, Hammersmith.

Associated Industries Insurance Corporation, Ltd. (165,439).—Registered March 19th. Capital, £1,000,000 in £1 shares (900,000 7 per cent. participating preference). To carry on marine, land transit, fire, life, accident, burglary, boiler, engine, electrical plant, motor, aerial and general insurance business, &c. £20,000 Exchequer Bonds have been deposited with the Court in respect of bond investment business and £20,400 in respect of life assurance. The subscribers (who are also provisional directors) are: A. Long, 51, Harvist Road, N.W.6, secretary; T. Walford, Lilleshall Villa, Mawneys Road, Romford, accountant; A. Brigstock, 1, Tancred Road, Finsbury Park, N.4, book-keeper; C. M. Jenner, 29, Larnier Road, S.E.13, clerk; W. Gull, 8, Wragby Road, E.11, secretary; T. W. Simpson, 3, Carlyle Road, E.12, clerk; R. P. Care, 46, Birkhall Road, Catford, S.E., clerk. Four-fifths of the directors to be subsequently appointed are to be shareholders holding policies effected with or through the company (to be known as "policy holder" directors) and one-fifth are to be shareholders not holding such policies (to be known as "shareholders'" directors). Qualification, £500. Remuneration, £300 each per annum (president £200 extra), all free of income tax, and any further sums voted by the company. Solicitors: Kerly, Sons and Karuth, 10-11, Austin Friars, E.C.

R. P. Boyd & Co., Ltd. (165,423).—Private company. Registered March 18th. Capital, £10,000 in £1 shares. To carry on the business of manufacturing, electrical and mechanical engineers, manufacturers and workers of metals, minerals, wood, porcelain, glass, asbestos, india-rubber and natural and synthetic products, &c. The first directors are: J. M. Newton, 19, Burton Street, Loughborough, manager with Brush Electric Co., Ltd.; R. P. Boyd, 115, Barclay Road, Warley Wood, Smethwick, Birmingham; G. H. Sherrow, Churchfield, Harborne, Birmingham. Solicitor: D. Blackadder, 32, Castle Street, Dundee. Registered office: Hooper Street, Birmingham.

Vickers-Helvetia.—Private company. Registered March 20th. Capital, £1,000 (£1). To carry on the business of manufacturers of and dealers in steel, iron, brass and metals, founders, metal workers, shipbuilders and shipwrights, manufacturers of guns, torpedoes and ordnance of all kinds, electricians, electrical engineers, &c. The first directors are: Sir Francis H. Barker, Lowndes House, Lowndes Place, Belgrave Square, S.W.; S. V. Dardier, The Grange, 48, Grange Road, Ealing, W.5; N. Robinson, Westmoor Green House, near Slough. Solicitor: F. H. E. Branson, 2, Bond Court, Walbrook, E.C. Registered office: Vickers House, Broadway, Westminster. (165,529.)

Paterson Manufacturing Co., Ltd. (165,557).—Private company. Registered March 22nd. Capital, £10,000 in £1 shares (4,000 preference). To carry on the business of electrical and mechanical engineers and contractors, electricians, &c. The first directors are: T. Erndt, 96, Warren Road, Leyton, E.; H. E. E. Ault, 75, Malvern Road, Thornton Heath, Surrey; L. G. Clarke, Ridge Vicarage, Barnet, Herts. Secretary: H. E. E. Ault. Solicitor: T. L. Grimes, 3, Finsbury Circus, E.C.

Dick, Kerr & Co., Ltd. (165,546).—Private company. Registered March 22nd. Capital, £100 in £1 shares. To carry on the business of electrical and general engineers and contractors, &c. The subscribers (each with one share) are: E. J. Alldis, 18, Macdonald Road, E.7, clerk; G. Dickson, 4, London Road, S. Benfleet, clerk. Table "A" mainly applies. Registered office: Queen's House, Kingsway, W.C.

Precision Instrument Co., Ltd. (165,516).—Private company. Registered March 20th. Capital, £5,000 in £1 shares. To carry on the business indicated by the title. The first directors are: E. W. Smith, Eastwood, Worcester Park; E. A. Petithory, 36, Dartmouth Road, Forest Hill, S.E.; F. C. Harding, Bracekenwood, Leatherhead. Secretary: R. E. Petithory. Registered office: 25 and 27, London Road, Forest Hill, S.E.

A. Murray & Co., Ltd. (165,486).—Private company. Registered March 20th. Capital, £4,000 in £1 shares. To take over the business of electrical, mechanical and motor engineers carried on by A. Murray, H. Morris and D. Murray at Liverpool. The first directors are: A. Murray (chairman), 4, Viola Street, Bootle; H. Morris, 6, Victoria Road, Litherland, Liverpool; D. Murray, 5, King Street, Newcastle-on-Tyne; R. J. Hamilton, Laurel Bank, Buxton Road, Stockport; R. W. Anderson, 54, Derby Road, Liverpool; J. Connell, 22, Queen's Road, Bootle. Solicitor: G. Oates, 20, Cross Street, Manchester. Registered office: 15, Brazennose Road, Liverpool.

Will Smith, Ltd. (165,533).—Private company. Registered March 20th. Capital, £2,000 in £1 shares. To take over the undertaking of W. Smith, electrical manufacturer's agent, general electrician and contractor, of 24, Hampstead Road, Liverpool. The first directors are: W. C. Smith, 24, Hampstead Road, Liverpool; T. Richards, 73, Hampstead Road, Liverpool. Registered office: 21 and 23, North John Street, Liverpool.

Woodward Sons & Co., Ltd. (11,051).—Private company. Registered March 18th. Capital, £5,000 in £1 shares. To take over the business carried on by F. J. Woodward, electrical engineer and contractor. The subscribers (each with one share) are: F. J. Woodward, Overton House, Riddrie, Glasgow, electrical engineer; J. O. Woodward, Overton House, Riddrie, Glasgow, electrical engineer; F. Woodward, Overton House, Riddrie, Glasgow, electrical engineer. The first directors are: F. J. Woodward, J. O. Woodward and F. Woodward. Secretary: J. O. Woodward. Registered office: 147, Renfield Street, Glasgow.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Musselburgh and District Electric Light and Traction Co., Ltd.—Bond and disposition in security, dated March 10th, 1920, to secure £400, 15, Ravenshaugh Road, or/and 1, Mayville Bank, Musselburgh. Holder: D. A. Tod, Braehead, Dunkeld.

Switchgear & Cowans, Ltd.—Issue on March 11th, 1920, of £11,500 debentures, part of a series already registered.

Connollys (Blackley), Ltd.—First debenture dated March 9th, 1920, to secure £10,000 charged on the company's undertaking and property, present and future, including uncalled capital. Holders: London County Westminster and Parr's Bank, Ltd., 41, Lothbury, E.C.

Quain Electric Co., Ltd.—C. W. Rooke, of 2 and 3, Norfolk Street, Strand, W.C., as receiver and manager by Order of Court dated March 12th, 1920.

CITY NOTES.

City of London Electric Lighting Co., Ltd.

Mr. J. B. Braithwaite, presiding at the annual meeting on March 24th, said that the year 1919 was the most difficult year the company had been through. He referred to strike troubles, the time absorbed by the Electricity Bill, and to coal supply difficulties. Under the circumstances they could congratulate shareholders upon a relatively good statement. The gross revenue increased by

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£134,707, but that increase had been very largely absorbed by increased costs. The result was that they carried £179,991 to net revenue account, an increase of £41,835. That they had any balance at all was almost entirely due to the great activity which had prevailed in the City and the great increase in their business in the latter months of 1919. They had sold 4,599,693 additional units. Had it not been for that increase in the units sold, which had produced something like £73,000, the company would have come out without any increase in profit at all. As it was, the great increase in business during the last few months of the year had enabled the company, in addition, to make a reduction to their customers on the extra charges that had been put on for war expenses. With the uncertainty of the outlook at present, they could not make a further reduction in the price at the moment. They were raising the dividend from 8 per cent. to 10 per cent.—the pre-war figure—and in addition were restoring two years of the war-rate to the 10 per cent. basis, which would take the form of a bonus of 3 per cent., and would still leave two years to be made good on a future occasion if profits admitted of that. With regard to the depreciation fund, he would like to point out, in view of the capital proposals which were to be laid before the shareholders, exactly what had been done out of revenue during the last 19 years. The total amount provided from revenue and other sources from 1901 to 1918 was no less than £1,161,314. In other words, they had carried on the affairs of the company for 19 years without making any further capital issue. Referring to the Electricity (Supply) Act, the speaker said that in the Act as it stood the Electricity Commissioners would have power to approve schemes brought forward by authorised undertakers for giving a supply of electricity on a comprehensive scale. Their own company, owing to its central position and the abundant supply of condensing water it possessed, was in a position to aid very materially in the provision of a comprehensive supply for the London area, and the directors had already placed orders for large generating units, which would enable them to provide for the growth of the company's own business, and to give bulk supply to the neighbouring undertakers pending the completion of the super-power house down the river, which it was anticipated would form a feature of any comprehensive scheme put forward. The board had already entered into an agreement with the County of London Electric Supply Co. for the supply of a considerable amount of current in bulk, and it was hoped to have that supply available by the end of the year. It was obvious that capital expended on works of this character undertaken in the interests of the general supply of electricity to the London area must receive special protection, and in his opinion the only chance of cheapening the supply of electricity in the London area was by utilising and co-ordinating the resources of the existing companies. Their engineer estimated that it would be possible to put down additional plant at Bankside to increase the capacity up to 100,000 KW.; that figure included the present plant and the three large units now on order, and would still leave a margin for a substantial contribution to tide over the interregnum until the new power house down the river was ready to deliver current. Accordingly, if proper security was given for the capital outlay, their company would be able to save the whole of London from running short of an electricity supply during the next three or four years. As to the outlook for the present year, their own business continued to show extraordinary expansion, and the demand showed no signs of slackening at present. With the additional revenue derived from the bulk supply he looked forward with confidence to the results of the present year's working, in spite of the difficult conditions still obtaining. To carry out the extensive programme outlined above would involve the expenditure of a considerable amount of capital, and resolutions for increasing the capital by £800,000 would be proposed at the extraordinary meeting to be held on April 14th.

British Insulated and Helsby Cables, Ltd.

Presiding at the annual meeting at Liverpool on March 22nd, Sir J. S. Harmood Banner said that the profit for the year showed an increase of £40,408. With the exception of 1917 the profit was the highest they had ever earned. During the year war work ended and a complete change over to their ordinary business in wires and cables took place. So great had been the demand for these that they had been subjected throughout the year to a constant pressure to deliver more than they could manufacture, and that pressure still continued. This remark also applied to the accessory products, which now formed a very important part of the business. The bonus of 2½ per cent. (in addition to the 12½ per cent. dividend) must not be taken as a precedent. After alluding to the business of the Midland Electric Corporation for Power Distribution, in which they were largely interested, also the Electric Supply Co. of Victoria, and the Automatic Telephone Co., the speaker referred to a statement which had appeared in the Press to the effect that the Government were going to spend a large sum of money on the telephones of the country, and that they were to have a splendid system in existence. He said it was just as well for those who used the telephone to remember that it was going to be the old-fashioned system, and not the automatic system adopted in America almost entirely, and elsewhere, and, in his opinion, the Government would very shortly have to pull out what they were spending and come back to them for automatics. The changes which had been made during the war and the immediate duty to ensure the largest possible output of commodities made it necessary to rearrange the works and to add important buildings and machinery, and the very satisfactory result of the year's working was largely due to the devotion of the staff under new and trying conditions.

At an extraordinary meeting which followed it was resolved to increase the capital from £1,500,000 to £2,000,000 by the creation of 500,000 new shares of £1 each as the directors might determine. The chairman said that in the future they might have to find enormous funds for stores, there might be big rises in price of material, wages were up, and they did not want to be caught so that when they found a favourable opportunity for the issue of capital they would not have the means at their disposal. There was not the slightest intention of an immediate issue, but they wanted to be ready when the time came.

Midland Electric Corporation for Power Distribution, Ltd.

Sir J. S. Harmood Banner, M.P., presiding at the annual meeting, said that the net revenue amounted to £89,438, an increase of £28,171. The capital expenditure for the year, amounting to £32,814, was chiefly for mains, transformers, &c., for new connections. The increase of £64,015 in gross receipts was very satisfactory, but it was quite impossible to say what the cost of generation and distribution would be in the future owing to the continual awards in respect of coal prices and wages. If the new demand by the Miners' Federation for higher wages, which was estimated to work out at 3s. per ton, should be acceded to, the extra charges to the company would be about £15,000 per annum. An increase in wages of 5s. per week per employé, plus Mr. Churchill's 12½ per cent., was made in December last, while a further increase of 6s. per week, plus the 12½ per cent., had been agreed upon in the engineering trade. In addition, the undertaking had been recently reassessed at a much higher figure for local rating purposes. These heavy charges made one almost despair of the future. With those extra charges it was impossible for the board not to make further advances in charges for energy. The increased profits for the year were largely due to the expansion of the business and to economies effected.

At a subsequent extraordinary general meeting it was resolved that in order to provide for additional expenditure the ordinary share capital be increased by £200,000, and that the £5 ordinary and preference shares be divided into £1 shares.

London Electric Wire Co. & Smiths, Ltd.

Sir G. H. Fisher Smith, M.P., presided at the annual meeting on March 23rd. He said that during 1919 they had had the greatest output since the business was inaugurated. The demand for their products continued to increase greatly. After being occupied in producing certain goods required by the Government, they had now resumed their usual business to a large extent. At present they had orders on hand which would last them many months to come. The demand was likely to continue for some considerable time, and they were endeavouring to make arrangements to cope with it. Consequently last year they issued £350,000 preference shares, and the issue was subscribed many times over. They had spent £93,749 for extensions in the form of new buildings and new machinery, necessitated to a great extent by the increased demand for the company's products, and also by the cessation of all night work. During the year they had had considerable difficulties to contend against. Shorter working hours naturally meant less production, but nevertheless the results were very satisfactory. At the present moment the country was passing through a most difficult time, but he had every belief in the sanity of the English nation, and although there were a good many clouds hanging over the commercial world, he thought these clouds would in time disappear. There never was in the history of this country a greater demand for English goods than there was at the present time, and the production was not anywhere equal to the demand, but in course of time further machinery would be put down in order to increase production.

Constantinople Telephone Co.

At a meeting of the holders of the obligations, held in London, on March 24th, the resolution approving the scheme for discharging the arrears of interest since July, 1914, by the issue of certificates bearing interest at 6 per cent. per annum, was passed. Sir Alexander Roger, who presided, said that the company's operations were suspended by the Turkish Government taking over its plant on March 15th, 1915, and the company did not regain possession until April 1st last. They had made a claim against the Turkish Government, but it was impossible to say what the result would be or what period would elapse before any settlement was come to. Under the circumstances the directors came to the conclusion that some arrangement should be come to as early as possible for the purpose of discharging these arrears of interest. It was also proposed to deal with the pre-war indebtedness to contractors and others in the same manner, that is, adding 6 per cent. per annum to the ascertained amount of their accounts and issuing certificates for the

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aggregate amount of principal and interest. The political situation in Turkey was unsettled, but they hoped that when peace was signed matters would settle down and the trade of that country improve under the new conditions which must prevail. When they obtained repossession of the property a modification of the concession under which they worked the telephone system was granted for the time being by the Turkish Government in view of the altered circumstances and the increased cost of working. As a result the earning power of the company was improved, and they had every reason to believe that, unless anything unforeseen happened, they would be in a position to pay the interest on the obligations and the certificates which it was now proposed to issue.

Newcastle-on-Tyne Electric Supply Co., Ltd.

The annual meeting was held in Newcastle on March 25th, Mr. J. H. Armstrong presiding. The Chairman said that a year ago, being in doubt as to what the future might bring, they recommended that £41,427 should be carried forward; they wished to maintain the ordinary dividend for 1919 at the same rate as the two preceding years, and accordingly they again recommended the payment of 8 per cent. on the ordinary shares and to transfer £30,000 to the reserve. On this occasion they proposed to make no addition to the reserve for special depreciation and contingencies. They had good reason for knowing that the value of their assets duly represented the amount at which they stood in the books without bringing into account the unappropriated balance standing to the credit of the reserve fund. During the whole of the nine months after their meeting the whole of the trade of the district was adversely affected first by the railway strike and later by the moulders' strike. The latter dispute started in September, 1919, and did not terminate till the end of January of the present year. When it was borne in mind how seriously their business was affected by those stoppages, and by the disorganisation due to the change from war to peace work, it was not difficult to account for the falling off in their profits. Speaking as to the prospects of the company, the Chairman said they had now in commission some of their newer and more economical plant, and they looked forward before long to having further sections of this plant available for service. They were thus in a favourable position to deal with any load they were likely to be called upon to meet. The charts of their output showed a steady improvement as compared with last year. The effect of the moulders' strike was still felt by manufacturers, but when that had entirely disappeared the rate of improvement should materially increase. The applications on hand represented 82,900 H.P., which showed a substantial increase over the position twelve months ago. Provided that nothing occurred to interfere with the efforts that were being made by all large customers to increase production, he was satisfied they would be able to meet next year under happier circumstances. In view of the possible strike of miners, it was necessary for him to say that its effect, if of long duration, would be as serious as it would be disappointing in upsetting the prospects of a return to normal conditions.

Mr. R. P. Sloan, the manager, referred to the Electricity (Supply) Act. He said that through the deletion of the compulsory purchases clauses, the worst features of the Bill had disappeared. Although the Newcastle Company was the pioneer public electricity supply undertaking in the kingdom to introduce the three-phase A.C. supply, adopting a periodicity of 40 cycles per second as its standard, many independent undertakings on the North-East Coast, which came into existence later, adopted different systems and periodicities. The extension of the Newcastle system and the linking up to it of one undertaking after another had necessitated the expenditure of many thousands of pounds in changing over from the existing system to the system of the Newcastle Co. As an illustration of this he referred to the Cleveland Co.'s undertakings, where no fewer than three distinct systems of supply were in existence—none of which were the same as that of the Newcastle Co. Had the Board of Electricity Commissioners been in existence in the past, the multiplicity of generating stations and the extraordinary difference in the systems of generation which now existed throughout the country would not have been permitted, as one of the main duties of the Commissioners would have been to insist on concentration of generation and the adoption of standard systems of supply. Speaking of matters more directly affecting the company, he alluded to the substantial increase in the wages bill, which for the last year totalled £206,124, or an increase upon the basic rates of 92 per cent. The general feeling of uncertainty which had prevailed throughout the country was reflected in the comparatively small connections made to their company during the past year—7,686 H.P. The revenue they had received from these increased connections had only to a small extent counteracted the effect of the considerable reduction in their load due to the cessation of munitions manufacture. Turning to the brighter side of the picture, he was pleased to say that the tests that they had carried out on the sections of new generating plant so far completed had proved that the economies forecasted by the chairman at the meeting in November would be eventually fully realised as the plant was brought into commercial operation. The delay in the completion of the plant was a result of the strike, and the dates for the completion of the work at Carville power station, the extensions at Dunston, and the new Tees station had had to be extended from two to three months in each case, and the effect of the delay was that they would not obtain the full benefits that they had hoped for from the new plant as a result of the saving in coal consumption. The delay in finishing the Tees station was particularly regrettable, as the Cleveland area had for some considerable time been handicapped through a shortage of generating plant, and it had been necessary in order to meet the demands made upon that company to depend largely upon supplies obtained from generating plant that was far from economical. He concluded with a brief reference to the proposed electrification of the North-Eastern Railway main line between Newcastle and York. The development, if it took place, would be one of the most important in the railway world for many years. Negotiations were proceeding at the present time between the railway company and that company.

London United Tramways, Ltd.—The report states that the operation of the undertaking during 1919 resulted in gross receipts of £496,542, an increase of £134,115 over 1918. Owing to continued advances in cost of labour and material, the working expenses increased by £122,855 to £496,687. There is an adverse balance on working of £145. After charging debenture and loan interest for the year and bringing into the account the debenture interest for 1918 paid in May, 1919, the total deficiency to be carried forward to 1920 is £71,577. The expectations in regard to the increase of revenue to be derived from the raising of fares have been fully realised, but owing to the introduction of the eight-hours day, various labour awards, and the general rise in the cost of material, the additional revenue has been more than swallowed up by increased expenses. In the balance sheet effect has been given to the scheme of reduction and rearrangement of the capital. The company's Bill to authorise an increase in fares, &c., has passed second reading in the House of Commons.

Clyde Valley Electrical Power Co.—The balance of profit for 1919, including the amount transferred to contingency fund as stated below, is £135,751, plus £23,335 brought forward. The preference dividend absorbs £18,000; there is written off cost of accounts and duty on increased capital £2,784; transferred to contingency fund for depreciation £50,000; dividend on the ordinary shares, 5 per cent. for the year, £30,000; carried forward £58,302. The 15,000-KW. turbo-alternator at Yoker power station is now in operation. The extensions at Clyde's Mill power station for the installation of a 15,000-KW. turbo-alternator are proceeding; the plant will be in operation for next winter's load. The directors express regret at the loss of the services of Mr. Arch. Page, the general manager, on his appointment as an Electricity Commissioner. Mr. E. T. Goslin has been appointed in his stead.

Rangoon Electric Tramway & Supply Co., Ltd.—At the meeting held in London on March 25th, Sir F. W. R. Fryer, who presided, referred to the favourable position of the company, and said that this was the last occasion on which he would preside at the annual meeting as control was to be removed to Rangoon. The directors were convinced that the course adopted was based on sound reasons, and that the alteration was calculated to promote the future advancement and prosperity of the undertaking. On and after April 1st next the company would be represented in London by Messrs. R. Lawrence Spicer & Co., as London agents.

Dividend on the ordinary shares 7 per cent. for 1919, free of tax. Carried forward, £1,360. Total receipts increased by 12.58 per cent. Private lighting and power gross receipts increased by 11.87 per cent.

Browett, Lindley & Co., Ltd.—Net profit for 1919, £20,891, plus £10,593 brought forward. A further dividend on the preference shares of 9 per cent. on account of arrears and a dividend of 8 per cent. and a bonus of 4 per cent. on the ordinary are to be paid, leaving £19,484 to be carried forward. The *Financial Times* says that the question of further capital for enlarging the works on the lines of bulk production of standard engines is to be considered at once.

Mirrlees Watson Co., Ltd.—Dividend of 10 per cent. and a bonus of 7½ per cent., both less tax. £20,000 to reserve and £11,209 carried forward. The capital is to be increased to £250,000 by the creation of 125,000 additional £1 shares, 50,000 of which are to be issued to shareholders in the proportion of two for every five now held. 25,000 shares are to be made available on special conditions for employés and others directly interested in the business.

Stock Exchange Notices.—The Committee has specially allowed dealings in the following under Temporary Regulation 4 (3):—

Mann, Egerton & Co., Ltd.—Option certificates to bearer in respect of 19,023 ordinary shares.

Metropolitan-Vickers Electrical Co., Ltd.—20,172 ordinary shares of £1 each, fully paid. Nos. 6,185,001 to 6,205,172.

Liverpool District Lighting Co., Ltd.—Mr. C. McLaren presiding at the annual meeting on March 23rd, said that the sale of energy increased very considerably during 1919, and it was still increasing. Many more consumers might have been connected had they been able to get the necessary cable and meters. A new main cable was to be laid to Seaforth to deal with the growing demand there. They would not

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install any new generating plant at the Waterloo power station this summer, but it might be necessary to do so next year. Profit had increased from £2,469 in 1918 to £5,841 in 1919, due to increased consumption and increased price.

Newmarket Electric Light Co., Ltd.—During 1919 the new lamp connections were 1,882 (33 watts), making the total 35,692. Profit £2,351, as against £2,156. Debenture interest £710. Balance brought forward £412. Owing to the rising cost of machinery and plant a larger amount is put to plant renewals (£1,750); £303 is carried forward.

Electro-Bleach & By-Products, Ltd.—Further dividends are announced, making a total of 7 per cent. for the year (less tax) on the preference shares, and of 14 per cent. on the ordinary.

Sunderland District Electric Tramways, Ltd.—Year ended October, 1919. Dividend 5 per cent., less tax, upon preference shares. Carried forward £1,208.

South Metropolitan Electric Tramways & Lighting Co., Ltd.—Profit for 1919, £22,264; £7,500 for renewals; £5,000 to reserve; 6 per cent. preference dividend; £1,507 carried forward.

British Ever-Ready Co., Ltd.—Dividend 15 per cent. on the ordinary shares.

STOCKS AND SHARES.

Saturday Evening.

"Owing to the Easter holidays, please note that your article will be required two days earlier than usual." And so it befalls that yields p.c. may get entangled with the results of the 'Varsity sports, while, if the word Boat Race should happen to appear in obvious error for the Stock Exchange, may a kindly indulgence be extended to the hapless host of a boys-and-girls party to view the contest.

The principal effects of the Stock Exchange slump may now be regarded as past, and the markets show a moderate movement towards recovery. With the turn of the first quarter of the year, money will naturally become a little easier, so Bank Rate fears are relegated to the background. Nevertheless, the demands for accommodation on account of trade are so pressing and so widely spread that certain banks have rationed their customers as to loans. This is a state of affairs practically unique, and its influence is felt in hundreds of directions amongst trade and financial circles.

It is difficult to suppose, for instance, that the money famine has no part in governing the remarkably low range of prices now ruling in the electricity supply list. Brompton & Kensington ordinary yield no less than 9¼ per cent. on the money. Charing Cross pay a shilling or so more than this. County ordinary offer 8½ per cent. Westminsters, St. James' and Pall Mall and London Electric preference give an average of 8¾ per cent. on the money. Such returns are in themselves good enough, but they are wedded to prospects of better things in the future, such as were ably set forth in the chairman's speech at the recent County meeting. Bromptons look as cheap as anything in the list at 6½ ex the dividend.

Of course it is not to be overlooked that the standard of yields from investments has been greatly modified by the outpouring of new issues during the past three months. The attractions offered by the newcomers have had perforce to be made more and more tempting, with the consequence that stockbrokers find their clients want 8 to 10 per cent. yields from ordinary shares, and 7½ per cent. from good-class preferences.

Amongst Home Railway stocks, a jump of 5 points in Underground Electric income bonds accompanied the progress of the company's Bill seeking powers to charge increased fares. Another factor contributing to the spring in the price was the announcement that there will be no strike on the tubes over the Easter holiday. The £10 shares rose 7s. 6d., and Districts put on a point. If permission to raise fares should enable the company to resume 6 per cent. interest on the income bonds, the latter at 75 look cheap, because the dividends are distributed free of tax, and coupons are payable, moreover, in New York as well as in London.

Another fortnight remains in which holders of the cable stocks and shares can make up their minds whether to apply for their rights or to sell them. The new Eastern shares touched 8s. before reacting to 6s. 9d. Eastern Extension new are 3½ premium; Globes and Westerns both about 3⅝ premium. Movements in the prices of the old stocks are unimportant. Westerns at 15 ex dividend show tax-free return of 6 2-3 per cent., and Globes pay similarly. Eastern ordinary is about 3 down on the week. Oriental Telephones have lost a little of their sudden and mysterious strength. Marconis at 3 7-16 show ⅛ loss, there being a good deal of selling on behalf, apparently, of tired speculators weary of waiting for a rise that does not come. Great Northerns at 22½ shed 30s. in company with other Danish issues affected by foreign exchange. Telegraph Constructions are 25½ ex dividend.

London United Tramways preference were sold at half-a-crown on the issue of the report showing the company to have made £200 loss on the last year's operations. From whatever political angle the position may be reviewed, it seems ludicrous that any such undertaking which performs service of undoubted public utility should be run at a loss to those who put up the money, and whose original capital was ruthlessly scaled down in a reorganisation scheme. The 4 per cent. debenture stock stands about 38½. London and Suburban ordinary are 2s. 3d., the preference 4s. 3d., and the two debenture stocks 42½ and 70 for 4½ per cent. and 5 per cent. respectively.

Manufacturing shares are heavy. Edisons at 1⅛ are 2s. 6d. lower. Metropolitan-Vickers preference have gone back to 2¼, although the report was favourably read. The ordinary are 27s. 6d. Siemens at 28s. 6d. are sixpence down. Babcock & Wilcox at 3 3-16 continue their decline. British Insulated are quoted 38s. 9d. ex dividend and bonus, while Aluminiums braced up to within a shade of 40s. General Electrics are quiet, and there is not much doing altogether in this section.

Mexican issues keep on falling; this week it is Mexican Light and Power firsts which are down, a loss of 4 reducing the price to 47½. British Columbia Electric Railway stocks look as though they may have gravelled after their long drop. Bombay Electric ordinary are not quite so good at 145; the preference at 18⅜ have shed 5s. Brazilian Tractions weakened with the country's bonds. Argentine Tramways hold their ground. Rubber shares are dull and uninteresting. The commodity fell to 2s. 3d. per lb., but rallied a trifle, and the bulls in the share market resigned themselves to the prospect of there being no likelihood of recovery until after Easter.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1918.	Dividend 1919.	Price March 26, 1920.	Rise or fall.	Yield p.c.
Home Electricity Companies.					
Brompton Ordinary	8	12	6½xd	—	£9 4 8
Charing Cross Ordinary	4	7	8⅝xd	—	9 6 8
do. do. do 4½ Pref.	4½	4½	2⅜	—	8 8 8
Chelsea	3	4	8xd	—	6 3 4
City of London	8	10	13½xd	— ⅛	7 11 0
do. do. 6 per cent. Pref.	6	6	9½xd	—	6 9 8
County of London	7	8	9⅝xd	—	8 10 8
do do. 6 per cent. Pref.	6	6	9xd	—	6 13 4
Kensington Ordinary	6	7	5xd	—	7 0 0
London Electric	Nil	2½	1⅜	—	5 2 6
do. do. 6 per cent. Pref.	6	6	8⅜	—	8 17 10
Metropolitan	5	6	8½xd	—	8 0 0
do. 4½ per cent. Pref.	4½	4½	2⅛	—	8 0 0
St. James' and Pall Mall	10	12	6¾	—	8 16 10
South London	6	6	2⅝xd	+ ⅛	7 12 8
South Metropolitan Pref.	7	7	19/6	—	7 3 7
Westminster Ordinary	8	10	5½	—	8 13 10
Telegraphs and Telephones.					
Anglo-Am. Tel. Pref.	6	6	83½	−1	6 18 9
do. Def.	83/6	1½	19	—	7 18 0
Chile Telephone	8	6	6½	—	*4 13 2
Cuba Sub. Ord.	7	7	10	— ⅛	*7 0 0
Eastern Extension	8	10	15½	— ⅛	*6 10 1
Eastern Tel. Ord.	8	10	154½	— 3	*6 9 5
Globe Tel. and T. Ord.	8	10	15	— ⅜	*6 18 4
do. do. Pref.	6	6	9¼	—	6 6 4
Great Northern Tel.	22	—	22½	−1½	9 15 6
Indo-European	18	—	48½	—	6 18 4
Marconi	25	—	3 7/16	— ⅛	7 5 4
Oriental Telephone Ord.	10	—	5⅜	— ⅛	3 16 1
United R. Plate Tel.	8	—	7⅜	—	*5 8 8
West India and Panama	1/8	—	1⅛	—	5 19 0
Western Telegraph	8	10	15xd	—	*6 13 4
Home Rails.					
Central London Ord. Assented	4	4	47½	—	8 8 6
Metropolitan	1	1½	21½	—	5 16 3
do. District	Nil	Nil	18½	+1	Nil
Underground Electric Ordinary	Nil	Nil	2⅜	+ ⅛	Nil
do. do. "A"	Nil	Nil	6/6	—	Nil
do. do. Income	5	4	74	+5	5 6 8
Foreign Trams.					
Anglo-Arg. Trams. First Pref.	Nil	Nil	8⅜	—	—
do. do. 2nd Pref.	—	—	3½	—	—
do. do. 5 Deb.	5	5	62*	—	7 15 0
Brazil Tractions	—	—	51½	−1	—
Bombay Electric Pref.	6	6	18⅜	— ¼	8 8 0
British Columbia Elec. Rly. Pfce.	5	5	59⅛	−1	8 5 4
do. do. Preferrred	2½	5	80½	−1	9 18 0
do. do. Deferred	Nil	3	42½	+1	7 1 2
do. do. Deb.	4½	4½	57	—	7 9 1
Mexico Trams 5 per cent. Bonds	Nil	Nil	38½	—	Nil
do. 6 per cent. Bonds	Nil	Nil	25⅜	−8½	Nil
Mexican Light Common	Nil	Nil	17½	—	Nil
do. Pref.	Nil	Nil	27⅜	—	Nil
do. 1st Bonds	Nil	Nil	47½	−4	—
Manufacturing Companies.					
Babcock & Wilcox	15	—	3 3/16	— ⅛	*4 14 2
British Aluminium Ord.	10	10	1⅞	+ 1/16	5 5 0
British Insulated Ord.	12½	15	1 5/16xd	—	7 14 8
Callenders	25	—	8⅜	—	7 2 10
,, 6½ Pref.	6½	6½	4½	—	6 16 10
Castner Kellner	20	—	4	—	—
Crompton Ord.	10	—	21/6	—	9 6 0
Edison-Swan, "A"	10	—	1⅛	— ⅛	8 17 10
do. do. 5 per cent. Deb.	5	5	79½	—	6 5 9
Electric Construction	10	—	23/-	− 6d.	8 13 10
Gen. Elec. Pref.	6½	6½	18/6	—	7 0 6
do. Ord.	10	—	1 1/16	—	*5 10 4
Henley	25	15	2⅛	—	6 6 4
do. 4½ Pref.	4½	4½	8⅜	—	6 4 2
India-Rubber	10	—	16	—	*6 5 0
Met.-Vickers Pref.	—	8	2⅜	— ⅛	6 2 0
Siemens Ord.	10	10	2 5/16	— 6d.	*7 0 4
Telegraph Con.	20	20	25½xd	—	*4 14 1

* Dividends paid free of Income Tax.

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WIRELESS TELEPHONY ON AEROPLANES.

By MAJOR C. E. PRINCE, O.B.E.

(*Abstract of paper read before the* Institution of Electrical Engineers, Wireless Section.)

The summer of 1915 is believed to have been the very first occasion when wireless speech was received from an aeroplane. At that period the soft valve was in use, with a lime-coated platinum filament, and the handling of this by unskilled persons was one of the greatest difficulties. Except for this, the purely electrical difficulties have throughout been far less serious than the telephonic, practical, and mechanical ones.

In the early stages the difficulties of reception of speech in the air were so great that only transmission from air to ground was attempted, and the first practical set evolved was a transmitter, capable of employing either speech, continuous wave, or interrupted continuous wave (subsequently called "tonic train").

It was essentially a self-contained oscillating system, to which the aerial was loosely coupled. The microphone was inserted in the earth-lead, and modulated the radiation by varying the resistance of the aerial. Some of the best ground microphones proved useless in the air, and the choice finally rested on an old-type Hunnings Cone. It is almost impossible to predict from its behaviour on the ground whether any particular microphone or type of microphone will work satisfactorily in an aeroplane; and in the Royal Air Force every individual instrument was tested actually in the air.

The set was used on a trailing aerial 250 ft. long, and employed a wave-length of approximately 300 metres, not very far removed from the natural wave-length of the aerial. In consequence, the radiation was very good. On one occasion when the author was giving a demonstration before the late Lord Kitchener at St. Omer, in February, 1916, the spoken messages were picked up and recorded by the Lowestoft interception station at a distance of over 100 miles, although the aerial current in the transmitting aerial was less than 0.25 ampere.

The author was admirably assisted in the production of this set by Lieut. (now Capt.) McDougald, R.A.F.; it was the first practical aeroplane telephone ever produced.

This transmission was at first received on the ground on a Marconi double-magnification circuit in which a single soft valve was employed for both high-frequency and low-frequency magnification, a carborundum crystal being used for rectification. The ordinary working limit of range from air to ground was about 20 miles for telephony, 30 to 35 for tonic train, and about double this distance for pure continuous-wave transmission.

The author made up a valve receiver with one soft valve, with practically similar circuits to the ground set, which was tested in the autumn of 1916, and ranges of from 30 to 50 miles were obtained from a ½-kw. spark set. It was on this receiver that intelligible speech was first heard in the air.

The overseas Forces did not for a long time make any use of air-to-ground telephony; an urgent demand arose, however, for telephonic communication between machines in the air, and all energies were devoted to solving this far more difficult problem. There was for a long time no demand for both-way working, and a machine was equipped either for transmission (for the leader to give orders), or reception (for his formation to receive them).

It was necessary to eliminate all possible adjustments; the transmitting apparatus had none, and the receiving apparatus only two, one of which was seldom touched.

A reliable, small, hard transmitting valve of French type, capable of handling about 20 watts, and similar valves with slightly more open grid for use in reception, became available.

Dealing first with the transmitting apparatus, an ordinary reaction or regenerative circuit provided the radio power, and the only electrical difficulty was the choice of the best method of applying the voice modulations. The coupled-circuit system was ruled out on account of the coupling and tuning adjustments and its output limitations.

In comparing different means of modulation, variations of intensity or output are always accompanied by some change of wave-length, and the receiver can be adapted to take advantage of one or the other factor. In practice both factors can be laid under contribution, though probably the ideal method of modulation would change intensity only.

In any system in which the change of wave-length preponderates, good or bad articulation can be produced on a reaction receiver according to the slope of the resonance curve on which the adjustment is made.

No method of controlling the radiation directly by the microphone proved free from grave disadvantages, and the choice therefore fell on some form of indirect control. The arrangement finally adopted is generally known as "choke control," in which the modulation is applied to the anode circuit of the control valve.

Let us suppose that in the anode feed circuit of a simple valve oscillator is placed the secondary winding of an ordinary step-up transformer, the primary of which is a microphone and battery circuit (fig. 1). The variations produced by the voice will give rise to changes of potential in the anode feed circuit, which will be equivalent to applying to the oscillating valve more or less high tension, and will alter the radiation in a sympathetic manner. Since, however, the energy dealt with will be weak compared with the main supply, success will be only partial. For magnifying this effect let us now introduce another or "control" valve whose grid is acted on by the original microphone transformer, and whose anode is in series with a one-to-one transformer in place of the original one (fig. 2). If the two valves are comparable and have applied to them similar high tension, we are now able to apply a modulation or variation of the same order as the energy dealt with by the first or "power" valve.

From this point easy steps take us to the actual circuit employed. The control valve can be supplied from the same source of high tension as the power valve; the transformer can become a choke coil (which is, in effect, a one-to-one transformer), and it is an obvious arrangement to work the filaments and the microphone primary circuit off the same low-tension battery.

The circuit now becomes as shown in fig. 3, in which P is the power and C the control valve, L is the choke coil, and T the microphone transformer. H T is the source of high-tension supply, and F is the filament battery.

It will be seen that the anodes of both valves draw their high-tension D.C. supply through the choke winding, and as long as the microphone is quiescent, the output and general behaviour do not differ from that of the power circuit considered as a plain one-valve oscillator. When, however, variations take place in the control-valve anode circuit at speech frequency, very large surges are set up in that of the power valve, which may approximate to the original high-tension D.C. potential and so sweep the output from nearly double its steady value to almost zero.

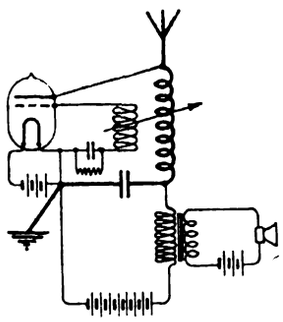

Fig. 1.

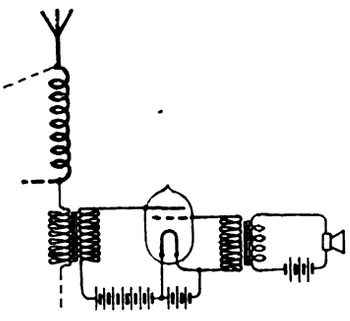

Fig. 2.

Choke control proved pre-eminently suitable for air working, and no other method of modulation survived in competition with it. There are absolutely no critical adjustments to be made. Almost every constant can be changed within quite wide limits, and though it may thus be caused to work more or less efficiently, it never reaches a point of complete failure.

The little 20-watt choke control set, designed by the author on the principles outlined above, was very successful, and became the standard R.A.F. set with which all the air transmission has, up to the present, been done.

One of its features, which was largely responsible for its success, was the use of "remote control." Things were so arranged that the set proper could be mounted at a distance in any convenient position, and only a very small control unit for operating it was brought within reach of the user's hand. In the case of the transmitter no adjustments were necessary. The control unit carried only a switch, an aerial ammeter, and plugs for microphone and telephone receiver.

The switch made or broke the dynamo field, filament, and microphone circuits, so that when it was off every circuit was dead. It was necessary merely to switch on and talk. Simplification could go no further; but how necessary this was can only be appreciated, perhaps, by those familiar with air work.

Although the first telephone had been supplied with high-tension current from dry cells, these were completely superseded by small air-driven generators, the improved descendants of one made for the author by Mr. Mackie early in 1916. The standard generator adopted gave about 600 volts from one commutator at its normal speed of 4,000 R.P.M., while the 6-volt filament accumulators were floating across the low-tension side. Moderately good electrical regulation was provided by a demagnetising field-winding system, and in this way the size of the accumulator had not to be very great.

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It was found to be highly important that the speaker should be able to hear the effect of his own voice, and to do this in the simplest possible way a condenser was placed in the earth lead, and across it a pair of head receivers was connected, which were thus enabled to pick up the low-frequency effect. By connecting another pair in parallel, the other occupant of the aeroplane could also hear what orders were given.

Mechanical disturbance of the microphone is almost completely eliminated by holding the microphone in the hand—the finest possible shock absorber. The acoustical difficulties are far worse, as the noises which it is desirable to reject are of the same order as the sounds that are to be accepted.

After much experiment the Gordian knot was cut by devising a microphone almost insensitive to sounds of the noise intensity, but responsive to the powerful concentrated sound waves of a voice impinging upon it from a very short distance. The voice was raised to a higher power, as it were, by speaking very loudly, and thus two distinct orders of intensity were produced, which could be separated. By choosing a suitable thickness of diaphragm, size of granule, tightness of packing, &c., combined with heavy damping, a satisfactory microphone was arrived at. It appeared curiously dead and ineffective on the ground, but seemed to take on a new sprightliness in the air.

We now turn from transmitting to its complement, receiving in the air. When the general uproar is remembered, the difficulties need no emphasis. The problem here was to combine considerable sensitiveness, loud signals free from distortion, and the minimum of adjustment.

The arrangement which, as the fittest, survived, consisted essentially of a detector valve with reaction, and two note magnifications. The detector valve was not energised direct from the aerial, but through a so-called "aperiodic" circuit, which was really a circuit approximately syntonised by its self-capacity. This has always been found to reduce magneto noise considerably.

In some air-trials with the early 1916 soft-valve receiver, it was noticed that to alter the filament brightness made a very convenient way of finally controlling the reaction, after the circuit had been set near the critical point.

In spite of the diminished radiation of such an aerial, the increased sensibility of this receiver approximately restored the usual range. Fig. 5 represents a typical circuit of this kind and shows one high and one low-frequency magnification, with a fine-grid rectifying valve between. Increased sensitivity as well as the nearer average approach of the aerial system to the source of disturbance, made more apparent, however, one of the great bugbears of air work where great sensitiveness is necessary—magneto noise.

Since the new type of receiver had not come into general use up to the time of the armistice, all the actual work was done with the three-valve receiver and transmitter already described. Trailing aerial wires of 120 ft. length were used in the transmitting machines, with an aerial current of the order of 0.4 ampere, while the receiving machines had aerials 80 to 100 ft. in length. The normal safe working range from machine to machine was about 4 miles (though this was often very much exceeded), while the range to a ground station was from 20 to 50 miles or more.

A squadron of machines equipped with this apparatus could set out and fight or manœuvre in formation under the orders of their commander, whose machine only was fitted for transmission. So great was the importance of telephony considered to be, that a special school of wireless telephony was instituted under Capt. Furnival.

A demand for both-way working was easily satisfied by fitting both the standard sets in all necessary machines and arranging some form of switch-over.

In consequence of the greater ease of reception at a quiet ground station, and its superior transmitting power, the to-and-fro ranges became approximately equalised, in spite of the disparity of output, and a machine could speak or be spoken to at distances of the order of 70 to 100 miles.

In the most recent apparatus with which the author is concerned, the transmitter will deal with an input of 100 watts, and choke control will be retained. All types of transmission will be provided for. The receiver will have three high-frequency magnifications and one low, making with the detector five valves, and the combined transmitter and receiver will be worked from one remote control. Batteries

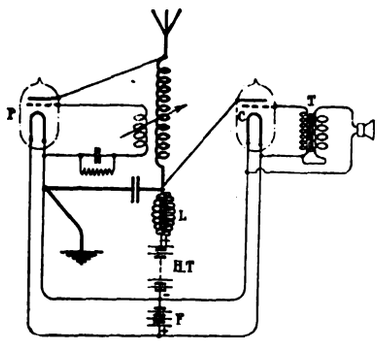

Fig. 3.

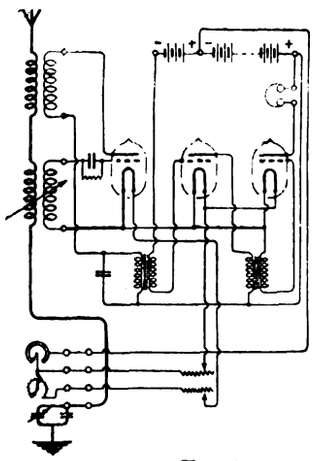

Fig. 4.

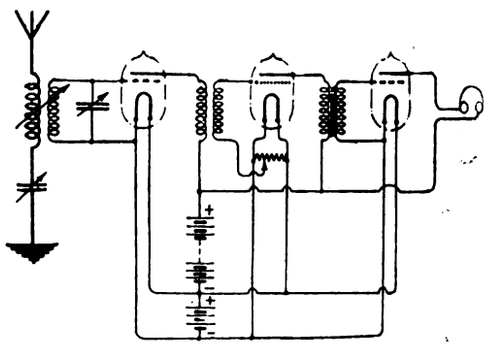

Fig. 5.

The principle involved is that the increase in emission caused by brightening the filament of the detector valve, whose anode current is concerned in the reaction, steepens the characteristic curve and so determines the oscillatory condition, when the circuits have been adjusted near the critical point; to alter the reaction electrically in this way makes but an infinitesimal change in wave-length, whereas in mechanical methods small changes of capacity are inevitable with every adjustment.

The remainder of the receiving circuits will be clearly understood from fig. 4.

Prior to the war high-frequency magnification by resonance methods had been in use; transformers with an iron core, highly laminated, were employed to deal with wireless frequencies, and worked efficiently over large ranges of wave lengths. Capt. Round showed how all such transformers could be considered to be essentially resonance transformers, differing only in damping. Special low-capacity valves were introduced, so that the damping produced by them could be made a maximum, and high-frequency magnification was tamed and harnessed. A cascade series of such valves could be set up, working with fairly constant efficiency over a large range of wave-length, so that no tuning (within these limits) was needful except that of the circuit applied to them.

The first fruit of this advance, as far as aircraft sets were concerned, was a five-valve receiver, designed by Major Whiddington, in which a choice was made of two high-frequency magnifications and two low, with a detector valve. This set was, as compared with the former three-valve receiver, about ten times as sensitive for strong signals, and 30 times for weak ones.

It was intended for use with fixed aerials rigidly connected to the wings and fuselage of the aeroplane—as opposed to the trailing aerial, which was a great embarrassment in fighting.

will have to be retained at present for filament lighting, but they can be small ones floating across the generator; and there seems good reason to hope that in the near future a perfectly silenced and regulated generator will permit of the abolition of the battery, all current, even for the receiver, being supplied direct from the dynamo.

Ground stations will be equipped for direction-finding with a transmitting mast one or two hundred yards away controlled from the receiving building, and matters will probably be so arranged that the ordinary P.O. land lines can be plugged direct on to the wireless, so that a man may talk direct from his office to a machine in the air.

Research at the P.T.R.—During 1918 the Physikalisch-Technische Reichsanstalt determined the coefficients of electrical resistance of a large number of pure metals in the form of wire, between − 192° C. and 500° C. The results are not given in the abstract reproduced in *Ztschr. des Vereines deutscher Ingenieure* for January 31st, 1920. Four kinds of aluminium of varying degrees of purity were investigated, and the coefficients of resistance determined between 0° C. and 100° C., and at various temperatures up to 600° C. At 250° C. the greatest conductivity and the highest temperature coefficient were found. The coefficient of resistance of aluminium tested under these conditions was found to be practically unaffected by impurities in the metal. The thermal expansion between − 78° C. and 500° C., and the breaking strength were also determined in the case of aluminium. The expansion of two samples of 98·8 per cent. and 99·6 per cent. purity respectively, within the limits of temperature mentioned, can be expressed by the equation—

$$l_t = l_0 \{1 + (22{\cdot}9\, t + 0{\cdot}009\, t^2)\, 10^{-6}\}.$$

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BRITISH ELECTRICAL AND ALLIED MANUFACTURERS' ASSOCIATION.

The annual general meeting of the above Association took place at the offices in Kingsway, W.C. 2, on Thursday, March 18th, Mr. W. O. Smith, chairman of the Council, presiding.

As has now become the usual thing with the B.E.A.M.A., the Press was not invited to the meeting, but we are officially informed that the certified income and expenditure account and balance sheet for the financial year ending September 30th, 1919, were adopted, and that in presenting the annual report the chairman referred to the election of the late chairman, Mr. Davenport, to be a vice-president of the Association. Unfortunately, he had to absent himself from subsequent meetings, as he was attacked by an illness from which he had not even yet completely recovered. They hoped he might be shortly restored to health again, and able to resume his work.

The Council had had a busy year. The change-over from war to peace conditions had brought with it many problems requiring careful consideration. Although it was not within the province of the Association to deal with labour and wage questions, they must recognise that labour difficulties during the year, including the recent strike of moulders, had had their effect on all industries. Coupled with the general increase in wages, the shortage of materials, and general unrest, industry had been prevented from reaping the full benefit to be expected from a victorious ending of five years of war. They hoped that reason would at length prevail, and that some path would soon be found along which employers and employed might march side by side, and thus enable the country to emerge from the period of darkness, and to attain, once more, to the proud position which it held for so many years as the leader of commerce.

The chairman then reviewed in detail the work of the Association during the year, as recorded in the report, particularly noting the excellent work done by certain committees, *e.g.*, the Overseas, Education, Standardisation, and Traffic Committees. On the subject of research, he said that the work of the Electrical Research Committee was at present somewhat restricted through lack of funds. Given the necessary funds, and the consequent Government grant, existing researches could be carried on expeditiously, and much work in contemplation could be put in hand. The Council had given very careful consideration to the subject, and had arrived at the conclusion that collective research was not only desirable but necessary in the interests of the industry, if they were even to keep pace with other countries, already well organised for research. In order to obtain Government grants of £1 for £1, a large sum per annum for five years would have to be guaranteed. The Council was of opinion that this sum should be found by the industry, and strongly recommended that to the sections of the Association. Referring to the recently appointed Committee of Chairmen of Sections, he said that it should do good work, and would be assisted by the Council's decision to issue to its members the Council's minutes, with permission to report to sections anything of special interest to them. On the subject of increased accommodation, he said that the Council had been compelled, owing to the increase of staff, the sectional activities, and the large number of committee meetings now held, to enlarge the office accommodation. They were now in possession of several additional Committee rooms. That, of course, entailed increased rent, but the Council had been mindful of the interests of the smaller firms, and had not varied their subscriptions in any way. The increase of the maximum subscription would affect the larger firms only. He was glad to say that some of the larger firms had already come forward and expressed their intention of paying the maximum subscription regardless of wages.

The report was adopted.

The chairman then announced the result of the ballot to fill the vacancies on the Council for 1920, as follows: The elected members were:—

The British Thomson-Houston Co., Ltd.
Brook, Hirst & Co., Ltd.
Browett, Lindley & Co., Ltd.
The English Electric Co., Ltd.
The General Electric Co., Ltd.

Messrs. Price, Waterhouse & Co. having been re-elected auditors, the proceedings terminated with a vote of thanks to the chairman for presiding.

We give the following extracts from the report of the Council for the year 1919:—

The B.E.A.M.A. is a peace organisation; but no better test of the strength of any organisation can be applied than the way in which it passes through the fires of war. The B.E.A.M.A. emerges from the war stronger than ever. . . . Now that we are confronted squarely with all the problems of peace, you have, in the B.E.A.M.A., an organisation tested by war, and qualified to deal with any emergency.

Of those problems none is more important than export business. Export inquiries have been secured sufficient practically to absorb members' whole productive capacity. But the home demand has also been such as to call upon their utmost capacity to meet it, and there the danger lies. It is easier and, in a sense, more immediately advantageous to do the home business, but, clearly, the big home demand cannot last for ever. Just as clearly, if the export demand is not met and connections are not kept up, even in the face of keen foreign competition, there is a grave danger of losing the future world markets upon which, at no very distant date, when home orders diminish, everything will depend.

The Council therefore strongly recommend that the greatest effort, even to the sacrifice of a portion of the home market, should be made to go vigorously into the markets abroad, to secure and keep alive all overseas connections, and to increase the volume of business, which must gradually grow to be very much above the pre-war level if the future is to be properly secured. Evidence is not wanting that export matters now occupy a large place in the minds of members. In no previous year has the Association entertained so many visitors from overseas. The results of these visits have been promptly communicated to members, in addition to special reports regarding trade in Spain, Scandinavia, Japan, Brazil, the Argentine, Canada, India, and China.

With regard to the work of the Overseas Committees: During the year the Argentine Committee issued to the British Legation, through the British Chamber of Commerce, in Buenos Ayres, a comprehensive report on business in the Argentine. The South Africa and Australia Committees have been active in ensuring reasonable conditions of contract for members; and the latter committee has also done good work connected with the proposed revision of the Commonwealth tariff, the arbitrary loading of invoices by the Customs authorities (regarding which a new Bill has now been introduced); and on a new Act of the Victorian Parliament requiring certain goods to be marked with the name of the country of origin. The India Committee has had the great advantage of the personal assistance of H.M. Trade Commissioner, Mr. T. M. Ainscough, O.B.E., and has furnished to the Director of Statistics, who has put into use, extended schedules classifying sea-borne electrical imports to India. This committee has, further, ensured that greater consideration shall in future be given to members in all work connected with the development of the many hydroelectric schemes now in prospect in the various States, in which connection the Government of India through the India Office has accepted from your Council a recommendation that the British standard frequencies of 50 and 25 cycles per second should be adopted for all hydro-electric and other alternating-current schemes in India. Many promising activities of these and other Overseas Committees have been delayed by the necessary return to England of the officers who held these outposts of British trade during the war.

The Board of Trade adopted a new classification of imports and exports based upon proposals furnished to them by your Association, and contributed to by almost every section of it. The new classification will exhibit increased lists both for incoming and outgoing manufactures.

The need for a sound and comprehensive cable code, providing specially for the electrical and allied industries, has been long felt; and your Council have given their provisional assent, with the support of members, to arrangements for the preparation of such a code.

The Department of Overseas Trade sent a British Engineering Commission, on which your Association was represented, to the occupied area of Germany, and the resulting report (I.M. 3612/19) was circulated free to members.

Your Council have noted with regret the sharp impact of political exigency on many of those excellent resolutions and counsels of wisdom (Government Committee reports on after-war trade), which, during the war, so stirred the nation as to evoke promise of their fulfilment from the Government. The promised restriction of foreign imports has gone, and, judging from the reception given by the country to the Anti-Dumping Bill, the restriction even of dumped goods cannot be looked forward to with much certainty. The influence of the foreigner has not been slow in making itself felt in municipal business, and the Board of Trade has no power to compel the adherence of municipalities to its recommendation to purchase only British goods. Save as to the Government's success with the Education Act, its financial assistance to research, its promised assistance to standardisation, and the passage into law of the Electricity (Supply) Act, all may be said to be left again to private effort; and reforms are to be expected only by such pressure as associations like your own may be able to exercise. Nothing could better illustrate the devious nature of Government "policy" on fundamental questions than their post-armistice actions in the matter of import restrictions.

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The report prepared by your Education Committee entitled "Education and Training for the Electrical and Allied Engineering Industries" was completed, and your Council authorised its publication. There is little question that this, the first practical effort towards systematising work in so promising a field, will not fail of effect. The Education Committee has now well in hand the deferred subject of provision for overseas students, and the scheme for the founding of studentships and scholarships offered by the turbine and turbo-generator sections of the Association for the study of problems of research relating to turbines and turbine-driven generators. These scholarships are being projected to encourage technically trained students to fit themselves for posts on the higher staffs of engineering concerns and research institutions, and such men will to some extent relieve the apparent shortage of suitably trained technical engineers.

The work of the Research Committee of the Association has been somewhat overshadowed during the year by that of the new representative body, the Electrical Research Committee, in which your Association, the Institution of Electrical Engineers, and the Committee of the Privy Council for Scientific and Industrial Research (Mr. Arthur Balfour, president), are the partners. That body now purports to cover not only all the researches previously conducted by your Association and the I.E.E. jointly, but to undertake all new work demanded by any section of the Association or by the profession. Mr. E. B. Wedmore was appointed its director, and commenced his duties on July 1st. As a result, the work in hand has been brought into a state of great activity, and a largely extended programme of new work has been laid down.

There is no question as to the value of this work. It must result in progressive reductions in the cost of plant, in its more effective use, and the elimination of defects both in machinery and raw materials. But in order to secure substantial assistance from the State, adequate guarantees of support must first come from manufacturers. We have a great deal of leeway to make up if Great Britain is to be put even on a level with America and the Continent. Only by the collective action of associated firms can such work be carried out effectively, most of the vital problems being too large for the efforts of any individual concern. Your Council, therefore, strongly recommend the Electrical Research Committee for the support of members of the Association.

The separate research into the corrosion of condenser tubes carried on jointly by your Association and the Institute of Metals, is reaching a stage when it will be possible to communicate important results to the contributors. Research into the most suitable materials for turbine blades and nozzles revealed at an early stage the importance of the metallurgical examination of materials; and arrangements have been made with the National Physical Laboratory for carrying out this work, for which the blades for test are being provided free of charge by the makers. Another turbine research is that of nozzle proportions, and arrangements for co-operating with the Institution of Mechanical Engineers in this research are now complete.

The B.E.A.M.A. publication, *Standardisation Rules for Electrical Machinery*, first published in 1913, has gradually won its way to popular favour as the standard work in its class. It reached its fourth edition early this year, and is, in that revised form, now the subject of discussion between various university authorities and technical colleges and your Association as to its adoption by the former as a handbook for the instruction of students.

The year has disclosed no diminution of the spirit of goodwill on the part of municipal engineers in settling their contracts on the I.E.E. model conditions, or such other reasonable equivalent as might be necessitated by subject matter.

Your Revising Committee, which has charge of the I.E.E. text, recently proposed certain amendments to your Council, and the Institution, to which these amendments were at once taken, considered them important enough to warrant the creation of a special committee of revision jointly and equally representative of the purchasing and manufacturing sides of the industry. It is hoped that this joint committee will sit permanently to consider amendments proposed by either side from time to time.

The sets of conditions of sale A and B for home work and AE, BE, and AEC for export work continue to set the standard practice for the whole trade, and are always in brisk demand.

The text of "Instruction for the Use and Conditions of Sale and Contract" was amended during the year by the addition of railway companies to the list of those purchasers from whom the Association's conditions must be obtained. The proposal was made to the companies on May 12th, inviting objection, and, none having been received, the rule was put into force on August 12th.

Translations of the Association's sets of conditions of sale for export work are now available in French and Russian.

In July last your Council set up a Traffic Committee which attended before the Railway Clearing House on September 25th, 1919, and gave evidence in support of a claim that slide rails and bedplates for dynamos and motors should be placed in a lower classification. The application was successful, the railway companies lowering the classification from 3y to 1m, a concession of considerable value, as the tonnage in this class of goods is approximately 20,000 per annum, and the saving in freight considerable.

Immediately upon the announcement of the proposal to increase goods rates by 50 per cent., the committee passed, and the Council sent, a protest to the Minister of Transport against all-round increases of this nature. The committee recognised the necessity for raising rates in order to meet the increased cost of transport, but recommended that instead of an all-round increase of 50 per cent. it should be on a graduated scale so devised that raw materials should bear the lightest burden. It was specifically recommended that the maximum increases for the classes covering raw and semi-raw materials should be as follows: Class A, 2s., class B, 2s. 6d., and class C, 3s. 6d. per ton. Two of the maximum increases which came into force on January 15th, 1920 were almost identical with the recommendations, the third to be without maximum, but on a graduated scale as recommended. At the date of going to press with this report there was an entire lack of uniformity in the manner of charging the new rates, not only by different railway companies, but by the local goods departments of the same company. The Traffic Committee has this matter now under consideration, and will shortly make recommendations directed at systematising the companies' practices. That committee also gave consideration to the question of demurrage, both in respect of private sidings and on the premises of the Port of London Authority, and on its recommendation your Council supported an F.B.I. proposal to challenge by means of a test case, the railway companies' action in this matter. This committee is, further, preparing evidence in support of an application for a revision of the classification of electrical machinery and apparatus generally. On the initiative of the committee, your Council was able to obtain concessions in freight rates for electrical machinery and apparatus to Australian ports. The Ministry of Transport has accepted from your Council the nomination of four members for seats on the panel of experts set up under section 23 of the Ministry of Transport Act.

Brief reference is made to the Electrical Development Association. Mr. J. W. Beauchamp, director and secretary, will welcome inquiries as to its scope and work. The Council recommend the E.D.A. to the attention of every member who has the future of the industry at heart.

The scientific and telegraph instrument section of the Association, with commendable enterprise, devised and adopted a mark for their apparatus showing the initials of the Association over-printed with the words SATIS, being the initials of the section. Your Council are now in correspondence with the Board of Trade as to a licence for the use by all members of the same or a similar mark for members' electrical manufactures of all descriptions.

A Committee of Chairmen of Sections has been appointed to provide for the better co-ordination of work common to, and the exchange of ideas between, sections.

Your Council has considered it expedient to defer the holding of a special B.E.A.M.A. Exhibition in London till 1922.

The following new sections were constituted and began work during the year: The Cooling Water Apparatus Section, the Gas and Oil Engine Section, the Reciprocating Compressor Section.

The system of tendering embodied in the cross-tendering agreements continues to find favour among members, but has not been extended. The condenser cross-tendering agreement was revised during the year so as to make it applicable to all inquiries whether publicly advertised or not.

In order to meet the increase of rent and general increase of staff and other expenses, your Council has had under consideration the question of increasing revenue by additional subscription. The Council decided as a preliminary measure, to raise the maximum subscription from the present figure of £200 to a new maximum of £500.

The annual dinner will be held this year on May 20th.

The report refers to the close working relations of the B.E.A.M.A. with the F.B.I., and to co-operative working with other bodies.

The number of members on the register at the end of the year was 225. Nineteen members were admitted to membership during that period and ten resigned. Of these resignations six were accounted for by amalgamation or reconstruction.

Australian Company.—The Australian papers state that a meeting of shareholders in Standard Waygood Hercules, Ltd., was held on February 3rd to alter the name of the company to the English Electric Co. of Australia, Ltd., and to increase the capital of the company to £600,000. Mr. G. A. Weymouth was to be appointed managing director, in which capacity he had been acting for some time. The programme of the company is an ambitious one involving great extension of the works in Australia. It is described as a virtual amalgamation with the English Electric Co., Ltd.

Prices of German Wires and Cables.—Quoting from a German paper, the *Economic Review* states that as from March 1st, the Price Section of the Central Association of the German Electro-Technical Industry ceased to publish increased metal prices for cables and wires. From that date, the prices for insulating wires are reckoned on the basis of the bi-weekly quotations for copper and aluminium, and vary with the fluctuations in the basic prices of these of Mk. 2,500 and Mk. 3,000 respectively per 100 kg.

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NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

The "Xcel" Utility Electric Cooker.

As an all-British production, the "Xcel" utility electric cooker, of which Messrs. Drake & Gorham Wholesale, Ltd., 67, Long Acre, W.C.2, have sent us particulars, deserves notice. This cooker, fig. 1, which is particularly adaptable to the many forms of cooking, *i.e.*, grilling, toasting, boiling, &c., consists of a heat together with a pan, grill, and deflector. It is nickel plated, highly finished, and can be used on a dining-room table, being supplied from an ordinary lighting circuit. The heater loading is 600 watts.

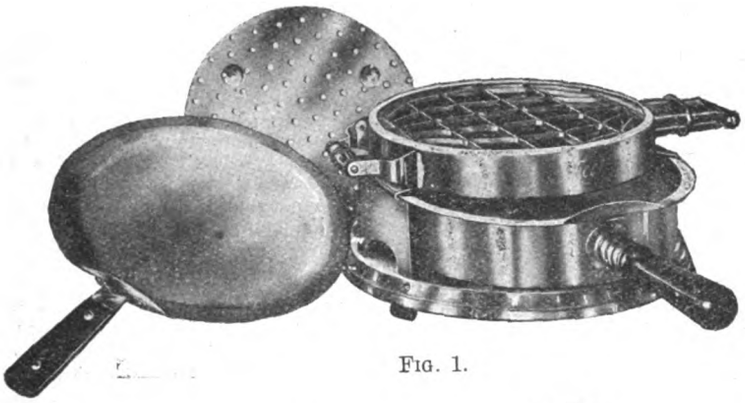

Fig. 1.

Fig. 2.

Fig. 3.

The "Xcel" Utility Electric Cooker.

By means of this apparatus, two cooking operations can be carried out at once. Fig. 2 shows steak and potatoes being cooked in two utensils, and fig. 3 illustrates potatoes being boiled at the same time as fish is being cooked.

Other agents for this cooker are Messrs. Siemens Bros., Messrs. Down & Davies, The Electrical Supplies, Berry's Electric Co., and the Sun Electrical Co.

The "W.R." CO_2 Indicator.

The importance of easily and correctly ascertaining the percentage of CO_2 in boiler flue gases, in order that fuel may be consumed to the best possible advantage, is now fully realised. The "W.R." indicator, which has been mentioned in several of our recent articles, and appears to be increasing in popularity, overcomes, it is claimed, many disadvantages of previous instruments. By its help it is said to be possible to maintain an average of 14 per cent. of CO_2 in the flue gases. With a flue gas exhaust temperature of 500 deg. F., by increasing the percentage of CO_2 from 6 to 12 per cent., a 13 per cent. saving in fuel can be effected, so that the usefulness of an apparatus of the above description will be obvious. Perfect combustion would show about 19 per cent. of CO_2, and while 17 per cent. is obtainable with the help of the W.R. indicator, the average figure is 14 per cent., which means with the average plant a saving of from 10 to 15 per cent. on the coal bill. The instrument, fig. 4, indicates by the height of a water column on a gauge glass tube and the fireman can thus see at a glance what adjustment of his dampers is necessary to maintain the highest average of CO_2 in the furnace. The device is quite simple, there are no moving parts in it, and it is stated that it is within 1 per cent. of absolute accuracy, and that it will last as long as a boiler. When dirty it may be swilled out with a bucket of water. The action of the indicator is as follows: An aspirator worked by a small jet of steam continuously aspires gases from the flue which it is desired to keep under observation. The path of the gases is indicated by the arrows in fig. 5. The pipe A may be connected to an induced draught fan if more convenient than connecting it to the aspirator.

The sample of gas is first drawn down the glass tube and passes through the water at the bottom of the instrument. It then percolates through the filtering material, eventually entering the upper chamber containing the porous pot, in the interior of which is the reagent. A small pipe connects the interior of the porous pot to the top of the recording gauge glass G, which is connected at the bottom to the water space. Some of the gases passing through the upper chamber penetrate into the porous pot and are absorbed by the reagent. A partial vacuum is thus formed, varying in intensity according to the percentage of CO_2 contained in the gases passing at the time. By this means the water is forced up the gauge glass tube, which is graduated to read directly in CO_2 percentages. The whole instrument occupies little space, and is particularly robust, accurate, and reliable. The apparatus

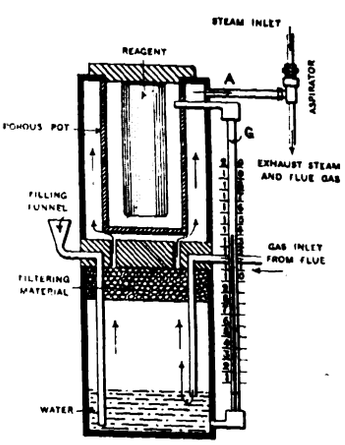

Fig. 5.—Diagrammatic Sketch of CO_2 Indicator.

requires practically no attention, except that a fresh cartridge has to be inserted in the porous pot every twenty-four hours, and about once a month the main filter and flue piping should be thoroughly cleared of soot. The instrument reads continuously, has very little time lag, and answers readily and rapidly to any variations. The makers are Messrs. "W.R." Patents, Ltd., of 8, Old Jewry, Cheapside, E.C. 2.

Fig. 4.—W.R. Patent CO_2 Indicator.

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BY-PRODUCT PRODUCER & BLAST FURNACE GASES.

At Manchester, on March 9th, Mr. W. H. Patchell's and Mr. S. H. Fowles' papers (abstracts of which appeared in our issues of March 19th and 26th respectively) were read and discussed before the North-Western Centre of the Institution of Electrical Engineers.

Mr. Pilling said it must be a revelation to electrical engineers to have gas engines brought prominently before their notice at this time. Many of them, and many steam engineers also, had an idea that the day of the gas engine was past, but during the war great developments had taken place. Largely because German competition had ceased, quite a large number of gas engines of considerable power had been made in this country for electricity generation and air blowing. It seemed clear from the papers that openings for development existed both with producer gas and with blast-furnace gas. It was extremely disappointing to an engine maker who had turned out engines of good quality to know that the good results obtained in one case were not repeated in another. It depended on the efficiency of the gas-producer plant. With the Halberg-Beth dry cleaning process uniformly clean gas could be obtained if reasonable attention was given by the engineer in charge. With the Halberg-Beth plant the gas could be made more pure than air. These facts pointed to the necessity of cleaning the air as well as the gas, and he had no doubt that when this was done an engine would be able to run for a much longer period without having to be stopped for cleaning. He knew no mechanical or physical reason why it should not run for an absolutely indefinite period if efficient plant was installed. In choosing the type of engine the decision of the purchaser appeared to turn upon the question of finance. As a rule a firm which had plenty of money was more inclined to take the low-speed set; if they had extensive demands on their capital and had an exceptionally large programme to carry out, the decision was apt to turn in favour of the high-speed set. For a given power it was cheaper to make a high-speed, multi-cylinder gas engine than to make a low-speed one, and, moreover, the former occupied less floor space. So the whole question seemed to turn upon finance, and the makers of low-speed engines had to face that difficulty. There was no difficulty in producing 3,000-h.p. with a 2-cylinder engine, and 6,000-h.p. with 4-cylinder engines. It was highly probable if the price of coal continued to rise that blast-furnace plant would be compulsorily used by order of the Government to produce blast-furnace gas.

Mr. Glover said that years ago when slack was being bought at 6s. to 8s. per ton, and with sulphate of ammonia at approximately £10 per ton, one could recover all the cost of gasification and something more on the by-products. But to-day, while coal was approximately 30s. a ton, sulphate of ammonia was sold at £19 per ton. The price was controlled by the Government and kept low for the benefit of the farmers. In addition to the price of the coal, it cost 10s. to 15s. per ton to gasify it. For these reasons the gas engine consuming producer gas was not now a tempting proposition, if power production was the only consideration; but other arguments might be found for it. For instance, the gas might be used in furnaces. However, there was a great economy obtainable from the gas engine using blast-furnace gas. From the electrical engineer's point of view, gas engines had a very undesirable failing. Sulphuric acid got into the engine room and attacked all electrical connections. A kind of oily vapour mixed with the sulphurous fumes was deposited on the windings, and there was a liability to short circuit. The 8-cylinder, 4-crank type gave extremely good results in some cases. Two had averaged 90 per cent. of the possible running time day and night over seven years. The large horizontal type had not so good a record. Little troubles crept in and caused stoppages, and when a large amount of the total power was put into one set there was a greater proportionate loss. An important factor was the amount of labour required for working gas engines and gas plant in comparison with steam turbines. He estimated that with the former the production of 1¼ million units per week would necessitate the employment of approximately 150 men, with turbines it would be about 30 men. When an absolutely even power supply was wanted difficulties cropped up. If the men could be trained to work the producers, in step as it were, so that they were not all poking at the same time, it would be all right, but it was very difficult to get the men to work in that way. The question of the ash in coal was also important. His own experience was that it was very difficult to obtain the sort of coals they wanted. If automatic switches were exposed to the atmosphere of the gas engine, there was a corroding action, and a deposit was formed. Tar was a very difficult thing to deal with. It had an unfortunate property of depositing at every change of temperature. The only way was to reduce the temperature to the lowest degree which it would reach at any point of the system afterwards; then they could be certain there would be no further deposit of tar. He doubted very much whether it was now an economic proposition to produce power from bituminous coal in gas producers.

Mr. T. R. Wollaston agreed that the waste gas from coke ovens ought to be utilised, but looking at the subject from the point of view of producing a large amount of electricity, coke-oven gas was an impossible proposition. In order to get it in that way, more coke would have to be produced than the whole world wanted. There were possibilities in low temperature distillation from the point of view of the production of benzol, but he saw no prospect of producing any large amount of electricity. He agreed with Mr. Pilling that the questions of capital cost and amount of floor space needed were factors in the choice between the gas engine and the turbine. He had great faith in the future of producer gas for firing boilers, even at the present prices of coal and sulphate of ammonia.

Mr. J. G. Walthew said it entirely depended on the type of gas engine whether sulphurous fumes would effect the electrical equipment. With the enclosed vertical type it was not possible for the fumes to escape and get into the engine room. If gas got into the crank chamber it was drawn away by means of a small exhauster fan which maintained a circulation of free air. When the dust was removed blast-furnace gas offered a much easier problem than producer gas because there was a fairly even quality of gas to deal with. He agreed with Mr. Fowles that the gas engine was quite as good a prime mover as the steam engine. If there was any trouble it was connected with the quality of the gas, and not attributable to the engine itself. He dissented from the statement that capital cost was the determining factor in the choice between high and low-speed types. Electrical engineers and power plant people generally would go in for the most satisfactory machine from the point of view of reliability and economy, irrespective of the capital cost. One cause of dissatisfaction in the past was insufficient stand-by plant. A power station should be properly equipped in that respect, so as to be in a position to overhaul any one set if it were necessary. He was recently at a works where notwithstanding the increased cost of labour, and the fact that the men did not do the same amount of work as formerly—three being employed where two sufficed before—they could meet the whole of their labour charges by the sulphate of ammonia recovered.

Mr. Fennell said the corrosion due to gas fumes escaping could be remedied. A great help was to grease the contacts with vaseline. An undertaking which used South Staffordshire Mond gas had as much trouble with the enclosed type of engine as with the open type. The fumes escaped from the crank chamber and were churned up by the flywheel. If an exhauster fan were used, as one speaker had suggested, the oil consumption went up by leaps and bounds. It was a curious thing that some plant produced a much greater quantity of tar than others. At Northwich, within a quarter of a mile from the Mond gas station, they had no trouble from that cause; at a South Staffordshire works, over four miles from the Mond gas station, there were quantities of tar, and the trouble was got over by reducing the temperature of the incoming gas to a level below which it would never go again. Mr. Fowles had made an excellent case for the use of gas engines, but, of course, they were up against present-day conditions. He had recently had occasion to go into the question of producer gas, and he found it paid to put down a non-recovery plant or anthracite plant in sizes anywhere near 1,000 h.p. and larger. He believed it was a fact that the price of anthracite had not increased in the same ratio as that of ordinary coal.

Mr. Patchell, in replying, said it was not quite a fact that the high-speed steam engine had been ousted by the low-speed type, but the field for it was certainly limited. His own feeling was that 1,500 h.p. was too large. Its limitations had been masked by the development of the turbine. Of course, the capital cost was a very important matter. At pre-war prices the steam turbine cost so little that practically fuel was the only thing that mattered, but the cost of a big plant for Birmingham Corporation now came to £45 per kw. A great deal could be said about the effect of gas on electrical equipment, and Mr. Pilling's statement that the gas was cleaner than the air was absolutely applicable to some of the old stations. In connection with two of the engines dealt with in the paper, forced lubrication was introduced. A fan blew air through the open casing, and by an open port in the crank chamber it entered the air inlet of the engine, so that it was constantly sucking air through. He was astonished at the quantity of oil that went through. He should not have thought there was so much more oil floating about in the crank chamber with forced lubrication than with the banio system of lubrication. They had absolutely no trouble with fumes in the engine room, and the engines ran quite as regularly as steam engines, and were as clean.

Mr. Fowles said they had had no trouble from fumes affecting the electrical connections. He thought much depended upon the type of engine, whether it was open or enclosed, and also how the men were looking after the machinery, and how the employers looked after the men. Mr. Glover had said 150 men would be needed to produce 1¼ million units per week. That figure was altogether too high. His experience was that both high and the low-speed engines were good in the right place, and one was as easily started as the other. On the stand-by question, again a great deal depended on how the men looked after the engine. They had not used vaseline, nor had they found it necessary to put an exhauster fan on the crank case. All the engines used forced lubrication.

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LARGE POWER TRANSFORMERS.

At a meeting of the Western Centre of the Institution of Electrical Engineers the paper by Messrs. A. G. Ellis and J. L. Thompson on "Large Power Transformers" (which was abstracted in our issues of May 9th and 16th, 1919) was read.

In the subsequent discussion Mr. Arthur Ellis (Chairman) said the subject of the paper was somewhat difficult to discuss, as most of them who had to utilise transformers, no matter what size, were more concerned in obtaining transformers which would comply with the conditions under which they would have to work, leaving to gentlemen like the authors to work out the details of construction. The authors referred to lack of opportunities for building large transformers, but he thought those opportunities would be amply afforded in the future under the new scheme of production and distribution generally. Manufacturers would produce transformers of large power in view of the larger units which were going to be utilised for public supply, and so long as the transformers were properly designed there was no reason why engineers should not rely equally upon transformer units as upon generating units. The authors suggested that crane capacity was a limiting factor in the production of large designs, but the installation of larger units would no doubt influence the production of bigger capacity cranes. He did not think it needed much understanding that transformers above 5,000 kw. should be forced cooled—some might suggest that those of smaller capacity should be so treated. He considered the core type had many advantages over the shell type. The authors suggested that the correct method of switching in was to slowly close the switch. Were the authors satisfied that no injurious effects would result to terminals by this method? He agreed that the British Engineering Standards ought to be adopted, and that the different designers of transformers should pool their designs.

Mr. W. A. Chamen said he did not quite know why he was expected to say that 25 cycle transformers were better than any other. What he did say was that they had a large number of 25 cycle gear installed, and he did not quite see how they were going to get rid of it. He considered the cost of the transformer was not everything, but if it were such an important thing why not go to 100 cycles? He thought a great deal too much was made of the supposed advantages of 50 cycles, and he did not know how it came to be adopted. It might be of interest to know that there was actually a proposal to give a supply in that district at 15 cycles. All he had to say was they had 25 cycles and 50 cycles, and the problem was how to work the two together or how to gradually make the change over so that there should be only one frequency. With all the brain work that had been expended on transformers he wondered why someone had not devised a static frequency changer. He was very glad to hear the authors' remarks on auto-transformers. He went into this question himself some years ago and arrived at the conclusion that they were most dangerous to use. He would like to know whether the automatic device for taking up the slack of contraction or shrinkage of the insulating material had been put to the test.

Mr. Lewis said there was one thing Mr. Ellis had not touched upon, and that was a straining tank wherein the oil circulated and some chemical was used to remove the moisture from it. Perhaps Mr. Ellis could let them know something about it.

Mr. A. J. Newman said that although the paper had been written something like a year ago, progress had not been so rapid as to cause the data given to be in any way out of date. He would like to know how much in the authors' opinion the costs per k.v.a. had been increased since the figures were compiled. During the war it was no unusual sight to see large pieces of machinery transported along main roads, and in his opinion a few remarks on the limit of the carrying capacity of some of the main roads would not have been out of place. The authors gave no particulars of weather-proof transformers suitable for use in the open. He understood it was common practice in Canada to install both transformers and switchgear without any protection from the weather whatever. No mention appeared to be made of utilising the latent heat of vaporisation of water in dissipating the heat due to losses in transformers. Personally, he had never favoured 3-phase transformers owing to the difficulty in handling, loss in efficiency, and greater cost when spares were taken into account. One had to agree that there was a great saving in floor space, but one must not lose sight of the fact that the external connections in the case of single-phase transformers are not easy to deal with, and are indeed a costly item. Was it not true that there was a greater difference in the case of a 3-phase transformer between the hottest point and the average temperature of the oil? On page 12 he noticed the authors made no differentiation between the annual charges in respect of iron and those pertaining to copper losses. An old time figure he remembered using was 1s. per watt for iron losses, but this was based on ¼d. per unit for 100 per cent. load factor units. If they took the authors' figure of ⅛d. and present day value of money the 1s. above referred to became something like 2s. 8d. per watt. Now, comparing the single-phase and 3-phase proposition, they had 5 kw. iron loss in favour of the single-phase proposition. This at 2s. 8d. per watt was equal to £666, a fairly substantial item amounting as it did to about 12½ per cent. of the cost of the 3-phase transformers, and more than adequate to provide the extra expenses of external connections.

Major David said he noticed that the cost of the self-cooled transformer assumed a very flat state above the 5,000 k.v.a., so there was really no saving in larger units. The weights also increased for machines above 3,000 k.v.a., and no one would install larger units if they were not going to cost less than smaller units. In the water-cooled type the curves did not flatten out until well after 20,000 k.v.a. The authors referred to the Manchester-Salford inter-linked system as having the highest working voltage. In that district there was an installation of 30,000 volts connecting up two large power schemes across a distance of 10 miles, and 16,000 kw. and 12,000 kw. running plant. This system was being extended at the present moment, and would finally form a transformer system consisting of three legs, each approximately 10 to 11 miles long, and feeding different sections at 3 or 4 points. In connection with this particular system they had installed at each end the 6,000 kw. forced cooled type. One point not mentioned in connection with forced cooled types was the enormous loss of oil. There was rather a depreciatory tendency as to the reliability of large transformers. His company, however, have not had a single case of failure on large units.

Mr. Carter said that as a colliery engineer he was interested in the conveyance of large transformers filled with oil underground. He considered this would be rather a difficult matter. He was inclined to think that the use of single phase current was the better way of maintaining the supply.

Mr. C. Morley New said the authors had omitted to particularly mention in their comparisons anything regarding the cost, reliability, and the type of connections used on the linking-up scheme. In the particular scheme referred to there were 3-phase transformers at one end and single phase at the other. He thought this was a pretty good start for standardisation. He would be interested to know whether the reactance could be altered on an existing transformer without altering or opening the transformer.

Mr. A. C. Macwhirter referred to the special form of clamping up bolt. He asked what provision the authors made in the core type for allowing the cables or the copper strip to take up their relative positions. He did not think the spring clamping bolt a very sound mechanical job, and much preferred an arrangement which would follow up the windings automatically by a coiled spring.

Mr. Wayne Morgan thought that a little more emphasis might have been laid on the nature of the oil to be used for cooling purposes.

Mr. Ellis, Junr., inquired as to the time which elapsed in connection with the shrinking of the insulation between the punchings.

Mr. A. G. Ellis, in the course of his reply, stated that the designer was often hampered by the conditions in the specification which told him how far he had to go as regards insulation, current density, &c., which precluded the production of a satisfactory article from his point of view. He agreed that crane capacity should not stand in the way of producing the best type of plant. On the question of spares, the comparison of single-phase with three-phase was on the same basis. Mr. Chamen raised the point of periodicity. He hardly thought that controversy should have been raised, as it was not really relative to the paper. Mr. Chamen asked quite rightly whether the spring attachment for taking up the shrinkage in winding had been tested in practice. There were several installations and no trouble so far had been experienced. In connection with the query raised by Mr. Newman as to whether there was any variation in the particulars since the data were compiled, prices had certainly gone up, especially of labour and material. He would give definite figures when replying in the *Journal*. The question of road transport had been considered, but his experience in this connection had not been happy. The question of drying out on site depended entirely upon how long the transformer had been on route and lying about. He considered weather-proof transformers should form the subject for a separate paper. Regarding the annual charges for copper and iron losses, he suggested that all the losses that went through a sub-station were chargeable at the same rate, because the losses, as such, could have very little effect upon the load factor in its entirety. The shrinkage of windings reduced the safety factor—hence the necessity for following up the shrinkage, and this led manufacturers to devising springs for taking up the shrinkage automatically. As regards water and air-cooled transformers, when one got down to 1,000 k.v.a. the water-cooled type was more expensive than the self cooled. Views differed considerably as to single or three-phase transformers, and in the end he considered local conditions were the governing factors. Mr. Carter spoke of transformers for colliery work below the surface. There were quite a large number of designs for this type of work, of particularly robust construction and practically oil tight. The type of connections suitable for transformers required a separate paper. It was very unsound practice to attempt, as some manufacturers did, to obtain high efficiencies by cutting down insulation. The question of oil raised by Mr. Wayne Morgan was a very important one, and a paper which dealt with transformer and switch oils would be very welcome.

The authors reserved their full reply for the I.E.E. *Journal*.

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NEW PATENTS APPLIED FOR, 1920.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by MESSRS. SEFTON-JONES, O'DELL AND STEPHENS, Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

7,614. "Arc lamps." A. E. ANGOLD. March 15th.

7,661. "Sparking-plug terminal." A. E. WADE. March 15th.

7,663. "Process of melting and reducing metals." E. C. R. MARKS (Scovill Manufacturing Co.). March 15th.

7,664. "Electric furnaces." E. C. R. MARKS (Scovill Manufacturing Co.). March 15th.

7,699. "Electric fuse-holders." A. H. MAXWELL and F. SHERGOLD. March 15th.

7,706. "Apparatus for continuous production of sheet metal, strip and wire." S. O. COWPER-COLES. March 15th.

7,714. "Sparking plugs." R. BRETON. March 15th. (France, October 16th, 1919.)

7,732. "Electric accumulators." A. B. TREGUANY and J. S. VILA. March 15th.

7,737. "Sparking plugs." G. CALVERT. March 15th.

7,785. "Vacuum tubes." WESTERN ELECTRIC CO. (Western Electric Co.). March 16th.

7,793. "Automatic electrical steering-gear for ships." W. P. GANDELL and A. K. MACRORIE. March 16th.

7,799. "Railway electric track-circuits." W R. SYKES INTERLOCKING SIGNAL CO. and R. W. TARRANT. March 16th.

7,801. "Electric resistance." R. A. R. BOLTON. March 16th.

7,804. "Electric fires." E. C. R. MARKS (Reed). March 16th.

7,809. "Gas-filled electric glow-lamp." SIEMENS & HALSKE AKT. GES. March 16th. (Germany, September 20th, 1913.)

7,815. "Electric generating devices." A. BARRE. March 16th.

7,824. "Magneto-electric machines." BRITISH THOMSON-HOUSTON CO. & A. P. YOUNG. March 16th.

7,831. "Electric switches." IGRANIC ELECTRIC CO. (Cutler Hammer Manufacturing Co.). March 16th.

7,838. "Dynamo-electric machines, particularly motors for use in mines." G. W. WALTON. March 16th.

7,849. "Wireless reception." H. MORRIS-AIREY, S. H. LONG and A. K. MACRORIE. March 16th.

7,850. "Reception in wireless telegraphy, particularly in direction-finding." H. MORRIS-AIREY, S. H. LONG and A. K. MACRORIE. March 16th.

7,851. "Wireless transmitting circuits employing thermionic valves." H. MORRIS-AIREY, A. K. MACRORIE, R. L. RANDALL and G. SHEARING. March 16th.

7,867. "Electric light distribution devices." C. G. SMITH. March 17th.

7,872. "Power-factor calculator for use with idle-current meters in alternating-current electricity systems." W. HUTCHISON. March 17th.

7,887. "Means for supporting arc lamps." A. E. ANGOLD. March 17th.

7,911. "Condensing steam-electric locomotive." D. M. RAMSAY and J. W. WOOD. March 17th.

7,914. "Terminal." I. NASTER. March 17th.

7,925. "Dynamo-electric machines." T. L. R. COOPER. March 17th.

7,932. "Combined electric motor and compressors or pumps." F. ANGELL and H. B. ANGELL. March 17th.

7,941. "Reflectors for electric lamps." J. F. FLETCHER and J. H. JONES. March 17th.

7,943. "Systems of electric ship propulsion." BRITISH THOMSON-HOUSTON CO. and F. H. CLOUGH. March 17th.

7,944. "Protecting compositions." BRITISH THOMSON-HOUSTON CO. (General Electric Co., U.S.A.). March 17th.

7,945. "Electric motor control." J F. TRITLE. March 17th. (United States, June 6th, 1919.)

7,973. "Electrical apparatus for medical purposes." H. J. MONSON. March 17th.

8,015. "Electric incandescent or glow lamp holders." R. T. NORTON. March 18th.

8,026. "Electric lamp holders." BRITISH L.M. ERICSSON MANUFACTURING CO., A. A. GODFREY and H. H. HAYES. March 18th.

8,062. "Electro-magnetic step-by-step mechanism." C. L. WALKER. March 18th.

8,063. "Apparatus for electrically controlling railway trains, &c., through the track." A. R. ANGUS. March 18th. (Sweden, October 10th, 1917.)

8,065. "Electric storage batteries." R E. BESWICK. March 18th.

8,073. "Continuous-current dynamo or motor." J. E. JONES. March 18th.

8,081. "Oscillation generators." WESTERN ELECTRIC CO. March 18th. (United States, June 4th, 1917.)

8,083. "Means of changing poles of four-phase windings." SIEMENS SCHUCKERTWERKE. March 18th. (Germany, June 30th, 1917.)

8,084. "Three-phase machines." SIEMENS SCHUCKERTWERKE. March 18th. (Germany, April 23rd, 1918.)

8,102. "Process for manufacture of wire." S. O. COWPER-COLES. March 18th.

8,114. "Electric candle lamps." C. A. DAMEY. March 18th.

8,118. "Device for lubricating bearing of distributor shaft of ignition apparatus for internal-combustion engines." R. BOSCH AKT. GES. March 18th. (Germany, May 10th, 1919.)

8,120. "Electric switch." W. F. BODDINGTON. March 18th.

8,132. "Inner and outer electrodes of sparking plugs." E. F. BURRILL, S. E. GRUBB and T. E. NANKIVELL. March 18th.

8,144. "Operating generating stations in parallel." A. M. TAYLOR. March 19th.

8,147. "Medical galvanic battery." L. O. SIMMONS and B. B. H. SUMNER. March 19th.

8,160. "Electrical heating elements." H. H. CRESSALL and THE CRESSALL MANUFACTURING CO. March 19th.

8,170. "High-tension magnetos." J. GUARDIOLA. March 19th. (France, January 16th, 1919.)

8,174. "Electric meters for alternating currents." AZIENDA ELETTRICA MUNICIPALE. March 19th. (Italy, March 26th, 1919.)

8,177. "Radio-navigational apparatus, &c." J. ERSKINE-MURRAY and J. ROBINSON. March 19th.

8,200. "Wireless transmitting and receiving apparatus." L. J. PRICE. March 19th.

8,215. "Utilising sound vibrations." H. FAIRBROTHER (Wireless Spitzescope Co.). March 19th.

8,234. "X-ray tube." SIEMENS & HALSKE AKT. GES. March 19th. (Germany, June 22nd, 1918.)

8,244. "Electric motors for starting internal-combustion engines." R. BOSCH AKT. GES. March 19th. (Germany, May 5th, 1919.)

8,245. "Transformers." WESTERN ELECTRIC CO. March 19th. (United States, November 15th, 1917.)

8,249. "Electron discharge devices." GENERAL ELECTRIC CO. and B. S. GOSSLING. March 19th.

8,262. "Terminal fittings for electrical devices." P. R. CARTWRIGHT and E. V. SIMS. March 19th.

8,316. "Spark plugs." O. F. STAHL. March 20th.

8,341. "Telephone systems." AUTOMATIC TELEPHONE MANUFACTURING CO. March 20th. (United States, June 30th, 1919.)

8,352. "Magneto-electric machines." L. N. REDDIE (Camillo Olivetti & Co.). March 20th.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1917.

8,904. ELECTRIC CABLES OR CONDUCTORS. T. S. Seymour and St. Helens Cable & Rubber Co. June 22nd, 1917. (Cognate application 11,528 of 1917.) (139,226.)

1918.

15,603. SYSTEM FOR THE INSTANTANEOUS AND ELECTRICAL HEATING OF WATER. L. E. Seimbille. September 28th, 1917. (119,474.)

19,670. PREPAYMENT DEVICES. British Thomson-Houston Co. (General Electric Co., U.S.A.). November 26th, 1918. (139,240.)

20,459. TELEGRAPHIC SYSTEMS. E. Frattola, V. E. Castelli and R. R. Regnoni. December 9th, 1918. (139,241.)

21,633. METHOD OF ELECTRIC WELDING. T. E. Murray. February 6th, 1918 (123,060.)

1919.

1,598. ELECTRIC TELEGRAPHS. W. H. Roberts and F. J. Matson. January 22nd, 1919. (139,259.)

2,194. CHARGING-BOARDS FOR ELECTRIC ACCUMULATORS. H. Leitner and W. H. Exley. January 29th, 1919. (139,264.)

2,203. ELECTRIC DRY BATTERIES. J. G. Hossack. January 29th, 1919. (139,265.)

3,434. ELECTRIC MOTORS FOR OPERATING PUMPS AND FOR OTHER PURPOSES. I. H. Reid. February 12th, 1919. (139,277.)

3,883. ELECTRIC AND GAS OVENS, STOVES, AND LIKE APPLIANCES. H. H. Berry. February 17th, 1919. (139,285.)

4,472. MONO-POLAR ELECTRODE ELECTROLYSERS. G. G. Hepburn. February 22nd, 1919. (139,296.)

5,736. ELECTRIC PRINTING TELEGRAPH MACHINES. Western Electric Co. (Western Electric Co.). March 7th, 1919. (139,306.)

16,024. GRIDS FOR THE PLATES OF ELECTRIC STORAGE BATTERIES. Van Raden & Co. and H. C. Smith. June 25th, 1919. (139,388.)

20,506. ELECTRIC COUPLINGS. E. H. Fuller & Ross, Courtney & Co. August 20th, 1919. (139,416.)

20,885. ELECTRIC ALARM OR DOOR SECURITY DEVICES. K. Krone. August 25th, 1919. (139,418.)

24,214. SOUND-REPRODUCERS FOR GRAMOPHONES AND TELEPHONES. Resonance, Ltd., R. A. Dibden and G. H. Glover. October 3rd, 1919. (139,431.

24,738. ELECTRICAL APPARATUS FOR OPERATING RAILWAY SIGNALS. Soc. d'Electricite Mors. October 4th, 1918. (133,703.)

27,265. MEANS OF FASTENING A COVER ON A MAGNETO FRAME. Soc. des Moteurs Salmson. September 10th, 1919. (139,440.)

Modern Lighting Methods in Small Houses.—That modern scientific methods of illumination are just as necessary and beneficial in the small house as they are in the largest interiors is an obvious truism to any lighting engineer. In many cases, however, the owners of ordinary suburban houses appear to be under the impression that the many new kinds of indirect and semi-indirect equipment, which have been developed during recent years, are for some reason not suitable for their small rooms. As a matter of fact, the very opposite of this is true, because it *is* in small rooms with comparatively low ceilings that the glare and bad distribution from bare or improperly shaded lamps is most pronounced, since it is impossible in such situations to place the lamps outside the normal range of vision, and equally impossible, as a rule, for several occupants to arrange themselves so that each secures a good reading light, free from shadows. The illuminating engineering department of the British Thomson-Houston Co., Ltd., points out that an electrical contractor who cares to carry out a simple demonstration should have no difficulty in convincing the average householder of the advantages of indirect and semi-indirect lighting for the illumination of small and moderate-sized living rooms. For example, in a sitting-room lighted by a central arm fitting equipped with, say, three 40-watt lamps in ordinary ornamental glass shades, the contractor could substitute temporarily, for demonstration purposes, a small semi-indirect fitting with a Veluria or Druid white glass bowl containing a single 60- or 100-watt Mazda half-watt lamp.

It will at once be apparent that, even with this reduced wattage, the lighting results are vastly improved. The intensity of illumination will be a great deal more uniform, the diffusion will be infinitely better, and it will be found possible to read comfortably in any part of the room, and in any position relative to the light source. In addition, there will be no glare, because the brilliant lamp is completely screened by the diffusing bowl of the fittings. Totally indirect lighting on the B.T.H. "Eye-rest" system is also admirably suited to the illumination of small living rooms, and the characteristics of good diffusion and absence of glare are even more pronounced than with semi-indirect lighting. An "Eye-rest" fitting can be temporarily rigged up in a very short time, and the illumination results are bound to make a strong impression upon anyone who has not previously had experience of this method of lighting.

Such a demonstration as this could be carried out very quickly. The substitution of one fitting for another should not take more than 10 minutes or so, and in all likelihood the contractor will not be asked to put the old fitting back.

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THE

ELECTRICAL REVIEW.

VOL. LXXXVI. APRIL 9, 1920. No. 2,211.

ELECTRICAL REVIEW.

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LONDON TRANSPORT.

THAT the problem of passenger transport in the Metropolitan area, which now contains nearly eight million souls, is one of extraordinary complexity and difficulty, is a matter of common knowledge. It is not, however, unique; the population of Greater New York is practically identical with that of Greater London—but after these two there is a sudden drop to about three millions in Paris and Chicago. In all such vast aggregations of humanity there are great tides of passenger traffic, which have to be provided for by the public transportation systems—railways, tramways, and omnibuses—and the task of obtaining, in the words of the Advisory Committee on London Traffic, "a just and true perception of the proper functions of each form of transit, in order that wasteful competition may be avoided, and each used to its highest efficiency," is a difficult and anxious question.

In view of these considerations, it was with interested anticipation that we took up a paper on the "Street Passenger Transport of London," which was read before the Royal Society of Arts, on March 17th, by Mr. W. Worby Beaumont, who has for many years made a study of passenger vehicles, and might be expected to make a valuable contribution to the literature of the subject. But alas!—although the author opened with a reference to the "partisan element which enters into discussions, writings, and conclusions" on systems of transport, and addressed himself to "a discussion of the arguments that are most commonly the cause of the fissiparous misdirection of public opinion," our hope of a judicial pronouncement was not realised. After giving figures showing the magnitude of the problem, and outlining the propositions of the London County Council for the extension of its tramways, Mr. Beaumont plunges into the controversy between the advocates of tramways and omnibuses, and reveals himself as an out-and-out partisan of the latter party. Ignoring some of the most important considerations involved in the question at issue, he can see no point in favour of the tramcar, while he eulogises the omnibus *ad nauseam*.

That the omnibus is not only a useful, but an indispensable factor in passenger traffic, we fully agree; we care not whether the tramcar or the omnibus survives, provided that it is the survival of the fitter. In point of fact, however, we do not believe that the continued existence of either is at stake—the tramcar is no less indispensable than the omnibus, and each has its proper functions to fulfil. As to the nature of those functions, we seek a "just and true perception," which is not likely to be gained by the uninstructed reader of Mr. Beaumont's paper.

To put the matter briefly, we look upon the motor-'bus as a luxury—the tramcar as a necessity. Luxuries have to be paid for at suitable prices, and all the arguments in the world will not dispose of the fact that the omnibus cannot compete with the tramcar on a commercial basis. In our issue of November 14th, 1919, we quoted Mr. Fearnley's figures, which showed that in Sheffield the total costs per passenger were 2·76 times as great with the omnibus as with the tramcar, and the average fares charged were in the ratio 2·3 to 1. In London the 'buses running on tramway routes are compelled to charge the same fares as on the cars; elsewhere they are more costly per mile. If the London tramways were not weighed down with enormous capital charges due to the adoption of the conduit system, the comparison would tell still more in their favour, while if they were relieved of the burdens of cheap fares for workmen, maintenance of the pavement that they do not wear, the cost of street improvements, and heavy rating, and if the omnibuses had to pay for the use of the roads as part of their legitimate working costs, the 'buses could not afford to run on tramway routes at all.

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Even under the existing conditions, what are the financial results? It was unfortunate for Mr. Beaumont that his paper was read at a time when the London motor 'buses were emitting a bitter cry for help through the medium of the underground railway companies. With a capital of 3½ millions sterling, the London General Omnibus Co. last year made a net loss of over £200,000, *without* allowing a penny for interest on debenture and ordinary stock. The estimated result of working in any future year, is no less than a "loss of £1,011,195 before providing for any interest on debenture and ordinary capital" (report of the Advisory Committee on London Traffic). Against these results, what showing will be made by the L.C.C. tramways? From the same source we find that for the year just ended the estimated deficit is £136,907, *after* paying interest and sinking fund charges on capital (8½ millions sterling), and for the year now current, £579,381. If the L.C.C. did not pay the capital charges, it would show a considerable surplus next year, contrasted with the loss of a million on the omnibuses.

Of course, steps are urgently needed, and are being taken by Parliament, to enable the tramway undertakings to be replaced on a sound financial basis by increasing fares to correspond with the present-day value of money; and one effect of that will be to enable the omnibuses on competitive routes to raise their fares also—but the relative positions of the two will not thereby be altered, and the fact, as we stated above, remains that the omnibuses, though not handicapped like the tramways, cost far more per passenger to run. Their proper function, therefore, is to ply on routes where there are no tramways, and where they can be made self-supporting by charging high fares.

To return to Mr. Beaumont's paper, he cites the fact that, with fewer seats, the 'bus carries more passengers per seat than the tramcar, as a proof of preference for the 'bus on the part of the public; but this ignores the fact that the 'buses can run at will through the busiest streets in the City and West End, and between North and South, skimming the cream of the traffic, where no tramcar has been permitted to ply. With charming artlessness, Mr. Beaumont claims for the 'bus that it has played a great part in "fitting the roads of London to the requirements of the vehicles they are to carry"; "although it can run on any road . . . good roads suit it and its passengers better. This fact encourages the making and maintenance of good roads"—*at whose expense?* As usual, the public pays. Again, he alleges that "repairs to the tramway track are the constant cause of breaking up the road surface"; we do not agree—but we know only too well what the 'bus does to the road surface in the suburbs. His gibe at the L.C.C. tramway system's incapability to meet its own trading costs—when the 'buses have to be subsidised by the railways to the tune of half a million, and have to face a deficit of more than twice as much in the future—savours of effrontery. The latter part of his paper is given up entirely to virulent abuse of the tramcar and the tramway, and he arrives at the conclusion that the number of omnibuses should be increased, the tramcars and rails sold, and the London traders should be invited to show their gratitude for the change by paying the difference between the receipts for the sale and the cost of reinstatement of the roadways and the redemption of outstanding capital! Really, we cannot help laughing!

Hiring Powers.

As we have pointed out, in addition to its main features, the Electricity (Supply) Act contains many minor provisions which are of great importance to the industry. Not least of these is the clause (No. 23) which confers upon every local authority which is engaged in the supply of electricity the power to provide, let for hire, connect, repair, maintain and remove "electric lines, fittings, apparatus and appliances for lighting, heating and motive power, and for all other purposes for which electricity can or may be used." Moreover, the undertaking is safeguarded against the loss of such plant on hire on consumers' premises by distraint, bankruptcy, &c.

We doubt whether it is generally realised by municipal supply authorities how wide are the powers with which they are thus endowed. So long as they do not manufacture or sell such apparatus (unless already authorised to do so), they have a free hand. They have long striven to secure these rights; we hope that, now that they have them, they will not fail to use them freely—and that in doing so, they will act in hearty co-operation with the contractor, who is their best friend, and ought to be enlisted as an ally in the good cause.

Circularising and Propaganda.

The thing which debars many electric supply undertakings from circularising widely is the cost of distribution. They do not begrudge a halfpenny or a penny for the cost of the circular, but when every circular costs a halfpenny to deliver, some undertakings jib at the expense. For the moment we are not criticising this point. But there are occasions when the distribution can be done free. First, with the usual correspondence with consumers; secondly, and this is a way of reaching every consumer, with the quarterly accounts. In a week or so, electricity undertakings will be sending out the March quarter accounts. During the war, of course, circularising was compulsorily stopped, and a habit sometimes persists when the original stimulus, or cause, ceases. But it is to be hoped, for the success of the industry as a whole, that this will not be the case on the question of renewing circularising. The present March quarter affords a particularly good opportunity for action in this direction, since the rebate to consumers will appear on these accounts. True, it will be small: but however small it is, there will be a refreshing impression given to the consumer. After an almost monotonous succession of increases a cessation is a relief, and a slip backwards in cost is certainly a pleasure. So there is not likely to be a better moment to suggest to a consumer the additional uses of electricity, and with the housemaid trouble as bad as ever, every household economy of labour is likely to be welcomed. We hear that electric washing machines at about £25 each are having a wide sale, so small apparatus ought to go well. Our friends, the Electrical Development Association, as we hardly need remind the undertakings, cater for all needs in the way of providing circulars; but whether use is made of these, or whether the undertakings print their own, the opportunity thus afforded by the sending out of quarterly accounts ought to be made the most of.

A German Loan in Switzerland.

A decidedly unfavourable statement was placed before the shareholders by Herr von Gwinner at the recent annual meeting of the Electric Light and Power Investment Co., of Berlin. It was possible for quite a number of years prior to the war for capital to be raised in Switzerland on lower terms than in Germany; and companies having international interests occasionally had recourse to the Swiss money market, partly on account of these interests and partly for reasons of economy. The Electric Light and Power Investment Co. represents a case in point. In 1907 the company raised a loan of 10,000,000 fr. in Switzerland, bearing interest at the rate of 4½ per cent., payable in Swiss francs, and redeemable in 1927. The company's total revenue in 1918-19 amounted to 3,600,000 marks, but owing to the depreciation of the mark in exchange with Switzerland, a sum of from 8,000,000 to 10,000,000 marks per annum is needed for meeting the interest charges on the Swiss loan, whilst an amount of 140 millions of marks would be required to redeem the loan at the present rate of exchange, or 4½ times the total ordinary share capital. It is quite impossible for the company to meet these obligations, and the managers have been instructed to enter into negotiations with the Swiss bondholders, so as to determine what steps are to be taken in the matter. If a practical way out of the difficulty is not forthcoming, Herr von Gwinner states, it will be necessary again to call the shareholders together in the near future, and perhaps utter the ominous word (bankruptcy).

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THE MANUFACTURE OF VACUUM CLEANERS AND ELECTRIC DRILLS.

A Visit to the Works of Messrs. Scholey & Co., Ltd.

Although the "vacuum cleaner" is one of the most popular electric helps in British households, it has hitherto been manufactured mainly in the United States; obviously that is a highly undesirable condition, particularly at a time when the reduction of imports from America, and the increase of our exports, urgently call for encouragement, in order to redress the adverse balance of trade. We had much pleasure, therefore, in visiting Messrs. Scholey & Co.'s works at Croydon last month, where the firm has embarked on the production of suction cleaners of wholly British make—the only exception to this claim being the switch.

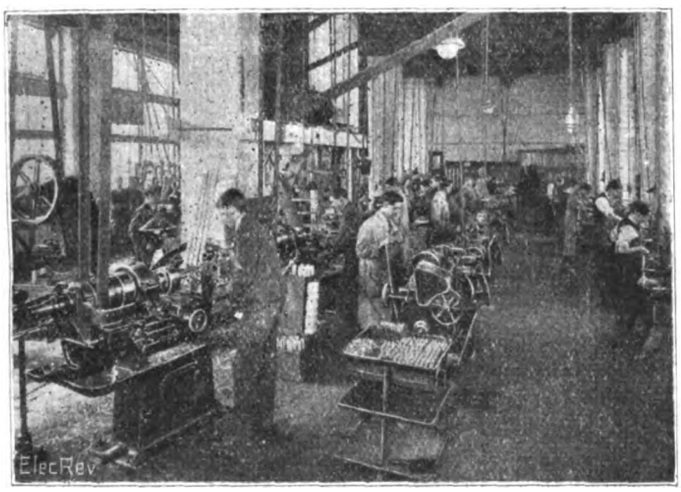

Fig. 1.—Machine Shop.

Simultaneously the firm has undertaken the manufacture of portable electric drills on original lines, a type of apparatus which has much in common with the suction cleaner, and which calls for a very high grade of workmanship, further accentuating the necessity of using close limits.

In both devices the motor is the crux of the design; it must be absolutely reliable and fool-proof, as it will receive

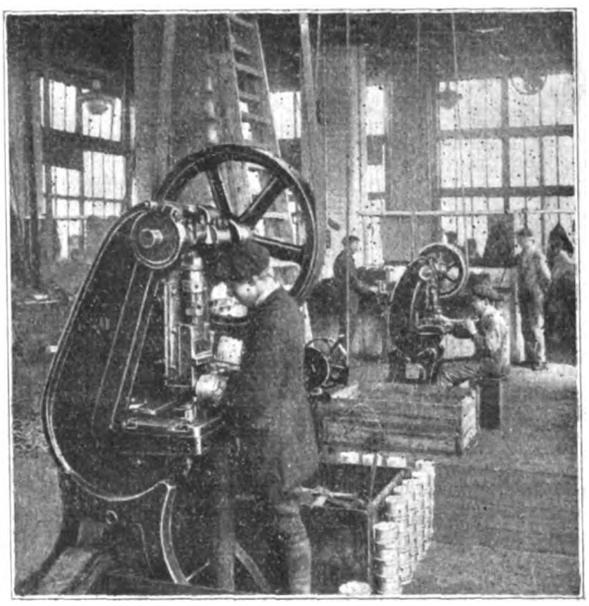

Fig. 2.—Stamping Machines.

The machine is of the well-known "Premier" type, which the company has sold for many years, and of which enormous numbers are made in the States; it comprises some 200 component parts, and in order to manufacture it on commercially competitive lines a high degree of organisation has been necessary. Moreover, in view of the

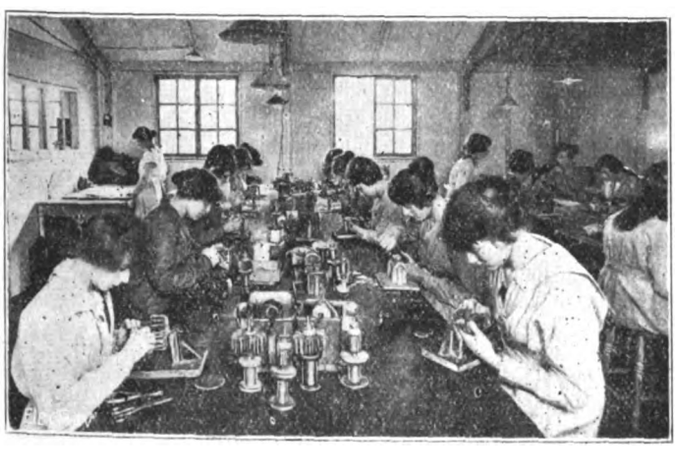

Fig. 3.—Armature Winding Shop.

no more attention than can be expected at the unskilled hands of the domestic and industrial user. The output is very small—one-tenth or one-twentieth of a horse-power—and the motor must be designed to run equally well on D.C. and A.C. circuits, at pressures up to 250 volts; consequently

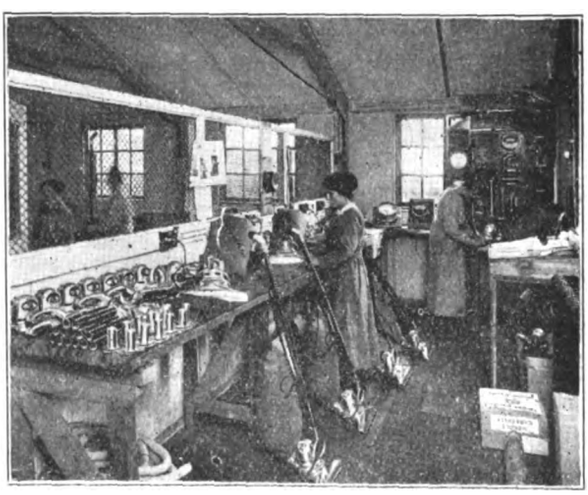

Fig. 4.—Testing "Premier" Suction Cleaners.

difficulty experienced by the firm in obtaining small parts elsewhere, almost every individual piece has to be manufactured on the spot, and this has necessitated the provision of a number of special tools and jigs, many of which are of exceptional interest. The components are manufactured to gauge within extremely fine limits, so that the parts can be passed into store in large quantities, and, being completely interchangeable, can be assembled without further operation.

the design of the motor presents some very interesting technical problems, and the manufacturing processes must be no less carefully worked out. Portability and price considerations both call for a high speed, which also reduces the number of turns on the armature, and allows of the use of stronger wire; a normal speed of about 10,000 R.P.M. has therefore been adopted, although even with a two-pole field magnet, this means a frequency of magnetic reversals in the armature core as high as 167 per second, necessitating very careful lamination and the use of the best material.

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In order to run on both D.C. and A.C. circuits at the same voltage and output, the field magnets have to be series wound, and this again offers the advantage of few turns and thick wire. The variation of speed with load is immaterial, as the light-load speed of a drill seldom exceeds the full-load speed by more than 50 per cent., and in the case of electric drills the fall in speed with increased load is a distinct advantage and safeguard. Further, the resistance and inductance of the series field-winding help to limit the maximum short-circuit or standstill current to two or three times the normal current, and as this can be safely carried for several minutes, no special cut-outs or fuses are needed to protect the motors. In the case of the cleaner the load is practically constant.

The commutation problem would naturally be expected to offer some difficulties at such a high speed, and with alternating current at 250 volts and any frequency up to 100 cycles per second; however, after a good deal of experimenting, the firm has evolved a satisfactory commutator, which closely resembles that used on a large motor, and, with high-grade carbon brushes, gives satisfactory results even under the severe conditions mentioned above.

At so high a speed the mechanical balancing of the rotor is also very important; any slight want of balance at once leads to trouble with the commutator and bearings, and causes noisy running. To provide for this, the armature core is carefully balanced, as well as the fans, &c., that are attached to the armature, and a specially-divided winding is used, which avoids bunching of the end windings.

The three machines chiefly turned out by Messrs. Scholey and Co. at present are:—

No. 1 vacuum cleaner, absorbing 160 watts and developing about 1/10 B.H.P. The pressure produced at the outlet, with the bag removed and the outlet closed, is about 10 in. water gauge, and the weight complete with base, handle, and flexible is 11½ lb. (fig. 8).

No. 0 drill, absorbing 100-120 watts and developing about 1/15 B.H.P.; weight complete, 3 lb. (fig. 7).

No. 1 drill, absorbing 160 watts and developing about 1/10 B.H.P.; weight complete with chuck, flexible, and switch, 9 lb. (fig. 9).

The base of the cleaner is an aluminium casting embodying the suction nozzle, fan chamber, and exhaust pipe; a suction fan on the armature spindle sucks the air through the nozzle into the fan chamber, and exhausts into a stout dust-proof drill bag through the exhaust pipe. The motor is controlled by means of a rotary switch contained in the handle. The cleaner is carried on three castors, two at the front and an adjustable one at the rear. The base castings are machined on all working and locating faces, and all holes in the castings are jigged. The motor case consists of two aluminium castings, the body being bored to accommodate the field magnet, cover, and bottom bearing, and turned to fit its housing in the cleaner base, while the cover is turned to fit the body, and bored for the bearing and brush-holders; the cover is secured to the body by means of two screws, and after assembly the bearings are finish reamed to ensure perfect alinement. The brushes are well insulated with fibre bushes and caps. The motor is secured in the base by means of two grub screws at an angle, making an air-tight joint. The armatures are built up of laminations of best electrical sheet-steel mounted on a spindle which is hardened and ground; after assembly the armature is finished on the periphery by grinding, thus ensuring as far as possible

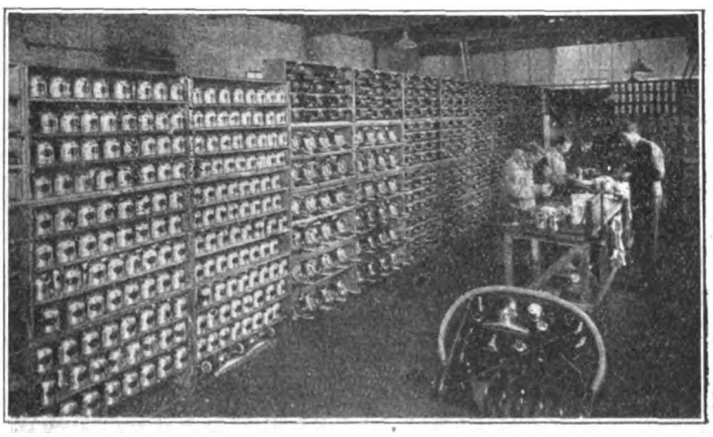

Fig. 5.—Store for Finished Parts.

Fig. 6.—Assembling "Kutmore" Drills.

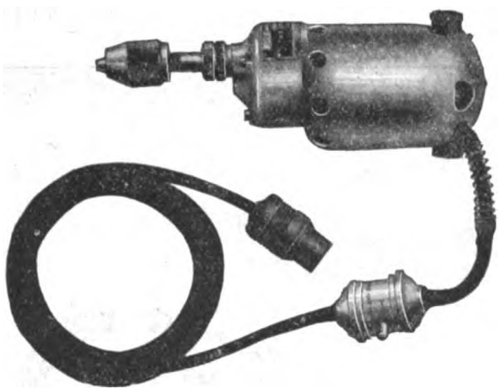

Fig. 7.—No. 0 "Kutmore" Drill.

Fig. 8.—"Premier" Suction Cleaner.

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perfect balance. The commutators are assembled whilst hot, which practically eliminates any possibility of segments working loose, should the machine become heated after a prolonged run.

The field magnet is built up from laminations which are made of the best electrical sheet-steel, secured together by means of four rivets and held in position in the motor case by means of two screws. The armature spindle runs in phosphor-bronze bearings lubricated by contact with felt pads saturated with oil—seized bearings in these motors are

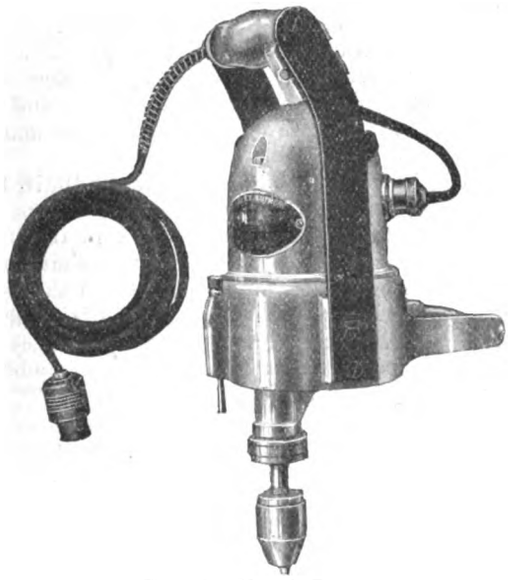

Fig. 9.—No. 1 Drill.

said to be practically unknown. All components are subject to a rigid inspection and test.

In drill No. 0 the body cover and gear case are made from aluminium castings of a special mixture embodying extreme lightness with the maximum strength: all working faces, and locating faces, are machined and are interchangeable.

The chuck spindle is geared down to 3,000 R.P.M. by means of a 2 to 1 reduction gear, the pinion driving a gear fixed to the chuck spindle, both of which are machine cut, case-hardened, and ground in gear, ensuring perfectly smooth running. All are contained in the gear case, which is packed with thick grease ensuring ample lubrication. The spindle fits into a tapered hole in the pinion, and is held in position by a nut, an absolutely positive drive being guaranteed by a feather.

All holes are jigged, and bearings are finish reamed in position. The end thrust on the chuck spindle is taken on a ball bearing; wear is taken up by means of a thrust collar and screwed cap at the front end of the spindle, the cap being secured by a locking nut, which is tightened up after adjustment.

The machine is fitted with a Goodell Pratt chuck, and will drill $\frac{1}{8}$-in. diameter holes in steel, $\frac{3}{16}$-in. diameter holes in brass, and $\frac{1}{4}$-in. diameter holes in hard wood.

No. 1 drill is double geared; the chuck spindle runs at 2,850 R.P.M. high speed, light, 1,700 R.P.M. high speed on load, 820 R.P.M. low speed, light, and 490 R.P.M. low speed on load: the changes in speed are provided for by means of reducing gears of 3·5 high, and 12·2 low, from the armature spindle running at 10,000 R.P.M. light and 6,000 R.P.M. under load. The chuck is of the Goodell Pratt pattern, taking drills up to $\frac{3}{8}$ in., and the machines will drill holes in brass up to $\frac{3}{8}$-in. diameter and in steel up to $\frac{1}{4}$ in. The machine is controlled by a switch contained in the handle, this being secured to the gear case by means of two stout steel plates $\frac{1}{8}$ in. thick, held in position by means of four $\frac{1}{4}$-in. countersunk head screws. The switch is controlled quite easily by two buttons which are in close proximity to the operator's thumb or index finger.

All electrical connections are well insulated, and provision is made for earth connections from the frame of the machine.

In conclusion, we may mention that a specially commendable feature of the company's organisation is the attention given to the comfort and well-being of the employés. Mr. Scholey, as one of the founders of the Industrial League, whose aim is to promote harmony between employer and employed, has naturally not failed to strive for this end in his company's own works, and we understand that the efforts which he and his partner, Mr. C. W. Hill, have put forward have been entirely successful. To command success, one must first, we are told, deserve it; Messrs. Scholey & Co. have set about it in the right way, and we wish them all the success that they would wish themselves.

CAPITALISTS ALL!

By H. R. TAUNTON.

Reconstruction!—O blessed word!

With what crippled resources are left to us, we are setting out to remodel the world—and incidentally to regain our pre-war pre-eminence in the world's markets. We are all, in theory, co-operating to this end; our hearts swelling with ideals, our mouths big with quotations from the text-books of political economy. In practice—in practice the employers are profiteering, the employed are slacking, and the Government is governing—too much!

We have all been hard at it, for 15 months—reconstructing; and we have arrived at nothing more tangible than a complicated triangular quarrel, in which each blames the other two. Leaving the Government out of it—would that we could!—the quarrel between Capital and Labour has developed to a pitch at which collaboration between them for any common end seems hopeless. Each has its own theory of the lines on which reconstruction should go; and, of course, that theory is fundamentally unacceptable to the other.

The trouble with all their theories is that they are based on class selfishness. To the capitalist, reconstruction means more profits; to the workman it means higher wages; and each thinks the other's advantage incompatible with his own. Between the two the country's advantage, the common weal, is altogether lost sight of.

But national prosperity, increased profits and higher wages are not incompatible. The first, the one essential, is to fuse the opposing interests of employer and employed. If, for instance, we were all capitalists, or if we were all workers, our interests would be identical. With nothing to quarrel about, we should have nothing to do but inaugurate the Golden Age. We have to meet on common ground before we can set out together on the path to national prosperity. And that common ground lies much further from the capitalist than from the labour man. It is the capitalist, therefore, who must make the first step towards it.

A few steps have been taken by individual capitalists. Little, timid, faltering steps; social clubs, model villages, bonuses, and profit-sharing schemes. Half-hearted, grudging experiments, eyed askance by Labour. They leave the employer still so far from the common ground that the employed has not thought it worth while to make a move towards it.

"These are very pretty notions," says he, "but I suspect I'll pay for 'em in the long run."

You offer a man paid by the hour a bonus for completing a certain job in a stated time; say, a day's extra pay. He smiles; quietly goes on "soldiering," and draws an extra week's money for the same amount of work.

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The inducement is too small. You expect too much *quid* for your *quo*. In short, you must make up your mind really to *give* something—something big, and without obvious return; to take many long, decided steps to that common ground aforesaid.

"Oh, yes!" says Labour. "National reconstruction. Co-operation. You talk, and you talk . . . and then you roll off in your car to Park Lane, and I battle for the 'bus to Battersea. United efforts—mutual benefits. Soft thing for you; but what price me?"

Of course, he's a narrow-minded materialist, enviously blind to the idealism of your altruistic schemes of reconstruction. But having been foolish enough to educate him, you can hardly be surprised that he has learned to think. He expresses himself crudely, maybe; but his thoughts are the obvious ones, and his phrases to the point. Be candid, capitalist. Ask yourself: How can I expect from my co-worker enthusiastic support of any campaign of national reconstruction which gives me pounds and him pence; or expect his grateful admiration of paltry profit-sharing schemes the invariable basis of which is that his share of my profits shall be strictly and narrowly limited?

The fallacy—the key to the whole problem—lies in those words "my profits" which came so naturally, so instinctively, to your mind. If, now, you could only bring yourself to the realisation that they are also "his profits," that he is a shareholder in your concern, in short, a capitalist like yourself, how immensely it would clarify the issue!

(In parenthesis, this is not, as you may perhaps be inclined to dub it, an essay in cheap socialism, but a logical attempt to argue from fundamentals to a workable scheme of co-operation between the apparently opposed interests of Capital and Labour. If some of the arguments savour of the Bolshevik, it is because the few solid truths on which are based the futile dreams of so-called socialism are fundamental to the present problem.)

We have arrived, then, at the point of considering the claim of the employé to be called a capitalist.

The usual idea of a capitalist is a person whose capital consists of cash, or assets easily and quickly convertible into cash. This capital he has acquired by thrift, by trading, by speculation, or by inheritance from others who have acquired it in the same way. By whatever fair means he has come by it, we are agreed (bar our Bolshevik friend, from whom we here part company) that he is fully entitled to do what he will with it—squander it, spend it, invest it. If he elects to do the last, he becomes the Capitalist, with a capital C, who figures so largely in the Labour Member's speeches.

He may invest this capital of his in a business which he himself controls, or in a company controlled by others. He is either employer or shareholder; and in either capacity he expects a return for his capital. But he will wait a very long time for it, unless he himself introduces, or pays others to introduce, other forms of capital. Money alone will not beget money. It is like muck, they say, no use unless it be spread. Like muck, too, which won't produce flowers without the aid of soil, sun, and rain, it needs the help of brain and muscle to produce that tender flower, a dividend.

There, then, are the other forms of capital essential to the development of any business: brains and muscles. Take the case of a professional man, say a doctor. His material assets may be practically nil, and if he can do nothing better than contemplate his bank balance, he will speedily find himself in the workhouse. But by making use of his other forms of capital—his specialised training, his medical knowledge, his surgeon's skill—he makes a living, and presently finds himself in Harley Street. The capital on which he earns his dividend is not his material capital, but his physical and mental capital.

Take, at the other extreme, a score of ignorant multi-millionaires, who pool their fortunes, and buy mammoth works and palatial offices, equipped with valuable stock and expensive machinery, marble staircases, and complicated card-index systems. They then retire to smoke Coronas in a mahogany-panelled board room, and await results. Nil! They have overlooked the necessity of introducing other forms of capital; forgotten to engage managers, foremen, clerks, and workmen, who posses those other forms of capital.

Thus, logically considered, material assets, although they have arrogated to themselves the sole title of capital, are really the lowest form of capital; for alone they cannot earn a dividend, whereas brains and muscles, the higher forms, can, and commonly do, earn a dividend without the aid of money. Naturally, however, the best results are obtained by the combination of all forms of capital—brains and muscles, and material assets; as in the case of all trading and manufacturing concerns.

Let us consider the case of an ordinary limited company, a firm, say, of dynamo manufacturers. The capital—the material assets that figure in the balance sheet—has been put up by a number of shareholders, who hold, some ordinary, others preference shares. At the end of the trading year they receive dividends proportionate to their holdings. They say as they hand the cheque across the breakfast table to their admiring wives, "See what my capital has earned me!" What is more, they believe it—implicitly. If they consider the matter at all, they think that by some mysterious process of spontaneous generation their big cheque has turned itself over in its sleep, and become the father of a promising family of little cheques. And they let it go at that.

But, of course, they are quite wrong. What has earned them their dividend is not *their* capital, which has been little more than a convenient tool, but the other and higher forms of capital used in the concern, in the shape of the character, business acumen, and powers of organisation of the managing directors, and to a less degree of the other directors, the training and experience of the managers and foremen, the technical accomplishments of the draughtsmen, the accuracy of the clerical staff, and the highly specialised skill or sheer physique of the workmen. These form the true capital which has earned the shareholder his dividend.

And the more this capital is developed, and the more valuable it becomes, the greater the dividend it earns. For whom? Not for the real owners of it, but for the shareholder, whose own capital remains the same as when he first introduced it. It may have acquired an increased nominal value on the Stock Exchange, but it is a fictitious one—a parading of borrowed plumes.

There lies the crux of the whole problem. On the one hand you have the men of money, on the other the men of brains and muscle. Each contributes capital to the business. It flourishes and develops. In this development the brain and muscle are active agents, the money a passive tool. But the increased value of the business benefits the contributors of one kind of capital only: the stationary capital, the money. The others—they get their fixed pay. In other words, the possible earnings of the lower form of capital are almost unlimited; those of the higher form, definitely limited.

There will be no solution of the present economic problem; there will be no co-operation in reconstruction; until it is recognised that every member of a firm, shareholders and employés, are contributors in different degrees and kinds to the working capital, and as such should be given equal opportunities, in proportion to their respective contributions, of sharing, without limit, in the development of the firm.

(To be continued.)

Egyptian State Railways.—H.M. Commercial Agent for Egypt has been informed on good authority that it is calculated that during the next five years the Egyptian State Railways will require about £2,000 000 for permanent-way renewals and minor bridges, £3,000,000 for engines and rolling stock, £1,500,000 for larger bridges, £500,000 for telegraphs and telephones, as well as additional sums for other improvements.

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A.I. ELECTRIC RESISTANCE WELDING.

The subject of electric welding is one which was very much to the fore during the war, and many and valuable were the discoveries and improvements made. One of the most promising was the extension of "resistance" welding, and in connection with this method we were privileged last week to inspect at the works of the A.I. Manufacturing Co., of Bradford, a most instructive demonstration of the capabilities of some of the welding appliances made by this enterprising firm.

The A.I. Co. is a descendant of the old firm of Armatage and Ibbetson, which during the war entered upon munition work, in course of which it had to make use of such welders as could then be obtained. This showed the utility and also the weaknesses of this kind of plant, and since the armistice the firm has developed a very full series of welders for spot, seam, and butt welding, as well as for the heating of rivets.

The range now covers eight machines for spot work, dealing with metals up to $\frac{3}{8}$ in. in thickness or "$\frac{3}{4}$ in. added," as it is termed, seven machines for seam welding up to 3/16 in. "added," and thirteen machines for butt welding; these last will deal with anything between, say, the filament of a tungsten lamp and a steel plate of 10 sq. in. section.

We have, from time to time (Elec. Rev., March 21st, 1919, p. 333), noted various apparatus for this duty, and whilst the different machines have their own special features the demonstration given by the A.I. Co. showed that its outfit was fully capable of doing all that was claimed for it, and incidentally the claims are by no means few.

Amongst those who had accepted invitations were representatives of the Admiralty, railway companies, shipbuilders, mechanical and electrical engineering firms, together with many of the leading manufacturers of hollow ware and similar articles.

The company's works are well organised for its purpose, and are laid out for mass production of the main standards and frames of all machines. The various attachments for spot and seam welding, for example, have been so designed that whilst a line of standard machines is built for a specified result, it is quite a simple matter to change over from one class of work to another. A feature to which special attention has been paid is the design and fixing of the transformer. It is claimed that its efficiency is much higher than is usual for this class of machine and the tracing of the secondary conductor is certainly mechanically sound. The actual voltage of the secondary is, of course, quite low, but the amperage of the larger welders reaches a value of several thousands. A switch is provided for altering the transformer taps so as to control the required welding heat. All machines are very simple and easy to operate, so that quite unskilled labour can be employed. Automatic trip switches are fitted so that when set repetition work can be turned out very rapidly with the full assurance that the work will not be unsound. The pressure necessary for "upsetting" on butt welding is obtained by springs which are adjustable to meet the full range of work of which the machine is capable. The power taken varies from about 3 K.V.A. in the small sets to 80 K.V.A. in the larger butt welders.

At the works all classes of welders were shown in operation. Spot and seam machines were dealing with thin sheets, and the ease and speed with which a box or drum could be jointed up was very fully demonstrated. Spot welding can also be done with the spots so close together that, in effect, it becomes a seam weld, and is particularly useful when the welding line or edge is irregular. Machines of this class are power driven—the top and movable arm making, as it were, many strokes or contacts per minute as the work demands.

The larger machines for both spot and butt welding were also in use—one interesting job being the welding of several steel tires for heavy motor vehicles. This was done by what is called a flash weld, *i.e.*, the rough edges of the joint are gradually burnt away, until fusion takes place across the full width. To the visitor the process is somewhat spectacular—the welding being accompanied by a fine pyrotechnic display.

Another machine dealt with the welding of steel rods, one test being the jointing of a piece of Vickers vanadium to a length of mild steel, the section of both being 1 in. by $\frac{1}{4}$ in. A special portable machine for welding stator conductors in position was also on view.

A large number of specimen welds was shown, ranging from the thinnest wire used in jewellery and platinum tips for bell contacts, up to large rods and plates. Special attention was directed to the welding of two metals hitherto found to have been difficult to deal with by this method, viz., soft steel to nickel, but samples of this work in connection with spark plugs and other articles were shown.

A noticeable exhibit was some 12 in. by $\frac{3}{4}$ in. steel plates, to which at one end were welded similar plates by the oxy-acetylene process, whilst at the other end were plates spot welded by the A.I. Co. These welds had been made in order that comparative tests of the two methods might be carried out, and the whole of the work is under the general supervision of the Admiralty, which will make the actual tests.

A rivet heating machine was also at work, and clearly demonstrated the advantages of this method. The general arrangement of a 3-head rivet heater is shown in fig. 1. The rivets are quickly heated, and it was interesting to observe that when the end to be upset was at the proper temperature the head already formed was much cooler. Heating by this means results in very clean rivets, and with the use of multiple head machines riveting becomes almost a continuous process.

Data regarding the current consumption, &c., for welding are as under:—

For spot welding M.S. clean plate, the single metal thickness varies from No. 34 S.W.G. to $\frac{3}{8}$ in.; added thickness from 0.0184 to $\frac{3}{4}$ in.; number of welds per KW.-hr. from 4,000 to 8; time of each weld from 0.25 to 15 seconds; and the diameter of the spot from 1/16 to $\frac{3}{8}$ in.

For butt welding M.S. clean bar, the section of the material varies from No. 24 to 2 in.; area of rod from 0.00038 to 3.14 in.; number of welds per unit from 15,000 to 0.77; and the time per weld from $\frac{1}{4}$ to $1\frac{5}{8}$ seconds.

For seam welding M.S. clean plate the single metal thickness varies from 34 to 16 S.W.G.; added thickness from 0.0184 to 0.128 in.; length of weld from 150 to 30 ft. per unit; and the speed of welding from 12 to 6 ft. per minute.

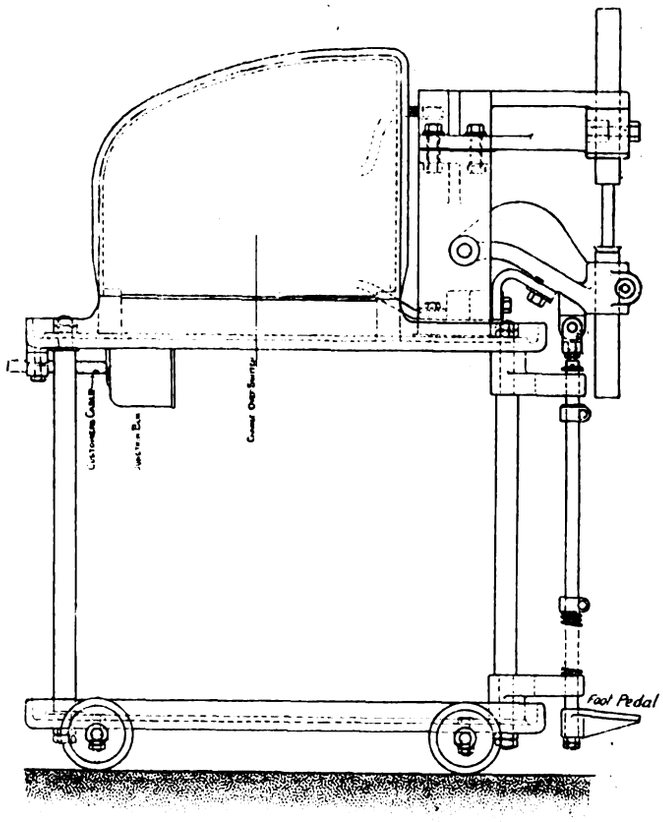

Fig. 1.—General Arrangement of Three-head Rivet Heater.

Rivet heating data according to the type of machine used are as follows:—

The size of rivet varies from 5/16 by $\frac{3}{4}$ in. to 1 by $4\frac{1}{4}$ in.; output per hour on 3-head machine from 2,000 to 100; and the number of rivets heated per unit from 200 to $3\frac{1}{4}$.

For drawing and forming work on certain materials, the dies should be heated, and a convenient method of doing so is by means of the application of electricity. Whenever a heating appliance of this nature is required the firm can supply the heating device separately, if desired, or ready fixed to the machine when ordered.

After the demonstration dinner was served in the company's well-appointed canteen, at which the genial works manager, Mr. R. F. Woodburn, presided. During the course of his few remarks, Mr. Woodburn spoke of the enthusiasm which permeated the whole of the staff, who, one and all, believed they were engaged in the manufacture of an article which would appreciably assist in improving and extending the trade of the kingdom.

The thanks of the visitors were suitably expressed by Mr. Piercey, of Newcastle, seconded by Mr. J. Wright, of the Bradford Corporation Electricity Department.

In conclusion, we wish to express our thanks to Mr. Woodburn and also to Mr. J. W. Poole and Mr. H. Eastwood for much assistance in the preparation of this article.

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LEGAL.

Assessment of Electric Motors.

Glasgow Valuation Appeal Committee has sustained by a majority a case selected for determining where power motors in use in factories and shops should be subject to local assessment. The assessor proposed to include motors under the provisions of section 1 of the 1902 Act, which gives power to assess upon machinery for producing or transmitting "first motive power." About 2,500 appeals were intimated, and it was decided to take one as a test case.

Mr. MacRobert, K.C., who appeared for appellants, said the case simply amounted to a proposal to revolutionise assessment. The extraordinary position of the assessor was that when he went into a factory he said that a motor was a machine producing first motive power, but when he went into the power station he said the motors there were not machines producing first motive power—that the boiler and engine produced first motive power in that case. It came to this, that wherever the assessor found shops or factories purchasing electric current from the T.C. and bringing it into their works, and putting it through a motor, he regarded that motor as a machine for producing or transmitting first motive power. His (counsel's) contention was that first motive power could be derived only from natural forces—water, coal, or air.

Mr. Fraser, K.C., for the assessor, contended that the proposal was not new, and had already been decided in the Court of Session.

Evidence was afterwards heard. Mr. R. B. Mitchell, chief engineer, Glasgow T.C. electricity department, asked what he understood by "first motive power," said that in his opinion that term and "prime mover" were interchangeable. An electric motor could not be regarded as a prime mover. First motive power was power derived from one of the sources of energy in nature. The boiler and engines in the T.C. electricity station used for producing or transmitting first motive power were already assessed. If there was an assessment put upon these motors that would be double taxation. Replying to Mr. Fraser, witness said that first motive power was in the generating station and stopped at the coupling on the shafting at the generating station. After that it became second or third power. Electrical energy entered the motor, passed through, and became mechanical energy.

Mr. R. B. M'Coll, accountant, T.C. electricity department, said the principle upon which the power station was assessed was that they should be rated for boilers, steam pipes, engines, or turbines as first motive power. The principle of rating had been defined when the Act of 1902 came into operation.

Prof. J. D. Cormack, Glasgow University, held that the words "first motive power" had no meaning for the engineer. The term used by engineers was "prime mover." In his opinion the words of the Act "first motive power" were meant to convey "prime mover." Similar evidence was given by Prof. Magnus MacLean, Glasgow Technical College.

In support of the assessor's case, Mr. Eckford, assistant assessor, Edinburgh, said that for the last ten years they had entered in the valuation roll in Edinburgh subjects similar to those which the Glasgow assessor now proposed to tax. No opposition had been offered. They assessed all motors in works and shops, down to small motors of ½ H.P.

Mr. Simpson, assistant assessor, Leith, said that in Leith they had assessed power motors in works and shops for the first time last year. They had thought of it earlier, but had been afraid to try it.

Mr. Walker, city assessor, Glasgow, said his action was based on all the Valuation Acts since 1854.

The Court found for the appellants on the ground that the motors were not so fixed or attached as to make them heritage.

City of London Electric Lighting Co., Ltd., v. Improved Wood Pavement Co., Ltd.

In the King's Bench Division on March 24th, Mr. Justice Bailhache heard this action, brought to recover for damage done to the plaintiffs' main in St. Paul's Churchyard, London.

Mr. O'Hagan, for the plaintiffs, said that the defendants, who were paving contractors, on March 1st, 1919, were repaving or relaying the south side of St. Paul's Churchyard. Apparently they had removed the old paving, which was laid upon concrete, previous to laying new, and were engaged in the process of breaking up the concrete. One of the workmen drove either a pick or a wedge into the plaintiffs' cable at this spot, causing it to fuse and putting it out of action. A representative of the defendants reported the matter to the plaintiffs, and on one of their employés going to the place he found the cable was stripped for the space of about four feet. The defendant company, continued counsel, gave no notice to the plaintiffs of their intention to work at the place, and did not inspect the map which the plaintiffs, under their statute, were bound to provide and show to persons concerned to indicate the location of their mains. This map could be seen at the Guildhall, and was in charge of a representative of the plaintiff company there.

Mr. Barrington Ward, K.C., for the defence, contended that there was no negligence on the part of the defendants, and that the main was so near to the concrete as to expose it to danger.

His Lordship found the plaintiffs had made out their case, and gave judgment for them for £62 10s., the amount claimed, with costs.

Contraflo Condenser & Kinetic Air Pump Co., Ltd., v. Hick, Hargreaves & Co., Ltd.

On March 25th judgment was delivered by Mr. Justice Eve in this action brought against defendants, of Bolton, manufacturers of the Hick Breguet condensing apparatus, for alleged infringement of the patent No. 23,140 of 1907, granted to Mr. D. B. Morison, of Richardsons, Westgarth & Co., Ltd., Hartlepool Engine Works, Hartlepool. This patent, which relates to "improvements in or relating to apparatus for withdrawing condensed steam water, air, and vapour from steam condensers," was amended in the year 1915. The plaintiffs claimed that the object of the patented invention was to remedy certain defects which they alleged to exist in the condensing apparatus patented by Sir Charles Parsons in 1902, and which they said chiefly lay in the waste of the heat of the steam used in the steam jet invented by Sir Charles Parsons. We are informed that the defendants contended, amongst other things, that the specification of the Morison patent did not clearly define the monopoly purported to be protected, and was incapable of bearing the meaning which the plaintiffs sought to put upon it, and Mr. Justice Eve so decided, and dismissed the action with costs. In the course of his judgment, Mr. Justice Eve said that it had to be borne in mind that the language he was called upon to construe was the language of a man (the patentee) thoroughly conversant with the state of the art existing when he formed his specification, fully cognisant of, and (if the construction claimed by the plaintiffs was the right one) quite alive to, the defects in the existing apparatus which the invention was designed to remedy, and competent to describe in plain and intelligible language the nature of that invention and the manner in which it was intended to effect the remedy. So approaching the specification, the first criticism which fixed itself on one's mind was the skill with which (if the construction of the specification claimed by the plaintiffs was right) the inventor had obscured the real nature of his invention. In the opinion of the judge the essence of the invention had nothing to do with the conservation of heat, which he did not think had ever presented itself to the mind of the individual who framed the specification. Mr. Justice Eve also stated that, even if he could have adopted the plaintiffs' construction of the specification, he thought it would have been very difficult to detect any substantial feature in the invention not already included in the patent of Sir Charles Parsons, and, moreover, that if the only possible feature of difference from Sir Charles Parsons's patent, which he (the judge) could detect had been held sufficient to support the Morison patent, it would not have availed the plaintiffs in this action, inasmuch as it was not reproduced in the defendants' apparatus which was alleged to infringe.

The trial of the action lasted for 12 days at the end of November and beginning of December last year. Mr. H. A. Colefax, K.C., and Mr. James Whitehead appeared on behalf of the plaintiffs, and Mr. T. Terrell, K.C., Mr. D. N. Kerly, K.C., Mr. Hunter Gray, K.C., and Mr. Courtney Terrell on behalf of the defendants.

British Thomson-Houston Co., Ltd., v. Corona Lamp Works, Ltd.

[Judgment.]

Mr. Justice Sargant, in the Chancery Division, on March 31st, delivered his considered judgment in this action, alleging infringement of plaintiffs' patent for improvements in electric lamps, the particular invention in question being the half-watt lamp. The trial of the action lasted several days, and many well-known experts gave evidence on one side or the other.

His Lordship said this was an action to restrain an alleged infringement of the plaintiffs' letters patent of 1913 granted for improvements in incandescent electric lamps. The lamp in the case was the gas-filled lamp, popularly known as the half-watt lamp, and had a large and increasing sale in this country. The present action was, therefore, a most important one from the commercial as well as the legal and scientific point of view. Any difficulty he had in expressing his judgment would be due to the complex nature of the subject that he had to deal with. Up to 1913 the incandescent lamp in general use was the tungsten vacuous incandescent lamp; during the development of that lamp the whole tendency was to obtain a more perfect vacuum. A good many attempts were made to produce a good gas-filled incandescent lamp; none, however, of the attempts up to 1913 led to any useful results, and no gas-filled lamp was then on the market. It was in these circumstances that the plaintiffs produced their invention. His Lordship proceeded to deal with the specification of the patent, and said the key-note of it was struck on the first pages of the specification, which described it as "relating to a gas-filled lamp of higher efficiency than the best lamp on the market." The specification went on to say that it was possible to manufacture a tungsten or other

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refractory-metal gas-filled lamp in which the loss of energy due to heat conduction and convection could be compensated if the gas employed was chemically inert and of relatively high pressure, and the filament was made of large diameter or cross-section or in a concentrated form. He took the view pressed upon him by the plaintiffs that the words "concentrated form" meant a filament which though not originally thick had been rendered thick for the purposes of the lamp by being closely coiled. The half-watt lamp used in this country was a lamp constructed with a comparatively thin filament which had been coiled thick, gas-filled lamps with uncoiled filaments being commercially unknown here. There were all the usual defences, but ultimately they were reduced to three, viz., want of invention or subject matter, insufficiency, and non-infringement. Of these the third might be shortly disposed of. A case for infringement had been completely established on the evidence. He thought the diameter of the coil of the defendants' lamp, 8.5 mils, was substantially of the order of 10 mils, and the figure clearly indicated that it was a thick filament according to the plaintiffs' specification; the defendants' lamp therefore fell within the description contained in the plaintiffs' specification. On the question of subject matter, the defendants contended that all the elements of the problem were completely known before 1913, and that the patentees had only applied this knowledge to the materials which had come into use, such as drawn tungsten filaments, and purely inert gases, and perhaps the bulbs were made of glass containing fewer impurities. With regard to the prior specifications, his Lordship said it had to be remembered that up to the time of the plaintiffs' patent the trend had for many years been in the direction of a more and more perfect vacuum, and gas-filled lamps were not commercially saleable. The utilisation of the new discovery to obtain high incandescence and high efficiency by what was at first blush a retrogressive step, was an inventive step of a high order of merit as well as of the greatest practical utility. He therefore did not think that the disclosures in the specifications mentioned deprived the plaintiffs' patent of subject matter. Coming to the third and most important objection, viz., want of sufficiency, he said the objection turned on the use of the word "large." Ten mils was indicated as large diameter and was recognised as such, while on the other hand three mils seemed to be indicated as small diameter. As to the meaning of the word "large" he had come to the conclusion that the true view to take was that the word must not be regarded absolutely in relation to mere diameter, but meant sufficiently large to take advantage of the new discovery as to convection or conduction losses, and accordingly to produce such a combination that a much higher temperature and incandescence might be obtained with a commercial length of life. On this view there was sufficient definition by the patentees of the ambit of their claim. But the method of giving effect to the discovery was one of degree, and the only change that was claimed was the change of degree of the thickness of the filament used. A degree of thickness that had to be ascertained not merely quantitatively but in relation to many other factors was a poor indication to the world at large of that which the patentees were claiming to monopolise. Apparently a lamp maker desirous of avoiding infringement must make elaborate experiments for the purpose of ascertaining whether his gas-filled lamp had such a degree of efficiency and length of life as to fall within the patent; that was, he might be in danger of being challenged by the patentees. The patentees might have limited their claim so as not to be subject to criticism of that kind and yet have secured a most valuable monopoly. The result would have been that while the patentees would have acquired for themselves the best of the ground definitely ascertained to be covered by the discovery, it would have been possible for others to make use of the principle of the discovery outside of that area. But the patentees had not done that. Whatever their reason, it seemed to him that they had in effect claimed the sole right comprised in the principle and had sought to prevent any other competitors from availing themselves to any great extent of the principle, and had failed to define or limit the ambit of their claim, with the result that the patent was bad. The action would, therefore, be dismissed with costs.

His Lordship granted a stay on the usual terms with a view to an appeal.

Theatre Lighting.—The low C.P. half-watt lamp has made its way into the theatre as elsewhere, but the high C.P. lamp of this type presents difficulties for theatrical use owing to the heat radiated necessitating large and well-ventilated fittings. Arc lamps have hitherto been much used for the simulation of daylight, twilight, and moonlight effects on the stage. The use of half-watt lamps in a special horizontal fitting described in *Electrotechnik und Maschinenbau*, is claimed to greatly simplify the very complicated arrangement of self-regulating arcs and rotating colour-disks employed up to the present, which required considerable skilled attendance. The horizontal fitting described takes 42 500-watt lamps, and gives an infinite number of adjustments and colour effects without the necessity of automatically moving disks or screws, being controlled by a central "dimmer" provided with multiple resistance steps.—*Technical Review.*

CORRESPONDENCE.

Letters received by us after 5 P.M. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Power from Blast Furnace Gas.

Referring to your issue of March 26th, and your report of the discussion held at the Institution of Electrical Engineers on Mr. Fowles's paper re "Power from Blast Furnace Gas," I wish to point out that your report of my remarks was not quite accurate.

I stated that owing to the trouble experienced with dirty gas, my firm used an external combustion chamber having fixed air ports, and therefore the difficulties encountered with variations in the pressure of the gas could be readily understood.

F. H. Preece.

London, E.C.
March 29th, 1920.

Conduit Supplies and Prices.

Within the last month or two the electrical conduit situation has became somewhat acute. Not only have prices risen, but supply has suddenly become difficult or impossible. Even those contractors who had covered their requirements by ample forward orders at agreed prices are now told that they cannot be supplied. Goods ordered for, say, January, and not yet to hand are still vaguely uncertain in respect of delivery. Meantime, the "heads the dealers win, tails the contractors lose" arrangement regarding prices accentuates the difficulty. The uncertainty regarding delivery is the worst trouble. It looks as if the longer the dealer can manage to delay his deliveries the bigger price he can get for his goods. The contractor loses further by delay of work and idle time of men; so he sets out to buy anything at all for immediate use, even though it may be sizes and types of conduit which cost him from two to five times the prices upon which he based his estimates.

A further disadvantage is occasioned in that the installations now being fitted become patchwork affairs of all sizes and types of conduit.

The contracting industry is surely entitled to more detailed information as to the real and not merely ostensible causes of this state of affairs.

If the explanation is that it pays better to send the conduit abroad, or if certain speculators have bought up all that is on the market, surely it is the duty of those who make or deal in conduit to protect the contracting trade, upon whose business they rely and may have to rely in normal times.

The present condition of affairs lends itself to all sorts of favouritism and profiteering. Other electrical traders, cable makers, for example, have not so completely failed or betrayed their clients.

Donald S. Munro.

Edinburgh.
March 29th, 1920.

Electricity Supply Service Costs.

You, who do so much to advance the interests of the electrical world, will no doubt be interested in the methods adopted to cultivate trade by the Nottingham Corporation.

The enclosed account speaks volumes. We require in all something in the neighbourhood of 20 H.P.; we have to balance both power and light on a 200 volt circuit, and we also need 400 volts for special purposes.

It will be seen that a charge is made for labour (44s. 4d.) and for terminal boxes (159s. 1d.); the latter amount includes cable, &c. Each of the six "terminal boxes" is within 14 in. of the floor, and there is only the thickness of the wall to add, in other words, it would be impossible to use less cable.

Our local engineer has ideas of his own; he does not like to charge for the main fuse which protects his cables and his station, so he drops the title of "main fuse," and calls the things the "customers' terminal boxes," and then charges at a price which must be satisfactory to the department. Incidentally the local price per unit for light is 8d., and for power 2½d.

Here in Nottingham we do all that is possible to induce would-be customers to do without electricity. For instance, my firm has removed from the very centre of the city to a new works situated nearly a mile from the electricity station; we are within forty ft. of a main road on which the tramcars run, nevertheless we have had to use every provision of the Act to compel the Corporation to lay down the necessary cable, and, will it be believed, this new cable is insufficient to supply a large factory just 120 yards further down the road!

The writer gathered the necessary six requisitioners for supply, and in order to save loss of time agreed himself to be responsible for the 20 per cent. consumption on outlay; three months has elapsed, but the Corporation has not yet had time to connect up any of the other requisitioners. In addition to the six requisitioners, quite a number of other shopkeepers are already "wired up" ready for connection, and

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this lack of business principle is keeping several electrical contractors out of their money, for clients naturally refuse to pay for the wiring, &c., until the current is on.

And the never-to-be-sufficiently-damned Local Government Board leaves us to stew in our own juice. At all events, the Board ought to step in and say: Those main fuses are for your own protection; they are under your control, and it is illegal for you to charge consumers for them.

By the by, as I read the Act, such things as maximum demand meters, and other meters must be placed on the undertaker's side of the consumer's terminals; that part of the Act is totally ignored by our local big wigs.

H. W. Cox.

Nottingham,
March 31st, 1920.

The Commercial Efficiency of Fuel.

My attention has been drawn to Mr. Barfield's letter in your issue of March 19th, and more particularly to your editorial comment on this letter.

Mr. Barfield complains that Dr. Walter did not make the best case possible for electric furnaces. I would like to point out, however, that Dr. Walter was speaking on behalf of the gas industry.

I am not quite certain, therefore, whether your comments refer to Dr. Walter's presentation of the matter, or to the part taken by those members of this territorial centre who stated the case for electricity. If you refer to the latter, I venture to think that your comment is unjust. It was the general view of those present that the statement for electricity was put very ably and successfully in the very short time which was available in one evening's discussion.

I would like to add that the report of the debate given in your issue of February 27th did not, by any means, do justice to the remarks made by the appointed speakers for electricity.

C. C. Garrard,
Chairman of the South Midland Territorial Centre of the Institution of Electrical Engineers.

Birmingham.
April 1st, 1920.

[The report which we published was provided by the only shorthand reporter, we believe, who was present at the meeting, and who, in a covering letter, said: "According to agreement between the two societies every speech has been corrected, and where necessary rewritten before being allowed to be sent to the technical Press." We have reason to believe, however, that Mr. Wood's remarks were entirely rewritten, and his corrections, forwarded later than those of other speakers, were not embodied in the report, nor have we received them. So far as Mr. Wood is concerned, therefore, we offer no criticism; but we adhere to our opinion as to the rest of the debate that the case for electricity was not adequately presented.—Eds. Elec. Rev.]

Wages in Kinemas and in the Electrical Industry.

I have just read with interest a letter written by Mr. G. E. Moore in the Electrical Review of March 26th, 1920.

His article that he mentions (Electricity and Kinematography) unfortunately I missed. From the tone of his letter I feel it must have been interesting. I should be glad if through your columns you would allow me to point out one or two errors that Mr. Moore has made.

First, the E.T.U. rules require that a man must have had five years' experience before he is allowed to become a chief operator. Again, the wage of £5 is very, very rare—in fact, only in the Newcastle and London districts has that been attained. Before me now I have working rules, &c., of various districts of the United Kingdom, as I am hoping to form a kinema section of the E.T.U. in and around Burnley. Mr. Moore's letter is not very complimentary to the operator, and an outsider would read it as such—but to one who knows his business, the letter only goes to prove that Mr. Moore's friend of the Midlands was not an operator—only a handle-turner; and as a handle-turner he would not be getting anything like £5 per week; more likely £3. The undersigned was considered the best-paid man in this district—my experience covers 15 years in various branches of the electrical kinema and variety industries. Wages £3 5s. My duties were all running repairs of National gas engine of 25 H.P., Mather & Platt 100 volt, 160 amp. dynamo, stage lighting, hall lighting, all extra wiring, average 14,000 ft. to 15,000 ft. programme twice weekly, and three kine-machine fans, 'phones and bells, and to keep everything in perfect order occupied 50 to 60 hours' work per week. Again, has Mr. Moore had to stand or sit in a confined space averaging 10 ft. by 12 ft. for hours at a stretch with the temperature anything from 90 deg. to 110 deg., and the strain of knowing that hundreds of people are dependent upon his level-headedness to prevent panic—not fire? He also says, in the case of a reported fire, that the plain fact was there should have been no fire. That sentence proves to me that Mr. Moore knows very little concerning the construction of a kinema machine. It is possible for the best and coolest of men to have a fire; but it is the coolest of men that prevent that fire spreading and creating panic.

Fifty shillings a week is a common wage to-day for kinema operators, because there are so many handle-turners in the game who do it as a part-time occupation.

The E.T.U. is certainly fighting very hard for the operator, but before a man can become a member and qualify for the £5 or £4 10s. wage he has to prove his worth.

In closing, I may say that I have recently left the kinema industry, and am working for the Burnley Corporation, and I find my hours less and my wage considerably improved.

Albert J. Cutler.

Padiham.
April 2nd, 1920.

The Portsmouth "Leader" Cable.

The note which appeared in your issue of the 26th inst. bristles with points of material interest. The system of using a cable laid below water in estuaries of rivers, harbours, and other like applications, and using high-frequency alternating currents as a means of guiding ships in fog and other such circumstances, was invented by my colleague, Captain A. H. Binyon, M.I.Mar.E., in 1912, in connection with which Captain A. H. Binyon proposed using my "Paragon" high and variable-frequency alternators, &c.

Bearing in mind the enormous value of such a means of guiding ships, so easily brought about in all conditions of sea and weather, my opinion is that the Board of Trade should make its application compulsory at all points along our shores.

Especially is this "Paragon-Binyon" system suitable for installation near sand banks, &c., and its application is so simple, and its use so effective, that it is wonderful that "Lloyds" or some other maritime insurance company does not insist on its application. I think the shipping companies should have their attention drawn to this very effective method of saving lives, and also keeping time under certain conditions around these shores.

William P. Durtnall,
Captain, M.I.Mar.E., M.I.Loco.E.

London, S.W.,
March 27th, 1920.

Whitley Councils.—The London District Council, Area No. 10, for the Electricity Supply Industry, was formed last month, the following being its composition:—

Chairman.—Mr. Alderman J. A. G. Beaumont.

Vice-chairman.—Mr. E. Cruse, Amalgamated Society of Toolmakers.

Joint secretaries for Employers' side.—Mr. Arthur J. Fuller, Electricity Works, Fulham, S.W. 6—Telephone, Putney 2479; Mr. A. F. Harrison, City of London Electric Lighting Co., Ltd., 1-2, Great Winchester Street, E.C. 2—Telephone, London Wall 9329.

Secretary for Unions' side.—Mr. W. J. Webb, Electrical Trades Union, 14, Baldwin's Gardens, Gray's Inn Road, E.C. 1—Telephone, Holborn 4745.

Members of the District Council (Area 10), 1920—1921.

For the Employers.

Municipalities.—Metropolitan Boroughs—Mr. Alderman J. A. G. Beaumont, St. Marylebone; Mr. Councillor A. J. Bamford, Bermondsey; Major C. R. Attlee, J.P., Stepney; Mr. P. A. Bond, Battersea; Mr. Arthur J. Fuller, Fulham.

Urban District Councils—Mr. Councillor W. F. Goodrich, Watford; Mr. Councillor A. Attwell, J.P., Walthamstow.

Corporations—Mr. Alderman Dudley Stuart, J.P., Wimbledon; Mr. Councillor Geo. Croot, West Ham.

L.C.C.—Mr. P. L. Riviere.

Companies.—London Companies—Mr. A. P. Harrison, secretary of City of London Co.; Captain W. R. Rendell, general manager, Metropolitan Co.; Messrs. F. C. McQuown, secretary, County of London Co.; C. G. Stanesby, secretary, Charing Cross and West End Co.; H. W. Miller, engineer, Kensington and Knightsbridge Co.; Mark Feetham, superintending engineer, London Electric Supply Corporation; R. S. Downe, engineer and general manager, Brompton and Kensington Co.; H. P. Gaze, executive engineer, Central Electric Co.

Provincial Companies—Messrs. M. Farrer, resident engineer, Twickenham and Teddington Co.; K. A. Scott Moncrieff, Hendon Electric Supply Co.

For the Employes.

Electrical Trades Union.—Messrs. W. J. Webb, W. Westfallen, J. Membery, W. Needham, H. H. Morton, T. A. Goode.

National Union of Enginemen, Firemen, &c.—Messrs. J. Meakin, W. Weeks, W. Chapman.

Workers' Union.—Messrs. L. White, J. Smith, F. Rosenburg.

National Union of General Workers.—Messrs. C. Borgia, F. Gilbert, C. Skinner.

Amalgamated Society of Toolmakers.—Mr. T. Enibbs.

Dockers' Union.—Mr. W. Pugh.

Steam Engine Makers.—Mr. R. Bates.

Amalgamated Society of Engineers.—

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BUSINESS NOTES.

The New Railway Rates.—The Railway Clearing House has issued a pamphlet showing very clearly in table form the effect of the new railway rates on the cost of various items going to make up the cost of living. The rates selected cover the carriage of foodstuffs and merchandise to towns in all parts of Great Britain, and the difference in individual items consequent upon the change appears to be very small. How much difference will be added to the retailer's charges it will be interesting to note. The effect of the charges on bacon, for example, from London to Peterborough is 1d. on 10 lb. What will the purchaser of 1 lb. pay toward the new railway rate?

An Inquiry from Peru.—The Department of Overseas Trade (35, Old Queen Street, S.W. 1) has received a communication from a firm in Lima, Peru, asking that United Kingdom manufacturers should quote them prices c.i.f. Callo for complete electric light plants (25 to 135 lamps), motors of 7-8 B.H.P. and upwards, complete windmill pumps and accessories, and other machinery, &c. The necessary particulars can be obtained from the Department.

New Belgian Company.—La Société des Fils et Cables Electriques is the name of a new company which has just been formed in Brussels with a capital of 1,000,000 fr., to manufacture electric wire and cables.

Patentees and Income-Tax.—In a letter on this subject, Mr. C. H. Tolley, A.C.I.S., L.A.A., points out that the report of the Royal Commission on Income-Tax contains several proposals of particular interest to patentees, and the owners of trade marks.

In the first place, as all profits are to be assessed whether of a capital nature or not, or whether annual or "non-recurring," it would appear that in future all patentees will be chargeable with tax on the sales of their inventions whether it is the first or not.

Then as to depreciation, the Commissioners hesitate a good deal, and consider that patents should be distinguished from copyright and trade marks; but, generally speaking, they consider that no allowance should be made where patents or trade marks are in the hands of the original owner, nor where they have been purchased, and the vendor is within the scope of British income-tax. If, however, they were purchased of a vendor not subject to British tax, they appear to agree that they should be treated as other wasting assets, that is to say, granted an allowance equal to a sinking fund for the difference between their life and 35 years.

They also recommend that the patentee should be granted a similar allowance in "respect of the proved costs of experimenting and patenting whether he works the patent himself, or lets it on royalty. If the patent is sold outright the allowance should be granted to the purchaser."

War Claim by the Chloride Co.—The Chloride Electrical Co., of Manchester, appeared before the Royal Commission on Awards to Inventors, at Queen Anne's Gate Buildings, to claim a royalty of 6d. for each of their improvements to electrical accumulators supplied to the Ministry of Munitions through four accumulator firms, on the ground that the Ministry had advised the claimants that they would be responsible for royalty payments. The claim covered the sale of 53,000 improvements, as against the Ministry's figure of 18,000. After hearing the claimants' statement, Mr. Justice Sargant suggested that the Chloride Co. and the Ministry representatives should go into the matter of the figures, and, if they could come to an agreement, he thought the royalty of expenses on each accumulator supplied was not unreasonable.—*Westminster Gazette.*

Selling Organisation.—For the purpose of strengthening their selling organisation, Messrs. George Kent, Ltd., have arranged for the holding of periodical conferences between the "Knights of the Road," the sales department, and representatives of the production side. The first such conference was held on Friday, March 26th, followed by a luncheon and discussion at the Connaught Rooms.

Australian Developments.—At the end of January the City Electric Light Co., Ltd. (Brisbane), resolved to issue 125,000 £1 preference shares (7 per cent. cumulative) at par for developments of the undertaking.

E.D.A. Activities.—Some recently-received pamphlets from the British Electrical Development Association strike a very artistic note, and, as usual, the personal appeal is very prominent. "Light in the Home" possesses an attractive cover reproducing a water-colour study. This booklet demonstrates beauty and efficiency in house lighting, and several good photographs are employed to illustrate the advice given. The pamphlet bearing the announcement "House to Let," dealing with domestic appliances, should secure a great deal of attention at the present time, although addressed chiefly to "owner-occupiers." "Just a Turn of a Switch" emphasises the utility and labour-saving propensities of electricity in the home. The economic side of the industry is put forward to the consumer in a pamphlet "Coal and Electricity for Domestic Use," which explains why costs vary in different districts. Many other publications dealing with electricity for domestic purposes accompany those mentioned above, and as they are "readable," the average householder, who looks with apprehension on semi-scientific circulars, will most certainly be interested in them, and they should achieve their object.

New French Company.—La Société Hydro-Electrique du Sud-Est is the name of a new company which has lately been formed in Paris (94, Rue St. Lazare), with a capital of 2,000,000 fr.

Trade Announcements.—Mr. F. Wood, who has for many years past represented the Consolidated Pneumatic Tool Co. in India, will shortly return to England, and be located at the company's head office in London. The representation of the company will be taken over by Mr. Rowland Jones, who was an officer in the British Army during the war, and previous to this was with the Great Indian Peninsular Railway. Mr. Jones is at the company's Bombay office, Pathe Building, Ballard Pier Fort, Bombay.

Messrs. F. C. Micklewright & Co., electrical engineers, have taken new premises at the Bower Engineering Works, Warwick Lane, Maidstone.

Mr. J. E. Dyson, electrical engineer and contractor, has removed from Shambles Lane, Huddersfield, where he has been established for over 20 years, to 1, Ramsden Street, Huddersfield.

We regret to find that an error occurred in our notice of March 26th (page 394) respecting the firm of A. G. and J. Smith, of Kilmarnock. It is Mr. Joseph Smith, who has retired from the firm, not Mr. A. G. Smith. It is the latter who is continuing the business on his own account, and is attending to debts, &c.

Messrs. B.K.B. Electric Motors, Ltd., have returned to their original offices (now vacated by the Government) at Finsbury Court, Finsbury Pavement, E.C. 2. Telegraph numbers: "London Wall" 5630-1.

The works, business, stocks, patents, &c., of Engineering and Arc Lamps, Ltd., have been taken over by a new company with the title of Engineering and Lighting Equipment Co., Ltd. The entire staff of the old company has been taken over. The business will be continued with the same manufactures, and some new articles which are to be introduced shortly.

Messrs. Parker, Winder & Achurch, Ltd., have commenced business as electrical engineers and contractors at Broad Street, Birmingham, and they are specialising in country-house installations and general contracting work. Catalogues and lists of motors, switchgears, and other accessories are asked for.

Messrs. Automatic and Electric Furnaces, Ltd., have appointed Messrs. F. Hiorth & Sons, Josefinegade 13, Christiania, Norway, agents for Wild-Barfield electric furnaces for Norway and Denmark. A furnace will be erected at the address mentioned, and demonstrations will be given there.

Catalogues and Lists.—Holophane, Ltd., 12, Carteret Street, Queen Anne's Gate, S.W. 1.—Illustrated and priced pamphlet describing various types of "Holophane" reflectors for shop-window lighting.

The Vaughan Crane Co., Ltd., Openshaw, Manchester.—A new 100-page catalogue illustrating the range of the company's manufactures. This is a handsomely-bound volume, and contains a large number of photographs of installations carried out in various industrial shops, &c. The main part is devoted to electrically-driven cranes, but a few "hand-power" types are also given.

General Electric Co., Ltd., 67, Queen Victoria Street, E.C. 4.—Bulletin No. 1. "Important Plant" (60 pages). An interesting book consisting chiefly of photographs of installations of electrical plant by the G.E. Co., including turbo-alternators, D.C. and A.C. generators, rotary converters, motors, and motor-generators. A list is given of some of the more important orders executed by the company, containing the names of many large industrial undertakings and municipalities. The G.E. Co. has also sent a copy of a folding card of comparison tables of the old and new standards and other information for the use of wiremen. Copies of this will be sent to all interested firms upon application to the head office.

Engineering and Lighting Equipment Co., Ltd., Sphere Works, St. Albans, Herts.—"Fittings for Half-watt Lamps" (35 pages) An illustrated list of various types of lanterns, globes, reflectors, &c., giving prices in each case.

The Excelsior Shade Manufacturing Co., 1, Hounds Gate, Nottingham.—An artistic catalogue of "Betterway" specialities for electric lighting work, illustrating shades, pendants, &c.

Messrs. Higgs Bros., Dynamo Works, Sand Pits, Birmingnam.—"Monthly Magazine," Vol. II, No. 2 (24 pp.), giving a list of motors and dynamos in stock, and notes on removing pulleys and couplings.

Medical Engineering Co., 71A, Englefield Road, N.—Illustrated price list (Section M, 12 pp.) of small-power D.C. motors, generators and converters, ranging from $\frac{1}{20}$ H.P. to $\frac{1}{4}$ H.P., also polishing motors, fans and power motors of $\frac{1}{2}$ to $\frac{3}{4}$ H.P., with speed-reducing gear.

Railway Traffic.—The Mansion House Association on Railway and Canal Traffic has recently published its reply to 14 questions on the problem of railway transport put to it and arious other Associations of the same nature by the Ministry of ansport. The 14 points are exhaustively dealt with, and conclusion complaints received from the Association's members are used for the purpose of emphasising the injury caused to the interests of traders by restrictive regulations made by the railway companies, and request is made that ample protection be afforded to traders when the new scheme is formulated by the Ministry of Transport.

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Book Notices.—"Gattie Committee. Report of the Departmental Committee, together with an analytical reply by the New Transport Co., Ltd." 39 pp. London: The New Transport Co. Price 2s. 6d.—This publication, to quote the foreword, is to show "that the Committee's Report is against the weight of evidence, and that it should not be accepted." The report is given in full, and the criticisms and replies to the Committee's statements are placed on pages opposite to each item.

"Electrical Practice in Collieries." By D. Burns. Pp. viii + 407, 241 figs. London: Chas. Griffin & Co. Price 10s. 6d. net.

"Radio Engineering Principles," by H. Lauer and H. L. Brown. Pp. xiv + 300; 241 figs. London: Hill Publishing Co., Ltd. Price 21s. net.

"The New Rhine." 16 pp. By R. Gelpke, civil engineer and Member of the Swiss Parliament. London: La Nouvelle Société Helvétique.—This pamphlet presents Switzerland's position with regard to clauses in the Peace Treaty regulations by which France is to be permitted to use the hydraulic resources of the Rhine from Basle to Lauterburg, and thus interfere with Switzerland's sole access to the North Sea.

The Syndics of the Cambridge University Press announce a forthcoming treatise on "Thermodynamics," by Sir J. Alfred Ewing, Principal of the University of Edinburgh, who was Professor of Applied Mechanics at Cambridge, and subsequently Director of Naval Education. The volume treats the subject mainly from an engineering standpoint.

"Preliminary Report upon Possible Development of Hydro-Electric Power in British Guiana" (39 pp.) By Stafford X. Comber, Member of the American Society of Civil Engineers. Georgetown, Demerara: "The Argosy" Co.

"Works Committees and Industrial Councils: Their Beginnings and Possibilities." By the Right Hon. J. Whitley. A lecture given in the Department of Industrial Administration, College of Technology, Manchester, October 7th, 1919. London: Longmans, Green & Co. Price 1s. net.

Scientific Papers of the U.S. Bureau of Standards, No. 370, "A New Form of Vibration Galvanometer" (8 pp.); No. 156, "Cements for Spark-Plug Electrodes" (10 pp.); and No. 366, "Contrast Sensibility of the Eye" (15 pp.). Washington: Government Printing Office. Price 5 cents each.

"Electricity, the Burden Bearer." By W. E. Kelly. Chicago: Illinois Committee on Public Utility Information.

"*Journal* of the American Institute of Electrical Engineers," Vol. XXXIX, No. 3. March, 1920. New York: The Institute. Price $1.

A Sydney Discussion on Japanese Manufactures.—According to the *Sydney Morning Herald*, the Electric Lighting Committee of the City Council had before it, on January 19th, tenders for insulators, and of the three received a Japanese agent tendered at £595 lower than an Australian manufacturer. Mr. Mackay (electrical engineer) said there was no reason why these goods should not be manufactured at a competitive rate in Australia. The local firm evidently was afraid to launch out lest there would not be a market for the goods. If they were assured that concerns such as the City Council would take their goods, they would probably launch out and manufacture in large quantities. Alderman Meagher said, if he could prevent it, not a halfpenny would go from Australia for Japanese goods. Alderman Lindsay Thompson: If the Japanese electrical fittings are of the same grade as their matches, give me the dear article every time. It will be the cheapest in the end. It was agreed that the consideration of the matter should be deferred to enable negotiations to be entered into with the Australian manufacturers.

Private Meeting.—Edward Wingfield Fuller Heath (trading as Heath, Wingfield & Co.), 6, Hans Road, Brompton Road, London, S.W., electrical engineers. The creditors interested herein were called together on March 27th, at the offices of Messrs. Corfield & Cripwell, accountants, Balfour House, Finsbury Pavement, E.C. 2, when Mr. H. E. McKrell, of the International Electric Co., Ltd., was elected to the chair. A statement of affairs was presented by Mr. W. Osborne, showing the position as at March 26th, and this disclosed ranking liabilities of £4,473, of which £4,325 was due to trade creditors, the balance of £147 being due to a partly secured creditor. The assets were estimated to realise £3,209, from which had to be deducted £44 for preferential claims, leaving net assets of £3,165, or a deficiency of £1,307. Book debts of the face value of £2,906 were written off as bad and doubtful. The partly secured creditor was stated to have advanced cash to the extent of £2,355, of which £707 had been repaid, making a balance of £1,647 still owing. Securities of the estimated value of £1,500 were held. The partly secured creditors' claim arose in respect of advances made from last November, and the security held consisted of the lease of the premises and a charge on a book debt. The lease had 14 years to run from March, 1919, at an annual rental of £200. The debtor paid £200 for the lease. Attention was called by Mr. Osborne to the doubtful and bad debts, and he stated that the debtor had incurred two heavy losses during the last six months, and it was expected that little, if anything, would be obtained. The deficiency in the statement of affairs was more than accounted for by the loss on the book debts. The The debtor was for some time with the Ministry of Munitions, and he re-started in business for himself in November, 1918, with a capital of £200. He commenced in Cannon Street, E.C., but owing to the growth of the business, removed to the present address. No definite offer was made to the meeting, and it was stated that the Sheriff had levied execution at the suit of a creditor. After a short discussion, it was decided that the debtor should be requested to file his petition failing the withdrawal of the Sheriff, and that if the Sheriff withdrew, a deed of assignment should be executed with Mr. W. Osborne, as trustee. It was stated that there was every likelihood of the execution being withdrawn, and a Committee of the principal creditors was appointed. The following are creditors:—

Bliss & Co.	£148	Jones & Shipman	£63
Brookman & Co.	14	London Electric Co.	36
Commercial Elec. Access., Ltd.	210	Measures Bros.	24
Crompton & Co.	678	Mansell & Hogan, Ltd.	38
Cutting Bros.	81	Pidgeon Bros.	82
Croft, Ltd.	28	Ruston & Hornsby, Ltd.	154
Ediswan Co., Ltd.	134	Sullivan, W. H.	34
Electrician	69	Standard Electric Co.	35
Engineering Industry	36	Shenton, J. F.	91
Electrical Times	104	Siemens Bros. Dynamo Works	339
Electrical Appliances, Ltd.	18	Vickers, Ltd.	102
Electric Generators Co., Ltd.	15	West, Allen & Co., Ltd.	66
Foster Engineering Co.	16	Whitehead & Son	11
General Electric Co.	41	Dick Jackson	28
Hampton & Beeby, Ltd.	66	*Hardware Trades Journal*	18
Hindley, E. S., & Son	922	Orliff, M.	43
International Electric Co.	581	Meares, A. W.	45
International Electric Novelties	163		

Capital Requirements of the German Electrical Industry.—A German Siemens official recently published an article dealing with the increased capital requirements of the German electrical industry and its present prospects. Among other things he said that the costs of raw material had increased on an average about ten-fold on account of the rise in international prices and the depreciation of currency—*e.g.*, 1,000 kilos. of copper before the war cost about 1,400 marks; now the cost was 24,000 marks. Electrical sheets could be had for about 526 marks before the war; but now their price was nearer 4,600 marks. The necessity for higher capitalisation of industrial concerns was all the greater by reason of the longer period of time required in getting material through the processes of manufacture. In the Siemens Electrical Works in October, 1918, the monthly output per head was about 3¼ tons; in January, 1919, it was between 1¾ and 2 tons with the works running for about the same hours. The falling off in production was attributable partly to the introduction of the eight-hour day, but mostly to the strikes, and Government restrictions upon the use of coal. In the Siemens Works, for instance, recently, for several weeks only three days a week could be worked. This deficiency in fuel, combined with the strikes, resulted in one of their works in a reduction in the number of hours worked by about 26 per cent., with corresponding diminution in production. These factors, of course, contributed again to the need for more capital. It was also to be remembered that compared with the period before the war, stocks of all kinds were practically non-existant. It appeared that five to six months' delivery was the best that could now be offered by the iron rollers and the brass workers. Electrical sheets were not obtainable under a delivery of from five to six months. Their manufacture into the complete dynamo absorbed a further six months.

Plant, &c., for Sale.—Lancaster Corporation Tramways Department invites offers for one open-top tramcar, 35-H.P. Westinghouse motors, Scott & Mountain single bogie truck, and one covered top-deck tramcar, 25-H.P. Westinghouse motors, Brill truck; Dundee Corporation Electricity Supply Department has for sale one Thomas Parker bipolar over-type 105-volt generator, mounted on C.I. bedplate, &c. Watford Urban Council electricity department has for disposal one air pump, by Cole, Marchant and Morley; 50 v. dynamo, by Parker, slide valves, steel main, &c. Croydon Corporation electricity department has for sale one 1,100-B.H.P. Belliss & Morcom triple-expansion engine, coupled to 750-KW. English Electric alternator and exciter; also one 450-B.H.P. Belliss & Morcom tanden-compound engine, coupled to G.E.C. 250 KW. alternator, &c. For particulars see our advertisement pages to-day.

Liquidations and Dissolutions.—Engineering and Arc Lamps, Ltd.—Winding up voluntarily (the directors having sold the business, goodwill and plant as from January 31st, 1920); liquidator, Mr. W. A. Henderson, 29, Gracechurch Street, E.C. Meeting of creditors called for April 14th. This matter is referred to under "Trade Announcements."

Ebonitis, Ltd.—Particulars of claims, &c., to be sent by May 6th, to the liquidator, Mr. E. C. Moore, 3, Crosby Square, E.C.

Victor Engineering and Supply Co., electrical engineers and contractors, 17, Lloyd Street, Manchester.—Messrs. F. G. Burton and R. Boardley have dissolved partnership. Debts will be attended to by Mr. R. Boardley, who will continue the business.

Couzens & Brown, electrical engineers, 9, Old Queen Street, Westminster, S.W.—Mr. H. W. Couzens and Mr. D. A. Brown have dissolved partnership. Mr. H. W. Couzens will attend to debts.

Sentinel Waggon Works, Ltd.—Winding up voluntarily, with Mr. W. F. Andrew, 209, West George Street, Glasgow, as liquidator. An agreement is to be entered into for the sale of the undertaking and assets to the Sentinel Waggon Works (1920), Ltd. All creditors will be paid in full.

Auction Sale.—By order of Messrs. Irving, Son and Jones, Ltd., of Vauxhall Rice Mills, Liverpool, who are retiring from business, Messrs. G. N. Dixon & Co. will sell by auction on the premises, the electrical power installation recently installed by the British Westinghouse Co. See our advertisement pages to-day.

Australian Co-operative Electric Trading.—Press reports (January 14th) received from Sydney, state that the Electrical Trades Union was proposing to establish a co-operative electrical engineering company, the shareholders to be exclusively members of the Union.

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Catalogues Wanted.—The A.B.C. Tramway Appliances Co., Hepworth Chambers, Briggate, Leeds, wish to receive catalogues and lists from manufacturers of accumulators for electric vehicles, electric fittings, motors up to 20 H.P., resistances, controllers, cables and wires, gears, &c., for electric traction vehicles.

Messrs. Perry Carbonising, Ltd., of 220, Westminster Bridge Road, S.E. 1, want catalogues of spiral and other conveyors; elevators; other labour-saving machinery for the handling of coal, coke, and ash; blowers and exhausters.

Electrification of Poland.—An Advisory Council on Electricity has been formed, attached to the Polish Ministry of Commerce, for the purpose of considering and promoting legislation to be introduced in the Polish Parliament. The Advisory Council is opposed to the suggested increase in the tax upon the use of electricity in Warsaw. Two committees are to be entrusted with the working out of the general scheme for electrifying the whole of Poland.

Wages in the Electricity Supply Industry.—Messrs. W. J. Webb and T. W. Cole, joint secretaries, inform us that at a meeting of the Home Counties (No. 9) Area Joint Industrial Council for the Electricity Supply Industry, held on March 31st, the application from the Trade Unions represented for a further advance in wages was considered. It was felt that the question was contingent on the fixing of basic rates, but in order that something might be done in the matter to meet the case, it was resolved as follows:—

"That an advance of 3s. per week be paid to all employés by electricity supply undertakings in the Home Counties (No. 9) Area, as from April 1st, 1920, and that if basic rates are not fixed before June 1st, 1920, a further increase of 3s. per week be paid as from June 1st, and that meetings be held as early as possible to fix the basic rates, such basic rates, when fixed, to be operative as from February 1st, 1920."

The various electricity supply undertakings in the area are, therefore, earnestly recommended to adopt the increase mentioned in the above resolution, as such was arrived at after long and serious consideration of the whole situation by the representatives both of the undertakings and of the Trade Unions concerned.

The question of applying the Engineering and Foundry Trades Award (No. 180) to all manual workers in the electricity supply undertakings has engaged the attention, in Birmingham, of the District Industrial Council for the Electricity Supply Industry, No. 5 (West Midlands) Area. Payment was recommended, except to those tradesmen whose wages are regulated by other Trade Union organisations. It was pointed out that under its constitution the District Industrial Council was unable to give effect to the award without the approval of the National Council. This body has yet to consider the matter, so that it may not be able to apply the award at once. It was explained, however, that any decision of the National Council would be retrospective. The District Industrial Council made it clear that future applications for alterations in wages, &c., in respect of the electricity supply industry should be dealt with by the Industrial Council for the industry.

Motor-Car Headlights.—Recently a demonstration of a variety of anti-dazzle devices, both British and foreign, was given in Oxshott Woods, Surrey, by Messrs. C. A. Vandervell & Co., Ltd., in the presence of representatives of the technical Press. Numerous photometric tests were taken, and the results should prove interesting and instructive.

Electric Vehicle Construction in Derby.—We learn that Messrs. Newton Bros., Ltd., electrical engineers, of Mansfield Road, Derby, have taken up the construction of electric motor vehicles for commercial and industrial purposes.

The Chinese Follow Suit.—It is reported in the Press that Chinese employés in the engineering trades at Hong-Kong have struck for an advance of 40 per cent. in wages. Early in the week it was stated that the strike was spreading.

Social.—The annual staff dance of the General Electric Co., Ltd., Newcastle, was held on Friday, March 26th, in Heaton Assembly Rooms. The company present, including staff and friends, numbered 200. A presentation was made to Mr. J. Spence, in commemoration of his 25 years' service as branch manager.

The Italian Pirelli Co.—The accounts of Pirelli & Co., of Milan, show net profits of 5,420,000 lire for 1919, and a dividend of 55 lire per share is to be paid. It has been decided to increase the share capital from 40,000,000 to 60,000,000 lire, of which 5,000,000 lire will be transferred from the reserve fund and allotted as gratis shares to existing proprietors.

Danish Accumulator Works.—The Dansk Akkumulator og Elektro-Motor Fabrik reports net profits of 293,000 kroner for 1919, and proposes to pay a dividend at the rate of 10 per cent.

The A.E.G. in Luxemburg.—The local newspapers at Luxemburg announce that the offices of the Metz branch of the A.E.G. have been transferred to Luxemburg.

Swedish Companies. — The Elektriska Svetsnings (Welding) A.B., of Stockholm, records net profits of 63,451 kr. for 1919, and a dividend at the rate of 12 per cent. The Bell Telefon A.B., of Stockholm, proposes to pay a dividend of 6 per cent. out of net profits of 60,013 kr. earned in 1919.

LIGHTING AND POWER NOTES.

Australia. — Sydney. — The City Council has passed a motion of protest against the Railway Commissioners' statement that electricity will be supplied by the railway authorities to municipalities in the Sydney area requiring it, notwithstanding the City Council's prior claim. The Council considers this action outside the Commissioners' legitimate scope.

Plant Shortage.—The effects of industrial disputes in this country are being felt in Australia. The City Council of Sydney is faced with great difficulties owing to the non-delivery of an 8,000-kw. turbo-alternator set ordered from an English company some time ago. It has been suggested that surplus power from the tramway department should be utilised for public services.

Coal Mine Purchase.—The Sydney City Council is considering the purchase of a coal mine for the purpose of supplying fuel to the electricity works. A consulting engineer advises the construction of a new 10,000-kw. power station on the coalfield instead of conveying the coal to the present works.

Increased Rates.—The Sydney *Evening News* stated, a short time ago, that the City Council had been forced to apply to the Government for sanction to an increase in prices charged for electricity. The position of Sydney regarding this matter is probably unique, as the ruling prices are practically the same as they were at the commencement of the undertaking in 1904.

Hydro-electric Power.—Mr. F. B. Rushton, chief mechanical engineer, South Australian railways, has furnished a report to the Government on the question of providing a hydro-electric power scheme for Adelaide. Mr. Rushton has outlined two schemes—one to utilise water power from the Square Waterhole, about two and a-half miles east of Mount Compass, and the other in connection with the Myponga River. Mr. Rushton claims there is a sufficient supply of water all the year round to provide 21,000 H.P. The other scheme is designed to provide a similar amount of power, and he expresses the opinion that 42,000 H.P. would be sufficient to provide electricity for all the tramways, suburban railways, and extensions, the Islington workshops, and all lighting and industrial power purposes in the metropolitan area. As indicating the importance of the project, he suggests that it would be possible to sell electricity for industrial purposes at a halfpenny per unit, and to make a profit out of the sale. The estimated approximate cost of each scheme is a little over £500,000, and the working expenses would be £2 8s. 9d. per H.P. per annum.—*Tenders.*

Barnard Castle.—Proposed Electric Lighting.—The directors of the local gas company have under consideration a scheme for providing an electricity supply for lighting purposes. A report upon the subject is to be submitted to the shareholders in six months' time.

Barnstaple. — Revision of Charges. — The Town Council has revised the sliding scale of charges for electricity for power as under:—First 6,000 units, 3d. per unit; next 6,000, 2½d.; beyond, 2d.

Loan.—A loan is to be applied for, for a boiler (£1,350), cables, &c.

Barrow.—Committee's Report.—The Electricity Committee reports that there is some delay in making connections to the mains owing to the difficulty in obtaining the necessary materials. A large number of applications necessitating extensions of mains were approved. With regard to a proposed extension to Piel and Rampside, it was decided that the electrical engineer should have a further canvass made of the residents of the district, and that he again approach the Furness Railway Co. on the matter, and report further. It was decided to make the deduction for domestic consumers, consequent upon the reduction in the price of coal, at the rate of 0·2d. per unit, as from January 1st to March 31st.

Bexhill.—Mains Extensions.—The Town Council is carrying out several mains extensions, and has obtained the permission of the L.B. & S.C. Ry. Co. to lay a cable along the railway from the electricity works to Seabridge Road, a concession that will save a great deal of expense.

Blackburn.—Extensions.—The Electricity Committee has approved the installation of new transformer plant at the Jubilee Street works in connection with the E.H.T. plant.

Blackpool.—Price Increase.—An additional 10 per cent. above pre-war rates is being placed upon charges for electricity, making a total increase of 50 per cent. Meter rents are being raised, and minimums of 7s. 6d. per quarter for lighting, 10s. for heating, and 15s. for power have been fixed.

New Boilers.—Two new water-tube boilers are to be installed at the electricity works.

Bo'ness.—Proposed Extensions.—The Town Council of Bo'ness has appointed Mr. J. M. M. Munro, consulting engineer, of Edinburgh, to advise on the proposed extension of the electricity works.

Burnley.—Joint Electricity Authority.—The electrical engineer has presented a report prepared by Mr. E. M. Lacey, M.Inst.C.E., and himself, regarding extensions required in the department, the proposed linking up of Burnley with neighbouring undertakings, and the policy to pursue under the new Supply Act, in connection with the establishment of a joint authority for this area. It has been decided to constitute an area from the coast through East Lancs. to Colne, in which there should be a joint electricity authority.

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Cardiff.—Extensions.—The Finance Committee has approved the Electricity and Tramway Committee's scheme for extensions of plant, cables, &c., to meet the estimated load of 1921, at a cost of £110,325.

Chesterfield.—Extensions.—The Town Council has decided to carry on the extensions at the electricity works, at a cost of £50,000.

Continental.—Belgium.—The report of the Société d'Electricité de l'Escout, of Antwerp, for the past financial year, shows that satisfactory progress is being made, the number of consumers of electricity having advanced from 6,303 at the end of 1918 to 6,966. The output of the company's generating station increased from 13,178,000 to 24,037,000 kw.-hours.

Spain.—Owing to lack of coal, consequent on the strike, Lisbon is without gas, and searchlights have been brought into use.

Congleton.—Proposed Electricity Supply.—A recent proposal at a Council meeting to approach one or more electricity corporations upon the subject of erecting a power station and supplying power and light in the town was referred back to Committee for further details.

Dewsbury.—Price Increase.—The Corporation has decided to increase the price of electricity to lighting consumers from 40 to 50 per cent. on pre-war rates, to rateable value consumers from 50 to 75 per cent., and to power and heating consumers from 75 to 100 per cent. In the last-named instance the advance will date from the last meter readings in March, and in the other two cases from the last readings in June.

Dover.—New Plant.—The Town Council has decided to purchase new plant for the electricity works, at a cost of £16,000.

Dundee.—Extensions.—A scheme for extending the Carolina Port Station has been decided on by the Town Council. Two 5,000-kw. turbines, now on order, will be installed, also two new boilers and other plant, at a total estimated outlay of £204,000.

Epsom.—Lighting Charges.—The Rural District Council has agreed to the South Metropolitan Electric Tramways and Lighting Co. making the maximum rate for electricity supplied to the new area to be lighted 8d. per unit, subject to revision if prices generally go down by the time the order comes into operation.

Exeter.—New Plant.—The Electricity Committee is considering the purchase of a turbo-generator, but stipulates that it must be delivered within a reasonable time. The engineer has been instructed to make a report on the matter.

Gloucestershire.—Act Suspended.—Under Section 63 of the Gloucestershire Electric Power Act, 1902, the Minister of Transport has ordered that the powers of the Gloucestershire Electric Power Co. shall cease as to the whole of the area of supply defined in the Act.

Lancaster.—Proposed Price Increase.—The Electricity Committee has made application to the Ministry of Transport for an order to increase the maximum charges for the supply of electricity in the borough, the scale asked for being :—Lighting, ordinary, 9d. (against 8d.); lighting, special, 7½d. (against 5d.); power, 30s. per quarter per B.H.P. installed, or per kw. installed for domestic purposes, plus 1½d. per unit ; with maximum charge of 9d. per unit (against 20s. plus 1½d., and 5d. per unit) ; meter rents are to be raised from 15s. to 30s. per annum.

London.—Hammersmith.—The Electricity Committee reports the receipt of a resolution passed by employés that all employés must be members of a recognised Trade Union, and that this be made a condition of engagement, or, in the case of a non-unionist, he must join a Union within one month of commencing employment. Agreement is recommended, provided that no obstacle is placed in the way of qualified ex-Service men becoming members of the Trade Unions concerned.

Bermondsey.—The Borough Council is applying for sanction to a loan of £38,558, in which is included £36,978 for mains extensions, £580 for a switchboard, &c., and £1,000 for an "assisted" wiring scheme.

Rochdale.—Extensions.—Owing to the increased demand for D.C. supply, the electrical engineer has been instructed to obtain tenders for a 1,250-kw. rotary converter.

Seaford (Sussex).—Electricity Supply.—The local Ratepayers' Association has urged the Urban District Council to obtain the necessary powers to supply electricity to the town.

TRAMWAY AND RAILWAY NOTES.

Australia.—New Tramway Control.—On February 2nd last the whole of the Melbourne tramway services, with the exception of the Brighton line (owned by the Railway Department) and the North Melbourne service, passed, under the terms of an Act of Parliament, to the control of the Metropolitan Tramways Board. The whole of the *personnel* of the various trusts, from which the services have been taken over, is to remain as at present, and it is stated by the Melbourne *Age* that no dismissals will be made at a later stage. When the almost completed Footscray and Fitzroy schemes are included, the undertaking will be one of the largest in the Empire, and in the same class as London, Glasgow and Sydney.

Barrow.—New Tower Wagon.—The Council has approved the purchase of a tower wagon chassis for £200, and has decided to become a member of the Municipal Tramways Association. With regard to the wages of the tramway employés, the heads of the different departments concerned have been asked to report to the Council's Workmen's Wages Sub-Committee any increase that may be granted.

Blackpool.—Employment of Motormen.—The suggestion was made that Blackpool Corporation was acting unreasonably, and that motormen of long experience were being put on car-cleaning work at the Bispham depôt. Mr. C. Furness, tramway manager, has explained that he had closed the two Fleetwood depôts, and the Fleetwood motormen were unemployed. To get over this difficulty he had offered the men alternative work at the same rate of pay. Seven out of 10 men accepted. The other three resigned.

Bradford.—Queue System.—The tramway queue system is to be radically altered under a scheme of the Tramways Committee, if the scheme receives the sanction of the City Council. The extensive circular garden and footway space around the Forster statue in Forster Square will become an "island" platform with a circular track round it close to the footpath, so that passengers can board the cars without stepping into the roadway. At various points around the "island" will be starting places for the different routes, and queues will form within the island. To further help this scheme, the Oastler monument, in another part of Forster Square, will be removed to another site in the city.

Buenos Aires.—Underground Tramways.—The Municipal Intendent has instructed the Public Works Department of the Municipality to draw up a scheme for the construction of a general system of underground tramways. It is considered that such a system is the only remedy for the enormous and still growing street congestion of the city. It is understood that once the underground system is adopted, the surface lines in the central part of the city will be taken up. When the scheme is prepared, the Intendent will place it at the disposal of Argentine or foreign firms which may be interested in working such services. This new project is said to be quite apart from similar ones contemplated by the Anglo-Argentine and the Lacroze Tramways Companies.—*Review of the River Plate.*

Continental.—France.—As from April 1st, all omnibus and underground railway fares were raised in Paris. The minimum fare is now 5d., as compared with 1½d. before the war.

Italy.—At the end of 1908 the question of the construction of a tramway line linking Cremonese and Lower Bresciano with the Lake of Garda was under consideration. Now a more ambitious scheme has been formulated for a system starting from Leno and ending at Ponte S. Marco, and concentrating on that centre a considerable traffic. The alteration is owing to a conference recently called by the Sindaco of Montichiari of the various civic bodies interested, at which it was decided to link the Lower Bresciano line to that connecting Virle Treponti, Bedissolo, and Padenghe at the most suitable spot, Ponte S. Marco. This arrangement creates a direct junction between the Cremonese and Lower Brexiano railway and tramway lines and with the Valle Sabbia, and the future Trentino railway while serving the populous Valtenesi centres. Agreement has consequently been reached on the need for the carrying out of a track running from Leno to Ghedi, Montichiari, Cacinato, Ponte S. Marco, Bedizzole, with a link at Ponte S. Marco with the Valtenesi line.—*L'Elettricista.*

Austria.—The Government has decided to complete the hydro-electric station started at Danöfen, on Lake Spuller, in the Vorarlberg, with a view to the electrification of the Vorarlberg railway. This station will work in parallel with the Lake Spuller station. The aggregate power of the plant, that of Lake Formarin included, totals 30,000 kw. The electrification is to be begun forthwith, and the line is expected to be working by the end of 1921.

Belgium.—Tramway-car workers at Brussels struck work on April 4th ; they demand higher wages.

Easter Tramway Strikes.—In spite of the general settlement of the claim of tramway employés for higher rates, averting an Easter strike, several towns were without tramcars during Easter. Cardiff, Pontypridd, Llanelly, Manchester, Salford, and Oldham employés refused to accept the terms of the award. After two or three days' absence from duty the Swansea men resumed work on Monday.

East Ham.—New Cars.—The Town Council has received sanction to a loan of £8,750 for the purchase of four new tramcars.

Fares.—The Minister of Transport, on March 30th, introduced in the House of Commons a Bill to enable tramway undertakings to increase fares to assist in meeting increased expenses and the demand for higher wages.

Lancaster.—Alterations.—The Tramways Committee has considered suggestions for alterations in the tramway and omnibus services, but has postponed further consideration pending the report of the expert engineer. Meanwhile, in order to provide a working margin, two new electric omnibuses are to be ordered forthwith.

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London.—"Shopping" Fares.—The special committee on tramways appointed by the London County Council recommends that no alteration be made with regard to children's fares. With regard to the introduction of return tickets, transfer tickets, and ½d. fares, the general manager estimates that there would be a loss in revenue of £100,000 on transfer tickets, £46,000 on ½d. fares, and £350,000 on return tickets. A further risk of loss of revenue in uncollected fares, additional cost of printing, checking, &c., is put at £80,000 a year. The adoption of any of these proposals, therefore, is not recommended. It has been decided by the Highways Committee to recommend the adoption of special cheap fares in the slack hours, so as to encourage shopping and pleasure traffic.

The L.C.C. tramway receipts for the full financial year were £4,157,311, against £3,479,287. The proposed tramway extension at Park Royal will, it is estimated, cost £150,000. A "lay-by" is to be constructed at Finsbury Park to relieve the tramway traffic congestion.

Some 400 electricians and fitters in the repair section of the L.C.C. tramways went on strike on April 6th, owing to the locking out of some of their members for not working during the holidays. Several of them were asked to work through the Easter week-end, but demanded special holiday rates of pay. This was refused, and when the men presented themselves after the holidays they were told they were not wanted. The strike was organised by the shop stewards, and the Trade Unions concerned denied official knowledge of the cessation of work.

St. Annes.—Tramway Purchase.—Following a conference of representatives of St. Annes and Lytham Councils in London, an agreement has been reached regarding the sale of the Blackpool, Lytham, and St. Annes Tramway Co. Under this, St. Annes will take over the line and Lytham will receive a percentage of profit made on the section in its area.

Petitions have been presented to Colne Town Council against the erection of a car shed in Keighley Road.

Tramway Settlement.—The threatened strike of tramway workers at Easter was only partly averted by the action of the Joint Industrial Council, which decided to allow the employés an immediate increase of 5s. a week with an additional shilling as from June 1st next for those above 18 years of age. The claim put forward by the men was for an additional 10s. per week, which would have brought their earnings to 44s. above pre-war rates. Employés under 18 years of age are to receive half of the above increases.

TELEGRAPH AND TELEPHONE NOTES.

Antipodes Island.—The *Aldebaran*, a French sloop of war, according to the *Sydney Daily Telegraph*, left Auckland, New Zealand, in January last, for Antipodes Island, in the far South Pacific. The object of her visit is to carry out wireless experiments, with a view to testing the practicability of establishing a wireless station at Antipodes Island. The ship will afterwards visit Noumea and the Society Islands.

Automatic Telephones.—It is announced that an automatic telephone system, on the lines of that installed at Leeds, is to be established at Sheffield, the exchange to be on a site at the corner of Bow Street, near the Cathedral, and the Cutler's Hall. An early start in building is expected; work has already begun on extension of the underground system of telegraph and telephone wiring.

Automatic Wireless Transmitter.—Among the exhibits to be seen at the Aeronautical Exhibition, at Olympia, in July, there will be two types of wireless signalling apparatus for use on aeroplanes. Both are the invention of Mr. F. Wates. One of these, for use on commercial aeroplanes, consists of an aluminium case measuring about 6 in. square, and enclosing a mechanism constructed so that it will not readily get out of order under the severe conditions in which it will be used. The front of the instrument has a series of messages engraved on plates in three rows. Alongside the messages are sockets into which a plug is inserted. On the right hand side of the case a handle is fitted. A plug is also provided attached to a lead, and is inserted in the desired socket. A handle is then depressed, and while it slowly returns to the normal position a signal in code is sent in Morse defining the message and preceded by the call sign of the machine and repeating. The advantage of the automatic transmitter is twofold. It enables signals to be sent in almost any circumstances, and it can be worked by the pilot himself, so that no operator need be carried. The first and simplest use to which this instrument might be put would be to install it in commercial aeroplanes flying over a definite route. Aerodromes along the route would be provided with decoding tables, and the pilot could report, by the use of the simplest possible mechanism, his progress, the weather conditions, and his experience and intentions. The second apparatus is to be used primarily by aeroplanes working in conjunction with artillery, and by the use of an aeroplane photograph or a map attached to the instrument, messages relating to the observation of fire can be sent back to the guns as easily as the messages sent to aerodromes by the first apparatus.—*The Times.*

China.—It is officially announced from Pekin that telegraphic connection has been re-established by the Northern Company *via* Kiakhta with Petrograd and various points between Astrakhan and Archangel. Communications are limited to Government and Press and Consular messages, but nothing relating to Russian subjects is permissible. For eastward messages the line is reopened only as far as Verkhneudinsk (east of Lake Baikal).—*The Times.*

France.—Postal charges were increased on April 1st; telegrams will now be 1d. instead of ½d. per word, and the telephone subscription is increased to £28, against £16, for unlimited service.

M. Deschamps, French Minister of Posts and Telegraphs, has completed a scheme for reconstructing the French telephone service. The cost of the scheme is estimated at 1,500 million francs, and 250,000 miles of new trunk lines are to be laid to link Paris with all the important French provincial centres, and to develop international communication. A new trunk line between Paris and Strasbourg is to contain 100 pairs of circuits, which are to link up all towns in Alsace and Lorraine by means of 15,000 miles of wire. New lines are also proposed between Paris and Brussels, a direct one to Antwerp and Amsterdam, and fresh lines between Lyons and the Swiss and north Italian towns. A second Paris, Milan, Rome trunk line is to be installed.

Ireland.—The Government authorities, owing to the frequency with which telephone and telegraph wires are cut in Ireland, are to make use of wireless telephony, and thus establish a means of communication which cannot be interfered with. The operators, according to the daily Press, are to be drawn from the Navy.

The Clerk of the Listowel (Co. Kerry) Rural Council has received notice of a claim against that body for £100 by the Postmaster-General in respect of the damage done to the telegraph wires and poles on the occasion of the recent attack on the Ballybunion police barracks, when all communication by wire was cut off for an entire day.

At Limerick Quarter Sessions last week, County Court Judge Pigot awarded the Postmaster-General four sums of £10, £15, £22 and £30 as compensation for the malicious cutting and damaging of telegraph wires on the occasion of the attack on the Murroe police barracks. The amounts were ordered to be levied on the entire County of Limerick.

Ships' Wireless.—Such good results have been obtained by the new long-distance Marconi wireless sets on board the Cunarders *Imperator*, *Mauretania*, and *Carmania*, that the White Star vessels *Olympic*, *Adriatic*, *Baltic*, *Celtic*, *Cedric*, and *Megantic* are being similarly equipped, and will carry this new apparatus on their next sailings from England. All these ships will now have direct intercommunication with land over a distance of 1,400 miles. Radiotelegrams intended for passengers may be handed in at any post office. The word Aberdeen must be included in the address after the name of the ship. The charge for such radiotelegrams is 10½d. per word.

Time Signals.—From Wednesday last the Eiffel Tower will transmit by wireless supplementary scientific time signals at a wave length of 2,600 metres, musical spark, each day at 10.30 and 10.32 [Greenwich mean time]. Such signals have hitherto been transmitted at 11.30 p.m. at a wave length of 2,200 metres.

Telephone Meter.—Mr. Eric Noble, of the telephone branch of the N.S.W. Government Railway Department, and formerly in the Commonwealth Telephone Department, has, according to the Sydney *Morning Herald*, perfected what he regards as a simple meter to enable subscribers to register their own effective telephone calls, and suitable alike for automatic and common-battery manual systems. The device, he claims, has been tested with success, and also has been tried out in the G.P.O., Sydney and at Melbourne. The chief electrical engineer to the Commonwealth has, however, rejected the device, because to enable city subscribers to make use of the meter it would be necessary to make an alteration to the circuit.

United States.—The Marconi Co.'s station at Carnarvon is said to be ready for opening regular wireless telegraphic traffic between this country and the U.S.A. The inauguration of the service depends on how soon the station at Belmar, New York, can be got ready; a tornado destroyed the aerials at the American station some time ago.

Wireless D.F. Stations.—An Admiralty Notice to Mariners, No. 524 of 1920, in the *London Gazette*, relates to the use of wireless direction-finding stations by the mercantile marine. The Admiralty has recently received evidence from various sources that the existence of wireless direction-finding stations in the United Kingdom, France, Canada, and the United States, and the regulations under which these stations are operated, are not as generally known throughout the mercantile marine as is desirable. On the other hand, returns rendered by the stations in the United Kingdom show that where the system is known to masters it is beginning to be more extensively used.

Wireless Telephony.—The Controller-General of Civil Aviation, Major-General Sir F. H. Sykes, left Croydon Aerodrome, on March 31st, by aeroplane for Paris in order to consult with the Civil Aviation authorities. The aeroplane was equipped with a wireless telephonic installation fitted by the Marconi Co., and the opportunity was taken to carry out wireless telephonic communication with the aerodromes *en route* on both sides of the Channel. The result shows the value (states the Air Ministry) of the system both for purposes of keeping in touch with aeroplanes from the ground and for informing pilots of the weather conditions ahead of them.

Marconi's Wireless Telegraph Co. has purchased a D.H. 6-type of aeroplane, to be used for wireless research work as applied to aircraft.

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CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the ELECTRICAL REVIEW *in which the "Official Notice" appeared.)*

OPEN.

Australia. — PERTH. — May 3rd. Postmaster-General's Department. Insulators, bolts, brackets, &c. Schedule 673. (April 2nd.)

April 14th. Postmaster-General's Department. Telegraph and telephone instruments and parts. Schedule 671. (April 2nd.)

May 14th. Government of Western Australia. One 7,500-KW. turbo-alternator and condensing plant. (See this issue.)

Bedwellty. — April 12th. Urban District Council. Electric wiring, fittings, &c. at Pengam and Aberbargoed. (March 26th.)

Belgium.—April 10th. Municipal authorities of Belgrade (Province of Namur). In connection with the local electric lighting scheme: (1) Transformer cabin and L.T. distribution mains; (2) supply and erection of H.T. overhead main.

April 17th. Post and Telegraph Authorities, La Salle de la Madeleine, Brussels. Supply of a large quantity of telephone apparatus and accessories. Particulars (Cahier des Special Charges No. 520) from the address given above.

Société Nationale des Chemins de Fer Vicinaux, of Brussels (48, Rue Montoyer). Supply of large quantity of copper wire, suitable for the re-winding of the armatures of tramway electric motors.

The D. O. T. learns that the Telephone Administration of a Belgian municipality is anxious to place a large order immediately for flexible telephone cable for movable posts; 20,000 metres will, eventually, be required. The address of the Chief Engineer, to whom quotations should be forwarded, may be obtained by United Kingdom firms upon application to the Department of Overseas Trade.

Canterbury.—April 19th. Electricity Department. One 1,000-KW. three-phase turbo-alternator, surface condensing plant, two rotary converters, superheater, &c. (March 26th.)

Cardiff.—April 29th. Corporation. One 5,000-KW. turbo-alternator and condensing plant. (See this issue.)

Darlington.—April 19th. Electricity Department. One water-tube boiler. (April 2nd.)

Edinburgh.—April 26th. Electricity Supply Department. E.H.T. paper-insulated lead-covered cables. (April 2nd.)

Eastbourne. — April 16th. Electricity Department. Supply and erection of one water cooling tower. (March 26th.)

Glasgow.—April 12th. Tramways Department. One 10 000-KW. turbo-alternator and one rotary converter; also electric lighting installation in connection with the Town Council's housing scheme at Gilshochill. Burgh Electrical Engineer.

Great Yarmouth.—April 16th. Electricity Department. One 2,000-KW. turbo-alternator, one 750-KW. rotary converter and transformer, and one 750-KW. frequency changer. (March 19th.)

Margate.—April 15th. Town Council. Electric light installation, pavilion and winter gardens. Mr. J. E. Saxby, Manager.

Salford.—Tramways Committee. Tramway rails. General Manager, 32, Blackfriars Street, Manchester.

Spain. — The Gijon-Musel Port Works Board is calling for tenders for three electric cranes for the service of the port.

May 18th. Provincial authorities of La Corunna. For the concession for the construction and working of an electric tramway between La Corunna and Sada. The adjudication is merely formal, the Compania des Tranvias de la Corunna having applied for the concession.

Sunderland.—April 28th. Electricity Department. Water-tube boilers, superheaters, stokers, economisers and chimneys; one 1,000-KW. rotary converter. Specifications, &c. (£1 each), from General Manager, Electricity Works, Dunning Street.

Tasmania.—LAUNCESTON.—June 7th. City Council. One 1,000-K.V.A. hydro turbo-alternator, with switchgear. City Electrical Engineer, Town Hall, Launceston.

CLOSED.

Australia.—MELBOURNE.—City Council. Accepted:—

Electricity recording meters, £920.—Met.-Vickers Electrical Co., Ltd.
Spare parts for rotary converter, £1,028.—Met.-Vickers Electrical Co., Ltd. (recommended). —*Tenders.*

Batley.—The Electric Lighting Committee has conditionally placed an order with the Metropolitan-Vickers Electrical Co. for a rotary converter and switchgear.

Cambridge.—Mental Hospital, Visitors:—

Electric fire alarms.—Mr. Negus, £95.

Gillingham (Kent).—Town Council:—

3-ton electric crane.—Anderson, Grice & Co., £1,865.

Glasgow.—Tramways Department. Accepted:—

Cable.—B. I. & Helsby Cables, Ltd.
Armature coils (5,000 each).—P. R. Jackson & Co., Ltd., Metropolitan-Vickers Electrical Co., Ltd.
Gear cases.—Equipment & Engineering Co.
75 car motor equipments; magnetic brake equipments.—Metropolitan-Vickers Electrical Co., Ltd.

Halifax.—Tramways & Electricity Committee. Accepted:

British Thomson-Houston Co., Ltd.—10,000-KW. steam turbo-alternator, £43,835.
Worthington-Simpson, Ltd.—Surface condensing plant, pumps, &c., £23,273.

Lancashire.—The following contracts have been secured by the Cork and District Electric Supply Co., Ltd.:—

Ulverstone Palladium Kinema.—Electrical equipment, £1,100.
Newby Bridge, Swan Hotel.—Engine, dynamo, battery and wiring, £150.
Graythwaite, Silverholme.—Engine, dynamo, battery and wiring, £475.

London.—ST. PANCRAS.—Highways, Sewers and Public Works Committee. Supply of motor wagons, with interchangeable water-van bodies:—

	Galls.	Price.
General Vehicle Co.—3½-ton electric, water-tank body ..	750	£1,750
Mossay & Co., Ltd.—3½-ton "Orwell" electric	700	1,673
Electromobile (Leeds), Ltd.—3½-ton electric	750	1,948
Edison Accumulators, Ltd.—2-ton "Edison" electric ..	500	1,507
Newton Bros. (Derby), Ltd.—3½-ton electric	750	1,718
Tilling-Stevens Motors, Ltd.—3/4-ton petrol-electric ..	750	1,650
Lacre Motor Car Co.—2-ton "Lacre" petrol tipping wagon	460	1,339
Eagle Engineering Co., Ltd.—"Dennis" petrol	750	1,487*
J. L. Thornycroft & Co., Ltd.—3½-ton "J" type petrol	750	1,495
Hailey's Indus. Mtrs., Ltd.—4-ton second-hand re-built petrol	750	1,000†
Atkinson & Co.—5-ton steam	1,000	1,525
Clayton & Shuttleworth.—5-ton steam	1,000	1,530

*Extras for side-tipping body; end-tipping body. †Extras for tool kit, lamps, horn, &c.; one vehicle only.

The Committee considers the electrically-driven vehicles would be more economical in cost of working, being simpler in construction and more easily controlled, less liable to accidents and cheaper in running costs, and that the Orwell vehicle is the most suitable for the Council's purposes, and recommends the purchase of two Orwell vehicles, at £1,673 each.

HAMMERSMITH.—Cartage, Cemetery and Town Hall Committee. 3½-ton electric vehicle for street watering and house refuse collection, with tipping gear, &c.:—

Edison Accumulators, Ltd...	£1,687 each.
Mossay & Co., Ltd. (recom.)	**1,556*** ,,
Electromobile (Leeds), Ltd...	1,480 ,,
General Vehicles Co., Ltd.	1,680 ,,

*Six Orwell electric vehicles.

Electricity Committee. Recommended. High and low-pressure steam valves in connection with the new Stirling boiler:—

J. Shaw, Son & Greenhalgh, Ltd. (recom).	**£221**
J. Hopkinson & Co., Ltd.	229
Cockburns, Ltd.	255

Steel frame-work for furnace for new boiler:—

Foster Construction Co., Ltd. (recom.)	**£131**
Aston Construction Co.	151
Measures Bros., Ltd.	160

St. Helens.—Tramways Committee. Accepted:—

Four top covers.—English Electric Co., Ltd.
Motors for four cars.—Metropolitan-Vickers Electrical Co., Ltd.

Whitwood.—Urban District Council. Accepted tender:

S. Rushworth, Shipley.—Electrician's work for the Wood Lane housing scheme.

Decimal Coinage and the Metric System.—With a view to checking the progress of the metric system in the United States and this country, Mr. F. A. Halsey prepared and circulated extensively pamphlets purporting to show that the system had not obtained any foothold in the United States, and that it had proved a failure in South America. In the *Decimal Educator* (the journal of the Decimal Association) for September last, the former was critically examined and shown to afford no real indication of the attitude of American manufacturers towards the metric system, while it was explained that no metric measure yet introduced had proposed to compel manufacturers to adopt it inside their works—it can only be imposed by legislation upon *commercial* transactions, and therefore would in no way affect manufacturing operations unless the owner of the works voluntarily adopted it. In the following issue (December) the second pamphlet was dealt with, and 24 letters from merchants, consuls, and other South American authorities were printed, repudiating in the strongest terms the suggestion that the metric system had not been successful in Latin American countries. A further instalment of letters from engineers, bankers, and other residents in Latin America was published in the issue for March, in which identical views were expressed, and Mr. Halsey's statements were emphatically denied. In the last-named issue Sir Auckland Geddes' recent objections to the metric system were effectively answered, and articles appeared on the advantages of decimal coinage, the International Bureau of Weights and Measures, &c.

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FORTHCOMING EVENTS.

Junior Institution of Engineers.—Friday, April 9th. At 7.30 p.m. At 39, Victoria Street, S.W. Lecturette on "The Development and Manufacture of the Thermionic Valve," by Mr. A. H. Howe.

North of England Institute of Mining and Mechanical Engineers.—Saturday, April 10th. At the Wood Memorial Hall, Newcastle-on-Tyne. At 2 o'clock. General meeting.

Association of Engineers-in-Charge.—Saturday, April 10th. At St. Bride's Institute, Ludgate Circus, E.C. At 7.30 p.m. Social and dance.

Wednesday, April 14th. At 7.30 p.m. Paper on "Hygienic Principles of Ventilation and Heating," by Prof. L. Hill.

Salford Technical and Engineering Association.—Saturday, April 10th. At the Royal Technical Institute. At 7 p.m. Lecture on "Water-softening Plant," by Mr. T. Whitehead.

International Building Trades Exhibition.—April 10th to 24th. At Olympia, London, W.

Society of Engineers.—Monday, April 12th. At Burlington House, W. At 5.30 p.m. Papers on "Flood Prevention Works at Troon, Ayrshire, and the Action of Sea Water on Concrete," by Prof. E. R. Matthews.

Association of Engineering and Shipbuilding Draughtsmen.—Monday, April 12th. At the Technical School, Barrow-in-Furness. At 7.30 p.m. Paper on "Critical Speed of Shafts," by Mr. G. E. W. Johnson.

Friday, April 16th. At the University, Sheffield. At 7.30 p.m. Paper on "Reinforced Concrete Beams," by Mr. J. Claughton.

Royal Society of Arts.—Monday, April 12th. At John Street, Adelphi, W.C. At 8 p.m. Cantor lecture on "Aluminium and its Alloys," by Dr. W. Rosenhain.

Royal Institution of Great Britain.—Tuesday, April 13th. At Albemarle Street, W. At 3 p.m. Lecture on "Recent Advances in X-Ray Work," by Major G. W. C. Kaye.

Friday, April 16th. At 9 p.m. Lecture on "Ions and Nuclei," by Prof. J. A. McClelland, F.R.S.

Institution of Civil Engineers.—Tuesday, April 13th. At the Institution, Gt. George Street, S.W. At 5.30 p.m. Papers on "The Richborough Military Transportation Depôt," by Lieut.-Col. J. K. Robertson,"; and on "The War Department Cross-Channel Train-Ferry," by Major F. O. Stanford.

Industrial League and Council.—Wednesday, April 14th. At 82, Victoria Street, S.W. Lecture on "Results Achieved in Industry by Modern Methods," by Mr. J. F. Butterworth.

Manchester Wireless Club.—Wednesday, April 14th. At 335, Oxford Road, Manchester. At 8 p.m. Lecture on "Radio-Telephony," by Mr. A. Couyoumdjiam.

Institution of Electrical Engineers.—Thursday, April 15th. At 6 p.m. At the Institution of Civil Engineers, Gt. George Street, S.W. Eleventh Kelvin lecture on "Modern Marine Problems," by Dr. C. V. Drysdale.

(Western Centre).—Monday, April 12th. At the South Wales Institute of Engineers, Cardiff. At 7 p.m. Lecture on "Thermionic Valves," by Prof. E. Bacon.

(Students' Meeting).—Monday, April 12th. At the Institution of Mechanical Engineers, Storey's Gate, S.W. At 8 p.m. Joint discussion with the Graduates' Association of the Institution of Mechanical Engineers, on "The Six-hour Working Day and its Effect on Industry."

Friday, April 16th. At Faraday House, Southampton Row, W. At 7 p.m. Paper on "The Vacuum Tube as a Transmitter and Receiver of Continuous Waves," by Mr. J. Scott-Taggart.

(North-Western Centre).—Tuesday, April 13th. At the Engineers' Club, Manchester. At 7 p.m. Annual general meeting and smoking concert.

(Scottish Centre).—Tuesday, April 13th. At 207, Bath Street, Glasgow. At 7.30 p.m. Lecture on "Highland Water-Power," by Mr. J. M. Munro. Annual general meeting.

(South-Midland Centre).—Wednesday, April 14th. At the University, Birmingham. At 7 p.m. Ordinary meeting.

North-East Coast Institution of Engineers and Shipbuilders.—Friday, April 16th. At the Literary and Philosophical Society, Westgate Road, Newcastle-on-Tyne. At 6.15 p.m. Paper on "Casting and Treatment of Steel," by Dr. J. H. Andrew.

NOTES.

Channel Tunnel.—Although sanction to construct the Channel tunnel has not yet been given by Parliament, the task of moving back the railway station platforms throughout the Great Northern Railway system to allow clearance for the passage of Continental trains when the tunnel is opened, has, according to the daily Press, been begun. The work of increasing the distance between platforms will take several years, and it is understood that the first station to be completed will be Finsbury Park.

Motor-Car Lighting.—The Accessories and Components Committee of the Society of Motor Traders and Manufacturers has appointed a Sub-Committee to confer with the British Engineering Standards Association with regard to standardising a small centre-contact lampholder in addition to one having a double contact.

Fatality.—On March 30th, Hetty Pape, a servant, at St. Annes, when having a bath, used an electric hair-drier; later she was found dead in the bath. At the inquest at Blackpool, Dr. Tennant said there were burns over the eye-brow, to the hair, and on the left arm; a low voltage of 240 should not kill a normally healthy person. He thought deceased had had an attack of syncope, and was drowned. Mr. J. H. Clothier, electrical engineer, said the girl might have been startled by a "blow" of copper dust, but he could see nothing wrong with the drier. He agreed that it was almost impossible to kill anyone with 240 volts. A verdict that deceased was accidentally drowned as a result of syncope, caused by burns from the electric drier, was returned.

Electricity in the Bakery.—A great deal of electrical plant for use in the bakehouse was on view at the Bakers' Exhibition recently held in the Kelvin Hall, Glasgow. There is every indication that electrical methods are gaining ground in this direction.

Rubber Trades Exhibition.—This international exhibition is to be held at the Royal Agricultural Hall, London, from June 3rd to 17th, 1921.

An Electric Motor Scooter.—With regard to the increasing popularity of motor scooters, an electrically-propelled machine is shortly to be put on the market by the G.N.U. Motor and Accessories Co., of Westbourne House, Westbourne Grove, London, W., under the name "Newton-Burgoyne."

The B.A. Meeting.—This year's meeting takes place at Cardiff, from August 24th to 28th, under the presidency of Prof. W. A. Herdman.

Educational.—The annual report of University College, London, has just been issued. The total number of students for the session 1918-19 was 2,048, an increase of 977 on the previous year. This increase took place after the Armistice, and mainly in January, 1919, and consisted almost exclusively of ex-service men. Arrangements were made whereby the ex-service men who resumed work in January, 1919, were enabled to complete a full session's work by the beginning of August, and most of them succeeded in so doing.

The total revenue of the college for the year 1918-19 was £75,781, of which £26,304 was from fees. The total expenditure was £77,824, causing a deficit of £2,210. This deficit arises from the increase in salaries that has become necessary, and generally from the increased cost of running the college.

The report sets out the scheme for the War Memorial, which is as follows:—(*a*) A war memorial album; memorial tablets; scholarships. (*b*) A great hall for the use of the college and medical school. (*c*) The endowment of University College Hall, Ealing. The sum of £30,000 is needed for this purpose, of which £5,000 has been subscribed. Members of the college who have not yet received the War Memorial statement are requested to communicate with the Secretary of the War Memorial.

The Board of Education states that the Draft, dated October 28th, 1919, of the Technical Schools, &c. (Amending), Regulations (No. 2), 1919, has been confirmed without amendment. The Draft now becomes Technical Schools, &c. (Amending), Regulations (No. 2), 1920, and copies can be purchased through any bookseller (price 1d.), or directly from H.M. Stationery Office, Imperial House, Kingsway, London, W.C. 2 (price by post 1½d.).

Appointments Vacant.—Charge engineer (45s. + 20 per cent. + £90) for the City of Carlisle Electricity Department; mains superintendent (£380) for the Stoke-on-Trent Corporation Electricity Department; telegraph foreman (£372) for the Post and Telegraph Department of the Government of the Gold Coast. See our advertisement pages to-day.

Wireless Operators.—Both before and during the war wireless operators on board ship have won the highest praise by their behaviour in the face of danger. They are paid by the Marconi Co., but, in order to comply with the Merchant Shipping Act, they receive a nominal monthly salary from the ship. As salvage awards are divided among the crew in proportion to their pay, "sparks" gets very little, although the job generally means as little rest for him as for anybody else. To Mr. Justice Hill belongs the credit of making a special order in a recent case before him that the wireless operator should rank with the fourth engineer.

Aerodrome Lighting.—Among the aerodrome lighting installations carried out by Julius Pintsch & Co., of Berlin, is, says *Luftflutte*, a system of eight bucket lights sunk in the ground symmetrically about a central light and about 40 metres from it, marking the cardinal points. The lights are switched on and off by a wind vane, and so give the airman the direction of the wind at any moment, four lights being always occulted, and the remaining five forming a pointer. Thick glass covers are fitted over the lights so that aircraft can run over them without danger of breakage. Other products of this firm are lighthouses with wandering fan-shaped beam, aeroplane landing projectors supplied by a small dynamo or accumulator, workshop lights, searchlights, and alarm signals.—*Technical Review.*

Norwegian Official Amenities.—The Etne electric station, which has just been handed over to the Communal Authorities of Haugesund, Stavangar, and which contains two turbo-generator sets, each of 2,500 KW., and a pressure of 5,000 volts, has only been completed after overcoming serious difficulties which arose through the war. Mr. Valentinsen, the engineer, states that the greatest difficulty was experienced with the Norwegian authorities, not from reluctance to assist, but from clumsiness and inefficient administration. Thus the many Government departments with which the contractors had constantly to be in touch seemed to have little comprehension of the questions put before them for decision, and every instance was treated in an incomplete manner. As a curiosity, the engineer refers to the arrival of plant from Germany, but which the authorities refused to allow to be delivered until the bill of lading had been endorsed by the Chemical Materials Department at Christiania. The bill of lading was sent in with an application for immediate return as every day wasted implied a loss of money. What was the result? No reply was received, and a telegraphic inquiry also failed to produce an answer. Under these circumstances, the engineer was compelled to travel to Christiania in order to get the matter cleared up. He was there informed that the reason for the delay was that a lady in the department was suffering from influenza, and the delivery of goods in different parts of the country was consequently stopped. This case does not stand alone, as a similar instance occurred three weeks later with another cargo of goods.

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Electric Lamps in Mines.—As a protest against the non-provision of electric lamps in the mine—which, they claim, give more safety and a better light below ground—1,400 men employed at the Tirpentwys Colliery, Pontypool, have given a fortnight's notice to cease work.

German Electrotechnics.—In a Berlin paper, Heinrich Müller, engineer, of Offenbach, discusses war-time electrotechnical progress. The special aim during that period was to develop along the lines of standardisation and specialisation. Motors for winding engines attained a capacity of 4,000 H.P., and those for reversing rolls 22,000 H.P. In electric railway traction on the D.C. system a limit of 3,500 volts pressure had, so far, been reached. The use of alternating current on railways has since reached an average pressure of 15,000 volts. No advance on these figures is anticipated. Germany has in operation long-distance conductors of from 110,000 to 150,000 volts, whilst generators have been built of a capacity of 50,000 K.V.A. The capacity of German electrical works has attained on an average 120,000 KW. The power station at Berlin has an output of 220,000 KW. An increase up to 500.000 KW. is possible. An increase also in the pressure of conductors and the capacity of generators is considered to present no difficulties. It is admitted that aluminium, as a substitute for copper, does not present equal value or advantages, at any rate, in the construction of electrical machinery and transformers. There is said to be only a poor future before the utilisation of aluminium in electrical manufacture; it is only in the building of transformers that it is possible to arrive at approximately equal losses with aluminium as with copper. The additional work involved is, however, so great, that makers are not likely to resort to aluminium to any extent. It is thought that some advantage may be gained from the use of electrolytic iron and sheet alloys. In switchgear and such apparatus copper may be replaced by aluminium in some cases. The distribution system is, however, the best direction for the substitution of aluminium for copper. During the war substitution had to be extensively practised in the case of insulated conductors. In view, however, of the improved position of rubber supplies, replacement of this material no longer needs to be contemplated. As an example of the benefits of standardisation, reference is made to a factory connected with the electric lighting industry whose price list used to include 13,000 different items; this number has been reduced to 6,000, and it is to be further diminished to 3,000.

Motor-car Headlights.—In his introduction to a discussion at a recent meeting of the Illuminating Engineering Society, Mr. J. W. T. Walsh, M.A., gave a brief outline of the history of the subject of motor-car headlights, including mention of experiments carried out at various times by the R.A.C. and other authorities. The interim report of the committee set up by the Ministry of Transport was quoted; the points noticed were that, first, no satisfactory device combined a safe driving light with freedom from dazzling effects; secondly, that the types of lamps in general use at the present time were far too powerful; and thirdly, that, pending the discovery of a satisfactory dimming device, a maximum power should be fixed compatible with safety in driving. An American Committee set up for the same purpose made several recommendations in this respect. This committee thought that all lamps should be such that no light was projected above a plane 42 in. from the road and parallel to it, but no lateral limit was put forward. Limitation of candle power was favoured, and also the fixing of a minimum of .001 foot-candle of illumination. It was considered that the "spread" of headlights should be at least 10 ft. measured 50 to 100 ft. from the front of the car. No objection was offered to the use of yellow or amber-coloured headlights. These recommendations were endorsed and to some extent amplified by the London "Safety First" Council. Existing rules regarding car lights are much more explicit in the U.S.A. than in this country. The New York regulations require that front lights must be visible 250 ft. in the direction in which the vehicle is proceeding, and in Connecticut the rules for car lights are based upon the recommendations of the committee referred to above. Mr. Walsh gave the following points to be considered in the discussion of this subject: (1) What value should be assigned for the minimum range of headlights? (2) What is the minimum permissible power? (3) What should be the limits assigned to the width of the beam? (4) Should any recommendations be made with regard to the illumination of the road between the car and the point of minimum range? (5) Is it desirable to fix a limiting horizontal plane or to restrict the candle-power in directions above a fixed plane? (6) Should a maximum value be assigned to headlights? (7) Should supplementary requirements be enforced governing the illumination of the area adjacent to the car? (8) Is it desirable that means should be provided to enable drivers to diminish the power of the lights according to the intensity of street lighting, &c.? (9) Should headlights turn with the steering wheel to afford an indication of the car's direction? (10) Is it practicable to provide a rear signalling light to indicate what the driver is about to do? and (11) Is there any available information regarding the fog-piercing effects of a yellow-coloured beam?

Brake Tests on a Kaplan Turbine.—Literature hitherto published concerning the Kaplan water turbine has been concerned chiefly with the history of the development of this machine. Sufficient information has been given to make it evident that the turbine departs widely from the principles of design hitherto accepted, but there has been some feeling that the results claimed in point of efficiency, flexibility, and speed have been inadequately supportd by experimental evidence. Such doubts appear now to be removed by a paper in *Electrotechnik u. Maschinenbau* describing brake tests undertaken by Berthold Blumel (Vienna) in collaboration with Prof. Budau. The machine tested was a single-wheel, horizontal shaft turbine, type KTc, with a specific speed of 700 to 800. The flow was about 1,400 litres/sec. at times of high water, and about half this amount in the dry season. The mean head was about 3 m. The test arrangements are described in the original paper, and appear to have been quite satisfactory. Brake tests were conducted at four admissions corresponding to flows of 420, 520, 1,000, and 1,100 litres/sec. With each admission in turn, tests were made at speeds of 350, 380, 420, and 450 R.P.M. Curves in the paper show that the efficiency was high and remarkably uniform over a wide range of speed. The curves for 40 per cent. admission show, for unit speeds $n_1=219$ to 280, $Q_1=230$ to 252 litres/sec., and efficiency from 81 per cent. up to 83 per cent., and down to 78 per cent. again. Corresponding figures for 50 per cent. admission: $n_1=220$ to 281; $Q_1=340$ to 316 litres/sec; efficiency = 85-86-82 per cent. At 100 per cent. admission, $n_1=228$ to 296; $Q_1=670$ to 674 litres/sec.; and efficiency = 88.5-84-82 per cent. At 115 per cent. admission, $n_1=234$ to 342; $Q_1=670$ to 870 litres/sec.; and efficiency = 80.5-81-75 per cent. These results are considerably better than can be obtained from a Francis-type turbine, which becomes more sensitive to variations in head and flow as the speed is increased. The efficiency of the Kaplan turbine is affected by variations in speed and flow to a less extent than that of any other type of turbine yet developed. This advantage is combined with that of remarkably high specific speed. After six months' service the above-mentioned turbine showed no appreciable wear and had required no repairs.

Admitting the validity of these test data and bearing in mind the fact that experimental Kaplan turbines are under construction with which it is hoped to obtain reasonable efficiency in conjunction with specific speeds up to 1,600, it is evident that we have here a type of turbine which will make possible the economic utilisation of many low and medium falls hitherto incapable of efficient development owing to fluctuations in head and flow—a type of fall which is very commonly met with in this country. It would be interesting to have a clear statement of the number and horse-power of Kaplan turbines already in use, and a statement as to the horse-power up to which these machines can be built.

Electrically-Heated Dwellings in Switzerland.—Under this somewhat vague heading, M. Hottinger discusses in the *Schweizerischer Bauzeitung* the future position with regard to Switzerland's coal requirements, and the possibilities of electrical energy for heating purposes. According to the *Technical Review*, the writer states that a saving in coal can be effected by converting steam bakeries into electric, as it has been found by experiments that the former consume about 1,000 short cals. per kg. of bread baked, and the latter only 300 cals. The writer has made a rough calculation of the quantity of electric energy that would be required to give the same useful effect as coal used *qua* coal, and on the 1913 coal basis this works out at 17 thousand million KW.-hours. He suggests that when the water-power resources are fully developed they will yield some 20 thousand million KW.-hours per annum at high-water level, the present yield being only 2.75 thousand million KW.-hours. He then enters into exhaustive calculations showing the amount of energy required to heat dwelling-houses, offices, &c., the result of which shows that, on an average January day, only 35 per cent. of the population could cover their heating requirements from the fully-developed water-power resources of the country. When this position has been attained, population will have increased, and industrial requirements will be higher; and, moreover, the large industrial concerns which will be large consumers in the summer months, will also be retained in the winter. Large-scale heating by electrically-heated boilers in conjunction with coal-fired plants is destined to play a considerable part in the country during the September-November and March-May periods, but for the coldest months the only solution lies in the use of coal as heretofore, and power from large hydroelectric stations.

INSTITUTION NOTES.

Institution of Electrical Engineers.—The following have been nominated by the Council for the vacancies which will occur in the offices of president, vice-presidents, honorary treasurer, and ordinary members of Council on September 30th, 1920:—

President (One vacancy).—**Ll. B. Atkinson, Cable Maker, Sardinia House, Sardinia Street, W.C.**

Vice-Presidents (Three vacancies).—**Dr. W. H. Eccles, Professor of Electrical Engineering and Applied Physics, City and Guilds Technical College, Leonard Street, E.C.; J. S. Highfield, consulting engineer, 36, Victoria Street, S.W.; S. L. Pearce, C.B.E., chief engineer, Manchester Corporation Electricity Department.**

Hon. Treasurer (One vacancy).—**J. Devonshire, managing director, London and Suburban Traction Co., Ltd., Electric Railway House, Westminster, S.W.**

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Ordinary Members of Council. Members (Six vacancies).—F. Gill, European Chief Engineer, International Western Electric Co., Norfolk House, Victoria Embankment, W.C.; P. V. Hunter, joint manager, Callender's Cable and Construction Co., Ltd., Hamilton House, Victoria Embankment, E.C.; J. F. Nielson, electrical engineer, Messrs. John Brown & Co., Ltd., Clydebank; W. Noble, Engineer-in-Chief, General Post Office, E.C.; A. P. Pyne, director, Redheugh Iron and Steel Co., Ltd., Gateshead; Dr. A. Russell, principal, Electrical Standardising, Testing, and Training Institution, Faraday House, Southampton Row, W.C.; F. Ryan, chief engineer, Eastern and Associated Telegraph Companies, Electra House, Moorgate, E.C.; W. O. Smith, director, Messrs. Elliott Bros. (London), Ltd., Lewisham, S.E.

In making the nominations, the Council has put forward the names of members who, together with those remaining on the Council, will represent various branches of the electrical profession, and the list is accompanied by an analytical statement showing the allocation of the nominations to the interests concerned.

Western Centre Summer Meeting.—At the invitation of the Committee of this Centre (Mr. Arthur Ellis, chairman), a summer meeting of the Institution will be held at the Western Centre on July 13th to 16th, 1920. The provisional programme includes receptions by civic authorities, dinners, and other public functions, as well as visits to works and places of interest at Cardiff, Newport, Caerphilly, Bristol, Weston-super-Mare, Wells, Cheddar, Swansea, and district, and the Gower Coast. A supplementary excursion to Hereford is also proposed for those members who are desirous of taking part, when visitors will be received by the Corporation, and visits paid to farms (electroculture), factories, &c. In the case of members residing in Bristol, Cardiff, Newport, Swansea, and adjoining districts who may not wish to take part in the whole of the meeting, arrangements will be made for them to do so on individual days. The presence of ladies at the meeting is cordially invited. It is requested that early application be made for tickets to the Secretary of the Institution, at 1, Albemarle Street, W.1.

Informal Social Evening.—On March 29th an informal smoking concert was held at the Albert Tavern, Victoria Street, Westminster; Mr. R. Rankin occupied the chair, and Mr. Roger T. Smith, president, was present, while there was a large attendance of members of the Institution and their friends. The formal programme was replaced by an informal "List of probable perpetrators of atrocities," with "forecasts of the direction in which their criminal instincts are likely to lead them," Mr. Rankin being (not unjustly) canonised—or should we say stigmatised?—as the "chief humorist." Mr. W. E. Warrilow, who, as "chief tragedian," was to "disinter some depressing anecdotes," was unfortunately prevented by illness in his family from attending. A full orchestra performed at frequent intervals, and other artistes were Messrs. Ambler, Brandon, Corthesy and Kelman, with Mr. W. E. Bradshaw at the piano, where he gave an excellent skit on "Our Works." The occasion was unquestionably a success, and will no doubt be encored next season.

Institute of Marine Engineers.—The recently published annual report for the Session 1919-20 announces an increase in the total membership of 147. Lord Weir, of Eastwood, has consented to continue in office as President for the current year. A list is given of papers and lectures delivered during the session, including a paper upon "The Electrification of Ships," by Captain Durtnall, R.A.F. Various awards for papers, and the allotment of scholarships are noted.

Iron and Steel Institute.—The annual meeting will take place at the Institution of Civil Engineers in London on Thursday and Friday, May 6th and 7th. It will be continued in Sheffield on Friday, May 14th. Dr. J. E. Stead, F.R.S., will preside. The list of papers to be read in London includes the following:—

C. A. Ablett: "Direct Current compared with Three-phase Current for driving Steel Works plant."

W. E. Hughes: "Some Defects in Electro-deposited Iron."

The list for the Sheffield meeting includes:—

C. A. Edwards and A. L. Norbury: "Effect of Heat Treatment on Electrical Resistivity."

A. L. Norbury: "The Effect of various Elements on Electrical Resistivity of Iron."

Australian Engineering Institutions.—As the outcome of a meeting of the South Australian Institute of Engineers held on October 17th last to consider a proposal for affiliation with the Electrical Association of Australia, the amalgamation of the various engineering societies throughout Australia has been accomplished. The two Victorian societies which have joined the new institute are the Melbourne University Engineering Society and the Electrical Association of Victoria. The first general meeting of the Melbourne division of the Institution of Engineers of Australia was held on October 16th at Collins House. Mr. W. J. Newbigin, the convener, stated that the support received had been most encouraging. It was pleasing to find that a Queensland Bill provided that membership of the Institution was a qualification for registration. Efforts were being made to obtain a similar provision in New South Wales. The Local Government engineers of New South Wales and Queensland had joined the Institution, but those of Victoria had not yet done so, though it was hoped they would do so shortly, thus leaving only one society in the Commonwealth not linked up with the Institution.—*Age.*

National Association of Supervising Electricians. — An interesting paper on "Electric Welding" was read before the Association by Mr. T. F. Tate, A.M.I.E.E., on March 30th. The description of recent developments in this subject, and the practical information condensed within the limits of the paper, were highly appreciated by the members present. The next paper to be read before the Association will be on "Wireless Telegraphy" on Tuesday, May 4th, when arrangements will be made for receiving and transmitting messages in the Lecture Hall. Visitors are invited to attend, and tickets may be obtained on application to the Hon. Secretary, 83, Deodar Road, Putney.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review posted as to their movements.

Mr. J. W. Church, A.M.I.E.E., of the Dover Dockyard staff, and for many years in charge of the Dockyard electrical department, has left to take up an appointment at Hong Kong.

Darwen Town Council has increased the salary of Mr. P Taylor, assistant electrical engineer, to £260 per annum.

Mr. W. W. Lackie, till recently general manager and engineer of the Glasgow T.C. electricity department, was on Thursday last week made the recipient of a presentation from the head officials of the T.C. departments on the occasion of his appointment as an Electricity Commissioner. Chief Constable Stevenson presided at the gathering. Sir John Lindsay, town clerk, made the presentation, which consisted of a silver tea service and a silver cigarette box.

On the retirement of Mr. R. Hudson from the service, the Dublin members of the G.P.O. telegraph department presented him with a silver tea service and salver. Mr. E. F. Sweeney, chief superintendent telegraph department, presided.

A smoking concert was held on March 31st to bid farewell to Mr. A. O. Holt, of the Manchester Corporation sub-stations staff, who is leaving to take up private contracting work. He was presented with a gold watch from his friends on the sub-stations staff. Mr. Bolton, the head of the department, made the presentation. Recitations and vocal and instrumental music were contributed by members of the staff. Mr. Holt will continue to reside in Manchester.

Mr. A. S. Tong, who has been with the Newcastle branch of the General Electric Co. for several years past, has been appointed branch manager of the Newcastle depôt of the Foster Engineering Co., Ltd., at Milburn House, Newcastle-on-Tyne.

The Peterborough Council has selected six applicants for the post of electrical engineer and manager to appear before it at its meeting on Monday afternoon next, April 12th.

A Press dispatch from Paris states that M. Vaillant, head of the radiographic service at the Lariboisière Hospital, who since 1910 has undergone eight surgical operations owing to X-ray burns, has now had his left arm amputated. He has only two fingers left on his right hand.

Mr. J. W. Thomas, B.Sc., A.M.I.E.E., has resigned his position as instructor in electrical engineering, Birmingham Technical College, to take up the post of assistant general secretary to the E.P.E.A. All future communications for Mr. Thomas should be addressed E.P.E.A. offices, 65-66, Chancery Lane, London, W.C. 2.

The London County Council General Purposes Committee recommends that Mr. C. D. Johnson, deputy comptroller of the Council, be promoted to the office of controller, at a salary of £1,600 (pre-war scale), rising by annual increments of £100 to £2,000.

Mr. E. E. Stark, Christchurch, New Zealand, city electrical engineer, has resigned.—*Commonwealth Engineer.*

Mr. F. P. Sexton, A.R.C.S., A.M.I.E.E. (late chief technical assistant to Mr. S. G. Brown, F.R.S.), has opened at 39, Parliament Street, Westminster, S.W.1, as a consultant, with special reference to gyroscopic compasses, &c., and illumination.

War Honours.—We tender our congratulations to the following gentlemen whose names appeared in the list of appointments or promotions to the Civil Division of the Most Excellent Order of the British Empire for services in connection with the war:—

Knights Grand Cross (G.B.E.).

Sir John Denison-Pender, K.C.M.G., managing director of Eastern Telegraph Co., Ltd.

Dr. A. E. Shipley, F.R.S., LL.D., D.Sc., vice-chancellor of Cambridge University.

Knights Commanders (K.B.E.).

Prof. W. H. Bragg, C.B.E., D.Sc., F.R.S., Quain Professor of Physics, University of London; superintendent of Admiralty experimental station at Parkston.

Mr. J. Devonshire, managing director of London United Tramways, Ltd., and London & Suburban Electric Traction Co., Ltd.

Mr. John Dewrance, member of Engineering Employers' Consultative Committee, Ministry of Munitions, vice-chairman, Managing Committee, Engineering Employers' Federation; chairman, Messrs. Babcock & Wilcox, Ltd.

Mr. G. K. B. Elphinstone, O.B.E., technical head of Messrs.

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Elliott Bros. (London), Ltd. Valuable services in design and manufacture of fire control apparatus for Navy.

Mr. A. B. Gridley, electrical adviser to Government departments. Director of Electric Power Supply.

Dr. J. E. Petavel, F.R.S., chairman of Aero-Dynamics Subcommittee of the Advisory Committee on Aeronautics.

Mr. H. B. Renwick, late director of Feeding Stuffs Department, Ministry of Food; managing director of County of London Electric Supply Co., Ltd.

COMMANDERS (C.B.E.).

Capt. J. W. Barber, organiser of travelling kinematograph propaganda.

Mr. H. E. Blain, operating manager, Underground Railways of London, Ltd.

Prof. H. L. Callendar, F.R.S., LL.D., Professor of Physics, Imperial College of Science, London.

Dr. C. C. Carpenter, member, Chemical Warfare Committee and Munitions Inventions Panel, Ministry of Munitions; chairman, South Metropolitan Gas Co.

Mr. R. A. Dalzell, chief inspector of telegraph and telephone traffic, General Post Office.

Mr. J. Edwards, O.B.E., manager, Messrs. Hick, Hargreaves and Co., Ltd. (Munitions Design).

Mr. A. L. C. Fell, manager of London County Council Tramways.

Mr. A. P. M. Fleming, O.B.E., vice-chairman of the Lancashire Anti-Submarine Committee.

Prof. P. F. Frankland, F.R.S., LL.D., Sc.D., Deputy Inspector of High Explosives, Birmingham Area, Ministry of Munitions; Emeritus Professor of Chemistry, Birmingham University.

Mr. J. B. Hamilton, manager of Leeds Corporation Tramways.

Prof. W. A. Herdman, D.Sc., LL.D., F.R.S., Professor of Oceanography, University of Liverpool; foreign secretary, Royal Society.

Mr. A. H. Human, technical adviser, Electrical Power Supply Department, Ministry of Munitions.

Mr. W. J. Larke, Director General of Raw Materials, Ministry of Munitions.

Mr. Michael Longridge, member, Munitions Inventions Panel.

Mr. C. Le Maistre, adviser to Aircraft Production Department, Ministry of Munitions.

Mr. Alexander Newlands, engineer-in-chief, Highland Railway.

Mr. G. F. Preston, controller of London telephone service.

Captain M. H. P. R. Sankey, C.B., honorary consulting engineer to Directorate of Fortifications and Works.

Mr. H. Scholey, London member of the Clyde Anti-Submarine Committee.

Mr. J. E. Sears, Junr., superintendent, Metrology Division, National Physical Laboratory, Ministry of Munitions.

Mr. F. J. Selby, secretary, National Physical Laboratory.

Mr. C. P. Sparks, services to the engineer-in-chief of the Admiralty's Department.

Dr. T. E. Stanton, F.R.S., superintendent, Aero-Dynamical Department, National Physical Laboratory.

Mr. R. J. Walker, director of Messrs. Parsons Marine Steam Turbine Co.

Mr. C. Hamilton-Wickes, H.M. Senior Trade Commissioner.

In the "O.B.E." class of Honours we observe the names of a number of well-known electrical men, including Dr. W. M. Thornton, Mr. E. T. Williams, Mr. Frank Gill, Mr. H. England, and Mr. C. E. Stromeyer.

Obituary.—MR. A. A. MOFFATT.—The death has occurred of Mr. Andrew A. Moffatt, electrical engineer, of High Street, Ayr.

MR. E. J. GILBERT.—Mr. Edwin James Gilbert, superintendent of the Corporation electricity works at Eccles, has passed away, in his 49th year.

MR. P. W. MCDOUGALL.—We regret to record the death, which occurred on March 31st, of Mr. Percy Walter McDougall, A.M.I.E.E., joint managing director of the Peninsular Engineering Co., Ltd., London. Mr. McDougall, who was 46 years of age, was late R.N.V.R., and he had been ill a long while. He was trained at Faraday House, and later was associated with Messrs. Ferranti, Ltd., and the Brush Company.

Will.—Dr. C. R. CHAWORTH, a pioneer in X-ray investigation, who died from the effect of exposure to the rays during his work, left £2,865. He bequeathed £100 to the Middlesex Hospital School of Medicine to endow a prize for physics.

NEW COMPANIES REGISTERED.

Widdop Engine Co., Ltd. (165,770).—Registered March 26th. Capital, £100,000 in £1 shares. To take over the business carried on by H. Widdop at Keighley, Yorks., as "H. Widdop & Co.," to acquire certain patents for an invention for improvements in centrifugal governors, and to carry on the business of manufacturers of and dealers in internal-combustion engines, auxiliary deck machinery and other engines, whether propelled by gas, oil, electricity or other power, &c. The first directors are: R. A. Vinter, Mawcroft, Nether Yeaden, near Leeds; F. J. Allen, Bridge End, Leeds; V. Calverley, Avondale Crescent, Shipley; H. Widdop, 2, Vale Street, Keighley. Minimum cash subscription, 20,000 shares. Solicitor: W. Dunn, Parkinson's Chambers, Hustlergate, Bradford.

C. T. Bowring & Co. (West Coast America), Ltd. (165,777).—Private company. Registered March 27th. Capital, £10,000 in £1 shares. To carry on in the U.K. or its Colonies or Dependencies, or in Chile, Peru or elsewhere, the business of manufacturers, importers and exporters of and dealers in plant, machinery, engines, hardware, electrical and mechanical engines, agricultural and mining implements, motor cars, aeroplanes, iron, wood, stone and other building materials, cloth, textiles, clothing, furniture, pottery, provisions, canned goods, wines, beers, spirits, drugs, toilet preparations, oils, hides, horns, skins, &c. The permanent directors are: F. C. Bowring, Terra Nova, Croxeth Drive, Aigburth, Liverpool; Sir Edgar E. Bowring, Hyde Park Hotel, W.; Sir John B. Wimble, K.B.E., 23, Cambridge Square, W.2; L. B. Stoddart, Ewell Court, Ewell, Surrey; C. W. Bowring, New York; E. H. Bowring, Taplow House, Taplow; C. Bowring, Purbeight, Chipstead, Surrey. A. Dick, of Lima, Peru, is the first ordinary director. Solicitors: Alsop, Stevens, Crooks & Co., 14, Castle Street, Liverpool.

Sheringham Daylight, Ltd. (165,610).—Private company. Registered March 23rd. Capital, £4,500 in 1s. shares. To adopt an agreement with G. Sheringham, and to carry out research work for proving and developing the invention therein referred to (not described). The subscribers (each with one share) are: G. H. Sheringham, 1, Clanricarde Gardens, W.2, artist; C. C. H. Milton, 4, Broad Street Place, E.C., engineer. The first directors are to be appointed by the subscribers. Solicitor: J. G. Bristo, 4, Copthall Buildings, E.C.

International Inventions and Patents Exploitation Co., Ltd. (165,698).—Private company. Registered March 25th. Capital, £1,000 in £1 shares. To carry on the business indicated by the title, and to adopt an agreement with M. Monot. The first directors are: M. Monot, 30, Doughty Street, W.C.; C. S. Hawkins, Penshurst, Dale Green, Finchley, N.; P. G. P. McCulloch, 8, St. James Street, W. Solicitor: L. Hubbard, 5, New Court, Lincoln's Inn, W.C. Registered office: 5, New Court, Lincoln's Inn, W.C.

De Martis Accumulators, Ltd. (165,685).—Private company. Registered March 25th. Capital, £200,000 in £1 shares (100,000 8 per cent. cumulative preference). To carry on the business of electrical engineers and contractors, suppliers of electricity, manufacturers of and dealers in railway, tramway, electric, magnetic, galvanic and other apparatus, &c. The subscribers (each with one share) are: F. G. Exell, 20, Copthall Avenue, E.C., accountant; P. W. Evenett, 30, St. Aubyns Road, Upper Norwood, S.E., managing clerk. The subscribers are to appoint the first directors. Registered office: 70, Lombard Street, E.C.

William Roman Co., Ltd. (165,815).—Private company. Registered March 27th. Capital, £10,000 in £1 shares. To take over the business carried on by G. F. Walker at B16, Queen Insurance Buildings, Liverpool, and to carry on the business of agents for electrical and mechanical engineers, manufacturers of and dealers in electrical apparatus, engineering and shipping equipment, and manufacturers of colours, paints and oils, &c. The first directors are: G. F. Walker (managing director), Cliff Cottage, Hoswall, Cheshire; D. P. O'Brien, Saaefell, Rock Ferry, Cheshire. Solicitor: G. W. Allen, 41, Castle Street, Liverpool. Registered office: B16, Queen Insurance Buildings, Dale Street, Liverpool.

Dimpo, Ltd. (165,833).—Private company. Registered March 29th. Capital, £5,000 in £1 shares. To construct, equip, repair, maintain and work tramways, to run motor and other vehicles, to let spaces for advertisements on vehicles, &c. The first directors are: Miss D. V. A. Ward, Grosvenor Villa, Bramley, Leeds; Miss G. V. J. Ward, Grosvenor Villa, Bramley, Leeds; Miss C. W. Ward, Grosvenor Villa, Bramley, Leeds. Solicitors: Bromley and Walker, Leeds. Registered office: 36, Commercial Street, Leeds.

Rigilte Manufacturing Co., Ltd. (165,849).—Private company. Registered March 29th. Capital, £5,000 in £1 shares. To carry on the business of electrical, mechanical, motor and general engineers, manufacturers, dealers, repairers, &c. The first directors are: C. H. Brown, 89, St. Margarets Road, St. Margarets-on-Thames; W. R. Goodman, 89, St. Margarets Road, St. Margarets-on-Thames; K. J. Goodman, 89, St. Margarets Road, St. Margarets-on-Thames; T. Craig, 89, St. Margarets Road, St. Margarets-on-Thames. Registered office: 18, Cowleaze Road, Kingston-on-Thames.

Durrants Engineers, Ltd. (165,780).—Private company. Registered March 27th. Capital, £5,000 in £1 shares. To carry on the business of sanitary and electrical engineers, founders, tool makers, &c., and to adopt an agreement with A. G. Durrant and W. E. Durrant. The first directors are: A. E. Durrant, A.M.I.E.E., 4, Suffolk Road, Lowestoft, electrical engineer; W. E. Durrant, 5, Beach Road, Lowestoft, sanitary engineer. Solicitor: J. A. Nicholson, Grove Chambers, Lowestoft.

Electrical Appliances (Blackpool), Ltd. (165,883).—Private company. Registered March 29th. Capital, £5,000 in £1 shares. To carry on the business of electricians, electrical and mechanical engineers, &c. The first directors are: E. Jones, 3, Central Road, Blackpool; W. Outhwaite, 9, First Avenue, Blackpool; T. S. Jones, 85, Reads Road, Blackpool; A. Mortimer, 110, Reads Avenue, Blackpool. Qualification, £500. Registered office: 1, South King Street, Blackpool.

United Electrical Co. (Birmingham), Ltd. (165,910).—Private company. Registered March 30th. Capital, £5,000 in £1 shares. To take over the business of engineers carried on by G. D. Mann, S. E. Sheerman and F. R. Pendergast, formerly at Newhall Chambers, Newhall Street, but now at 47, Summer Row, Birmingham, as the United Electrical Co. Permanent directors: G. D. Mann, 54, Audrey Road, Small Heath, Birmingham; S. E. Sheerman, 97, Earlsbury Gardens, Birchfield, Birmingham; F. R. Pendergast, 46, Wilton Road, Chorlton-cum-Hardy, Manchester. Registered office: 47, Summer Row, Birmingham.

Premier Electric Welding Co. (Mersey), Ltd. (165,602).—Private company. Registered March 23rd. Capital, £60,000 in £1 shares. To acquire from the Premier Electric Welding Co., Ltd. ("Parent") Co.) the business of the Parent Company as carried on in and near Liverpool, and to carry on in the U.K. the business of welders of metals, &c., but not to acquire the patents or patent rights of the Parent Company nor to sell welding plants which are manufactured in accordance with such patents. Such rights are to remain the sole property of the Parent Company, but the Parent Company may employ this company as agents for the sale of the said welding patents. The subscribers (each with one share) are: J. G. de Odingsells Coke, R.N., Bank Buildings, St. James' Street, S.W., director of companies; A. L. Haggerty, Bank Buildings, St. James' Street, S.W., secretary. The subscribers are to appoint the first directors. Solicitors: Bircham & Co., 46, Parliament Street, S.W.

Cahir Electric Supply Co., Ltd. (4,935).—Registered in Dublin, March 22nd. Capital, £6,000 in £1 shares. To carry on business as electrical engineers, suppliers of electric light, &c. The subscribers are: Lieut.-Col. R. Butler, D.L., Cahir Park, Cahir, 500 shares; W. M. Ryan, J.P., The Square, Cahir, draper, 200 shares; J. P. Hill, Belbrae, Cahir, wholesale commission agent, 200 shares; C. M. Downey, Castle Street, Cahir, grocer and wine merchant, 200 shares; E. O'Connor, Bridge Street, Cahir, cattle exporter, 100 shares; W. H. Irwin, The Square, Cahir, grocer and wine merchant, 200 shares; J. Walsh, The Square, Cahir, draper, 200 shares; M. Kennedy, The Square, Cahir, victualler, 150 shares; T. J. Walshe, Abbey Street, Cahir, corn merchant, 50 shares; J. T. Burke, The Square, Cahir, wine and spirit merchant, 100 shares. Secretary: J. Moloney. Registered office: Chapel Street, Cahir.

North Bolivian Power and Estates, Ltd. (165,657).—Private company. Registered March 24th. Capital, £1,000 in £1 shares. To carry on the business indicated by the title, and that of bankers, capitalists and financiers, &c., and to adopt an agreement with E. F. Lamb and J. R. Leach. The first directors are: E. F. Lamb, 59, Plaistow Lane, Bromley, Kent; E. Devereux, 96, Elmbourne Road, Tooting Beck, S.W.17. Registered office: 16, Dashwood House, E.C.2.

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CITY NOTES.

Metropolitan-Vickers Electrical Co., Ltd.

Mr. J. Annan Bryce presided at the annual meeting held on March 29th at the Central Hall, Westminster. After referring to the balance sheet, he said that the available profit for the year was £320,660, an increase of £74,085, or about 30 per cent. Considering the difficult times through which they were passing, the results were satisfactory. The orders received during 1919 exceeded those of 1918 by about 20 per cent., and the value of orders on hand at the end of the year by about the same percentage. The orders received during the first two months of 1920 were nearly thrice as large as those taken during the same period of 1919, but while it was gratifying to know that the demand for their products was increasing so fast, he warned them against forming any estimate of results founded merely on increase in volume of business. In former days work in progress represented a much smaller percentage than now of the total cost of products sold. The reasons were many; increased amount of material needed for stock, diminished output of labour, difficulties of transport, and at this particular moment, the aftermath of the railway strike in September last, and of the moulders' strike, the effects of both of which were still operating in the delay of shipments and would adversely affect the results of this year. The combined effect of all these causes was that they were not turning their capital over so often, while at the same time the increased volume of business required the investment of much larger amounts in plant, machinery, and buildings to enable them to handle it, and there was, moreover, trouble in getting the labour capable of dealing with it. It was to be hoped that some of these difficulties would prove to be temporary. Referring to the moulders' strike, this affected this company as well as all other engineering concerns in the country. The relations between the management and the moulders were perfectly satisfactory, and since they had returned to work they had done their best to increase their output, and so to restore the equilibrium of the work in progress in the shops. The strike lasted from September to January. This company did not suffer so much as some other engineering firms because in some of their departments where castings did not form a limiting factor, they were able to carry on practically throughout the trouble, while concerns engaged in work entirely dependent on castings had to suspend manufacture altogether when they were no longer to be had. The moulders ceased work at a moment when it was essential that every effort should be made to increase the output of the country. The result of the strike had been to militate seriously against the country's quick recovery from the war, and unhappily its evil effects would continue to be felt for many months to come. While the company had so far been exempt from individual trouble, the difficulties inherent in the general attitude of labour affected them, as they did all industries. There was a large drop in the output per man employed. The management was convinced that the shortening of the working hours had had a direct influence on this result, as the company was producing less per man per hour than formerly, in spite of the argument that the shortening of hours would mean increased production per hour. They were at present suffering from a shortage of male labour. The number of men and women workers, exclusive of those on the staff, was, on December 31st, 4,791, nearly 2,000 less than it was before the moulders' strike. The numbers were being gradually built up again, and at present reached 5,700, a figure, however, which was inadequate for the business, and the management was uncertain whether, notwithstanding the large number of men shown by the unemployment returns to be without a job, it would be able, notably in the case of certain departments where special skill was required, to secure the number wanted to deal with the increasing business. The difficulty was partly caused by the housing question. The average weekly earnings had risen as follows during the period 1912-19: Males, from 27s. 6d. to 61s., and women from 12s. 3d. to 37s., the figures including boys, girls, and night shifts. The earnings of the males did not rise in the year 1919 owing to the absence of overtime and piecework. Another difficulty was the delay in supply of material. The delay was not so serious since the removal of Government restrictions, but was still so considerable as greatly to hamper the programme of work. Concentrated efforts had been made to speed up their suppliers by special appeals, and the position now showed signs of improvement. If they could surmount these difficulties and succeed, with the aid of the large capital expenditure now being incurred, in providing the increased plant necessary to handle the largely increased orders, the management looked with confidence to the future. After stating that in the last few years the company had embarked on several new lines of manufacture, the chairman described the principal classes of manufacture that the company was now providing. He mentioned that they had just taken the Manchester Corporation order for two 25,000-kw. sets for its new super-power station. They had turned their attention to the production of marine turbines, and were booking increasing orders. In regard to switchgear suitable for super-stations, they had at present in hand switches with a breaking capacity of something like 750,000 k.v.a. In connection with their subsidiary companies, they were also manufacturers of electric lamps and were just about to commence the manufacture of certain lines of heating and cooking apparatus. The speaker later referred at some length to the labour situation. The "lion in the path" was suspicion—suspicion on both sides. There were already welcome signs that scales were falling from eyes on both sides. Many of the Labour leaders realised the problem and its solution; and the many set-backs lately suffered by the extremists showed that their influence was on the wane. The root fallacy entertained, he believed unselfishly in the case of the majority of the workers, that the individual's work must be restricted lest there be not enough work to go round, was still unhappily prevalent, though there never was so little ground for it as at present. It was poisoning every industry, and demanded constant refutation by every leader of labour. It was the product of ignorance, and if with more knowledge it had disappeared in America, surely more instruction would prove its antidote here also. In America the worker in any industry earned twice or three times as much as he would here, because his output was twice or thrice as great. He had no fear of new machines, for he knew that the diminished cost they ensured increased the demand for his labour instead of lessening it, as the worker here ignorantly imagined. At present their output per man was diminishing. It was the same in every industry. Take the bricklayer. Personally, he believed that the sole permanent remedy for the distrust which was at the root of the trouble was an identification of interest, whether in the form of payment by results or sharing of profit. It had so far apparently been the policy of the trade unions to discourage any movement in this direction owing to suspicion of the motives which might underlie any scheme for identification of interest. The company had lately had an apparent symptom of the existence of such a suspicion. £100,000 out of the million issue of ordinary shares had been set aside for subscription by the employés, with a provision of facilities for an advance on easy terms of interest and repayment to enable them to subscribe. The result was disappointing. Out of those £100,000, only about £10,000 were taken up by the workmen. The ordinary shares at once went to a substantial premium, and he hoped that if a similar opportunity was again furnished the workmen would know better how to avail themselves of it. As regards this aspect of the question there were some signs of increasing knowledge. A few days ago, at a meeting of the Federation of General Workers, presided over by Mr. Clynes, it was determined to consider the question of payment by results. There were many signs that employers on their side were far more disposed to take a more human view of their relations to labour than many of them were inclined to do in the past, when the fault was in many cases on their side. It was rather for them to devise the means of producing harmony of interest. The methods would necessarily vary with the circumstances of the particular industry, but with good will on both sides it should not be beyond the wit of man to arrive at a solution in each case.

British Aluminium Co., Ltd.

The annual meeting, held on March 30th, was preceded by an extraordinary general meeting at which the resolutions were confirmed increasing the capital by £500,000 and capitalising part of the reserves. Mr. A. W. Tait, who presided, in addressing the annual meeting, said that the trading profit was £292,327, a decrease of approximately £59,000. Interest on deposits and dividends on investments fell by £13,000. The decrease in trading profit had arisen since the cessation of hostilities and the stoppage of war work had caused a large accumulation of stocks of metal in the hands of the Government and of the manufacturers. It naturally took some time before industry could get going again upon its ordinary peace-time employment. For some months after the armistice the demand for the metal was almost negligible, and the company had to reduce the production of its various works to avoid piling up large stocks, and these conditions continued for at least the first seven months of the year. At the end of that period there were indications of a revival of demand, which had since gone on increasing, and in consequence, orders were given that the works should again be brought up to full output, and in course of time this was done. The demand since then had continued to increase steadily, and the works were now fully engaged in giving their maximum output, and it looked as if this would continue for some time to come. There was a healthy demand not only in this country, but also abroad, to meet the heavy requirements for the motor trade and for domestic utensils. Another factor in the situation was that practically during the whole of 1919 a substantial percentage of the sales made by the company was on account of the Government, in accordance with an arrangement made by them with the producers, so that the stocks in their hands could be gradually reduced. The existence of this stock was always a disturbing element in the industry, because manufacturers feared that at some time or other this stock might be forced upon the market for immediate realisation. The arrangements made were, therefore, as much in the interests of the industry generally as they were in those of the Government, and this steadying effect enabled manufacturers to proceed with the purchase of their ordinary requirements with a certain measure of con-

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fidence. The stock at the beginning of this year had come down to reasonable proportions. The company entered into negotiations with the Government, and finally purchased the whole of the balance of stock in their hands at January 31st last. In order to stimulate the demand, the price of aluminium was considerably reduced at the beginning of 1919, as compared with that of the previous year, and was maintained at the reduced figure during the whole of the period. There had been a small increase in price since the beginning of the current year. Now that these matters had been overcome and industry had returned in a large measure to its ordinary business, the prospects of the aluminium industry were good. They could foresee increasing demands in the motor, electrical, and other industries, and these demands were at present largely in excess of pre-war requirements. Although the productive capacity of aluminium was greatly increased throughout the world, particularly in America and Norway, during the war, it would seem as if this increased production was being rapidly absorbed, and that it would not be very long before further developments would require to be carried out in order to keep pace with consumption. The situation was, however, a little obscure, owing to the fact that the industry in France and in Switzerland was considerably handicapped at the present moment by the shortage of essential raw materials, such as coal, and, with regard to Switzerland, also bauxite. The large works which were put up in Germany by certain manufacturing interests, with the assistance of the German Government, depended entirely upon electricity generated by means of brown coal or lignite, and it was not considered probable that these works could be continued economically in normal times, although, owing to the great lack of essential metals in Germany, they might be continued in operation to a certain extent for some time yet. The company promoted a Bill for the development of a large water power in Scotland, which was known as the Lochaber Water Power Bill, but on account of opposition in the House of Lords, it was withdrawn on second reading. The Government had laid considerable stress upon the necessity of developing the natural resources of this country, one of which was water power, but he did not think that the company could usefully proceed further with their scheme until the policy of the Government with regard to hydro-electric development had been definitely settled. A Commission had been appointed to investigate the resources of the country in this respect, and a large amount of work had been done, but the final report of the Commission had not yet been made. He hoped it would be delivered in the near future, and that the Government would promptly announce its policy. The company would then again carefully consider the position, and should they decide to proceed further, the shareholders would be called together. As to the Orsières power scheme in Switzerland, upon which the company had already spent substantial sums of money, and which was closed down during the whole period of the war, work was recommenced during 1919, and it was hoped that they might be able to complete the construction of the tunnels, intakes, and penstock during the year. It was not intended, however, at the present time to place orders for the construction of the pipe line or for the erection and equipment of the power house and factory, in the hope that by the time this becomes necessary the situation on the Continent with regard to labour, materials, and transport would have become more clearly defined than at present. Costs of production had shown substantial increases, and the difficulties of obtaining essential raw materials, such as bauxite, coal, &c., had also increased, and the maintenance of supply to keep the works in operation had been a matter of great anxiety on more than one occasion during the year. The speaker referred to the balance sheet and the profit and loss account, to the reserves and bonus distribution, and to the services rendered by Mr. Murray Morrison, the general manager, and others.

Sunderland District Electric Tramways, Ltd.

Mr. H. R. Hogg, presiding at the annual meeting, said that the tramways operated in a colliery district, and the healthy state of things with all colliery workers had been reflected in the gross takings, which had exceeded not only those of the previous year by £12,963, some 34.9 per cent., but compared with 1914, by about 76 per cent. The upkeep of the property was during the war seriously interfered with by want of labour. Nearly everything which had to be postponed till now, and had to be done to-day, was costing far more than the rise in receipts could compensate them for. They were under the serious necessity of having to renew rolling stock, track, cables, electrical equipment, as well as enlarging car sheds, repairing shops, office accommodation, &c., all at prices from two to three times higher than they were at the beginning of the war. As the traffic was steadily growing they had to put themselves in the position of being able to carry quite 6,000,000 passengers annually, as compared with 4½ millions six years ago. The cars, which had not been able to be renewed during the war, had suffered very severely from being overworked, and must be gradually replaced at a cost of nearly £2,000 each for which they were paying £700, and even then they were unable to get delivery at fixed dates. The cost of current had been increased by nearly 100 per cent., and would no doubt be dearer still as coal went up. They were paying the staff large increases in salaries and wages. The money had to come from somewhere, and they had not so far been allowed to raise the fares beyond the table fixed by the Act 17 years ago, when the cost of everything was on a very different scale. Investors would not find money for such work unless there were receipts to provide a fair rate of interest. They hoped there was some prospect now of justice being done to the tramway industry, but serious delays might be created before any increase could be collected.

Waste Heat and Gas Electricity Generating Stations, Ltd.

The annual meeting was held at Newcastle-on-Tyne on March 29th. Mr. F. S. Newall, the chairman, said he had to announce with regret that Dr. J. B. Simpson, the chairman of directors, was now confirmed invalid, and it was doubtful if he would be able to attend any subsequent meeting. Proceeding, he said the actual capital expenditure during the year had been £45,000, practically all of which had been expended on Horden power station. During the year, however, an agreement providing for plant of the value of £25,985 on the hire-purchase terms, had terminated, and the amount has been taken out of both the capital expenditure and redemption fund accounts. The actual capital expenditure, therefore, was £19,000. The completion of the Horden power station had been considerably delayed owing to various causes, the chief of which had been the moulders' strike. Practically all the plant was now in the station, and it was hoped to get it into commission about the middle of the year. The new plant at Weardale had been in operation at various times during the year, but it had not yet run continuously. The plant was a new type of internal combustion engine using gas from the coke ovens, and in such plant delays were bound to occur in getting it into proper working order. There had been many delays in obtaining deliveries of material, and particularly in getting those special parts required in a new plant made satisfactorily. The engine had proved itself very efficient, using rather less than half the amount of coke-oven gas per H.P.-hour, compared with the existing boiler and steam plant. There had been a further diminution in the amount of steam placed at their disposal, and this had resulted in a still further decrease of units generated of about 2 per cent., compared with the previous year. During this year they might look for a better output, as, of course, the blast furnace works, from which they derived most of their steam, were very busy. They had spent a further £1,470 on experimental work. The experiments were being conducted upon the more efficient utilisation of coal in electric power stations, and so far the results, subject to some slight minor modifications and adjustment in the design of the plant were satisfactory. He had mentioned last year certain proposals which had come before the directors regarding a further waste heat station, but, so far, this had not fructified, and the matter was still under consideration. The profits of the year had shown an increase of £981.

Ceara Tramway Light & Power Co.—"The Financial Times" states that holders of the 5 per cent. first debenture stock are informed that, in consequence of the rise in Brazilian exchange and the improved prospects of the company, the arrangement made between the company and the holders of the 5 per cent. first debenture stock on April 28th, 1916, whereby the latter agreed to a reduction in the rate of interest payable upon their stock will be terminated prior to the expiration of the period fixed under that arrangement. The payment of interest falling due on June 1st next will therefore be made at the full rate of 5 per cent. in sterling.

Cleveland and Durham Electric Power, Ltd.—The report shows a profit for the year of £40,308, plus £12,305 brought forward. From this £14,000 is carried to reserve for plant renewals and improvements. Interest on debentures, &c., absorbs £25,282, leaving £13,331, which is to be carried forward. The connections to systems at the end of the year amounted to 113,951 H.P., as compared with 105,080 H.P. The capital expenditure on works during the year was £26,146.

Ward & Goldstone, Ltd.—Interim dividend on 7 per cent. participating preference shares has been paid. The final dividend is due September 30th, when it is anticipated that a participating dividend for the half-year ended March, 1920, will also be paid.

Callender's Cable & Construction Co., Ltd.—A meeting is called for April 15th to consider resolutions dividing the existing 180,000 £5 shares into 900,000 shares of £1 each, and increasing the capital by the creation of 400,000 "B" 7½ per cent. preference shares.

Anglo-American Telegraph Co., Ltd.—Interim dividend for the quarter ended March 31st, 1920, of 15s. per cent. on the ordinary stock and £1 10s. per cent. on the preferred stock, less tax.

Lanarkshire Tramways Co.—The company is offering 3,430 new shares of £10 each to existing holders to pay part towards the purchase of certain lines owned by the Corporation (£61,000), and now leased to the company.

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Stock Exchange Notices.—The Committee has specially allowed dealings in the undermentioned under Temporary Regulation 4 (3):—

India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.—25,000 ordinary shares of £10 each (issued at £13, of which £6 10s. is paid), Nos. 50,001 to 75,000, and fractional certificates.

British Electric Transformer Co., Ltd.—25 ordinary shares of £1 each, fully paid, Nos. 135,499 to 135,523.

Metropolitan-Vickers Electrical Co., Ltd.—20,172 ordinary shares of £1 each, fully paid (Nos. 6,185,001 to 6,205,172).

The Committee has specially allowed dealings in the shares of the following:—

British Electric Transformer Co., Ltd.—48 ordinary shares of £1 each, fully paid (Nos. 135,380 to 135,393 and 135,465 to 135,489).

Windsor Electrical Installation Co., Ltd.—During 1919 new lamp connections were 3,876 (30 watt), as against 815 for 1918. New capital expenditure £4,465. Profit, including £338 brought forward, £5,551. Debenture and other interest £457; 5 per cent. preference dividend £824; depreciation, renewal, and reserve fund, £2,000; directors' fees (free of tax), £350. Dividend on ordinary shares 3½ per cent., less tax; £591 carried forward. The improvement is due to increased revenue and to economy effected through the working arrangement with the Slough Co.

Slough & Datchet Electric Supply Co., Ltd.—New capital expenditure during 1919 £23,014, chiefly for new machinery and a larger cable to Eton in connection with the increased bulk supply to the Windsor Co. The lamps and motors connected during 1919 were 43,355, against 40,508 for 1918. Units sold, 1,571,338 for 1919, against 1,752,737 for 1918. Revenue 1919, £18,714; 1918, £16,971. Net profit £6,350. £2,500 to depreciation and reserve. Dividend 5 per cent., less income tax. £1,230 carried forward. The capital is to be increased to £125,000 by the creation of 50,000 cumulative preference shares (7½ per cent.) of £1 each.

France.—The shareholders of the Forges et Aciéries du Nord et de l'Est have authorised the directors to issue shares or bonds to the amount of 7,972,000 fr., and eventually, by convenient stages, to 24,000,000 fr. The company has lately entered into close relations with two other companies, the Société des Usines de l'Espérance and the Société Métallurgique de Pont-á-Vendin, and the fresh capital is intended for the reconstruction of works damaged during the war and for a more energetic enlargement of the companies' operations.

Companies to be Struck off the Register.—The following are to be struck off the register within three months unless cause is shown to the contrary:—

Alexandra Electrical & Engineering Works, Ltd.
Cathodes, Ltd.
Munster Electric Lighting Co., Ltd.
Phœmso Armouring & Cable Co., Ltd.
William Taylor (Electric Lamp) Co., Ltd.

Hadfields, Ltd.—Sir Robert Hadfield presided at the annual meeting at Sheffield on March 29th. He referred to the great difficulties of reconstruction, and to the trouble experienced in securing the workers' co-operation to give continued and increased production. The moulders' strike had brought unavoidable delays generally to industrial work. The meeting approved of the proposal to increase the capital of the company by £500,000 and to enter into the agreement with Harper Bean, Ltd.

Argentine Tramways & Power Co.—After providing for debenture interest and sinking fund and putting £4,000 to reserve for renewals, £5,356 remains, and this is to be carried forward in view of the considerable expenditure that is required for extensions of the power plant and for the completion of the tramways to comply with the terms of the concession.

Bromley (Kent) Electric Light & Power Co., Ltd.—During 1919 the connections increased from 4,854 to 5,111 kw. The gross profit was £10,479, against £7,744 in 1918. After meeting debenture interest, &c., £2,937, and adding £1,404 brought forward, the balance is £8,946, out of which a dividend of 4 per cent. is to be paid; £4,500 is to be put to renewal reserve account, and £1,446 carried forward.

British Ever-Ready Co., Ltd.—A meeting is called for April 19th to consider a reconstruction scheme under which a new company—the Ever-Ready Co. (Great Britain), Ltd.—will be formed with a capital of £500,000 in 300,000 ordinary and 200,000 participating preference shares of £1 each.

Vulcan Boiler & General Insurance Co., Ltd.—Dividend 12 per cent. and bonus 4 per cent., less tax, making 25 per cent. for 1919. To investments depreciation fund £7,500; to superannuation and benefit fund £2,500; carried forward £8,151.

Dictograph Telephones, Ltd.—We are informed that at the annual meeting held on March 29th it was reported that 1919 was the company's most successful year. Dividend 15 per cent. on the ordinary shares and 3s. 6d. per share on the deferred shares. Carry forward £4,021.

W. T. Henley's Telegraph Works Co., Ltd.—The profit during 1919 was £203,368, less £34,743 directors' and auditors' fees, debenture interest, and amount written off for depreciation on buildings and machinery, leaving £168,625, plus £122,009 brought forward. Income tax £45,458; to reserve £20,000; to reserve for depreciation of securities £9,543; preference dividend £9,000; staff pension and deferred pay funds £5,000; dividend on the ordinary shares (interim 6d., final 2s. 6d., making 3s. for the year), £60,000; carried forward £141,633. Provision has been made in the accounts in respect of the liability for excess profits duty to the end of 1919. The amount debited for depreciation includes an amount for special depreciation on machinery, due to the circumstances arising out of the war. Henley's Tire & Rubber Co., Ltd., the whole of the capital of which is held by the company, has had a successful year's trading.

Madras Electric Tramways (1904), Ltd.—Gross profit for 1919 £33,839; £12,000 to depreciation and renewal account; brought forward £4,820. Preference dividend, less tax, £6,000. Dividend on the ordinary shares, 8 per cent., free of tax. Contribution to a gratuity fund for the benefit of employés in Madras £1,000; to general reserve £3,000; carried forward, subject to excess profits duty (if any) £4,944. The running account was adversely affected by the strike in the early part of 1919. Wages and cost of materials having continued to advance, fares were revised, but the revisions have only partially met the enhanced cost of running. The traffic receipts and the expenditure in Madras show increases of 9 per cent. and 19.6 per cent. respectively on 1918.

Newcastle-Emlyn & District Electric Supply Co., Ltd.—The annual meeting was held last month. Dividend for 1919 6 per cent., free of tax. Revenue from supply of current increased 20 per cent. The engineer is preparing a scheme for extensions.

Vickers, Ltd.—Final dividend of 1s. 3d. per share on the ordinary shares, making a total of 11½ per cent., free of tax, for 1919.

STOCKS AND SHARES.

Tuesday Evening.

It cannot be said that the Stock Exchange markets have recovered from their Easter holidays so far, and to-day (Tuesday) business turned out to be somewhat confused, and the tendency turned heavy after being good. Until the Budget is "opened" it is not to be supposed that money will show much enterprise or elasticity. The scores of new issues that make a feature of the present year have erected a new standard of yield to which prices all round are mechanically conforming. Upon shares in companies paying 10 per cent. on the ordinary capital, the public now look for an 8 to 10 per cent. return, and the consequence is that quotations are bound to decline if they do not promise such a yield. It may be that more general appreciation of this factor will explain various falls in Stock Exchange prices that puzzle—perhaps somewhat exasperate—holders of industrial shares.

To take the case of an electrical manufacturing company as illustration: a year ago its dividend, say, of 10 per cent. would have entitled the £1 shares to stand at 25s., assuming the concern to be a sound and progressive one. But to-day, there are so many competitors for the investor's money that these same shares may droop to the neighbourhood of par before they begin to look attractive again. Nevertheless, the process of decline in prices is not always understood by shareholders, who become uneasy at the operation of this whittling-down of values, which is, however, due to the general financial conditions all round.

The electricity supply list shows signs of wavering, and several falls, ranging from ¼ to ½, have taken place. City Lights and County ordinary, London Electric preference, and Metropolitans are all 2s. 6d. lower. The returns in this list are gradually approximating an 8 to 10 per cent. level.

Many congratulations to Sir H. B. Renwick upon his K.B.E., a distinction well and truly earned by one to whom the London electric lighting industry owes more than is sometimes supposed. The honour comes to him through work in connection with the Ministry of Food.

Marconis have been again in considerable favour, and the parent shares are 6s. 3d. up. Cable shares as a whole are active, without showing marked variation in prices. The lists remain open until April 15th for sending in applications to the new issues of the Eastern, and the three other companies—Eastern Extension, Western and Globe. The premiums are fairly well maintained. With the falls in the existing securities, the prices of old and new have become so nicely balanced that between the two classes there is not much actual difference, making allowance for dividend payments. It may not be too late to remind allottees of the substantial price they can get for their rights should they not wish to take up the new shares.

Oriental Telephones are another 2s. 6d. lower at 2½, and rumours are current as to a possible melon-cutting scheme in connection with the company. These rumours are held to be

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the inspiration for the mysterious jump to over £3 which recently occurred.

The reply of the Lamp Manufacturers to the recent strictures of the Commission is interesting, but has no influence upon prices in the share market. Edisons are dull at 22s. 6d. General Electric new ordinary went firmer to 5s. 3d. premium, after the lists closed for sending in renunciations. The new preference stand at 1s. discount. New India-Rubber shares started at a trifling premium of about 3s. 6d., but are now difficult to sell to any advantage. For the half shares, one-and-threepence was bid. Telegraph Constructions have fallen £1 to 24½. India-Rubber old are £2 down at 14. Metropolitan-Vickers preference at 2⅞ are a better market. Babcock & Wilcox remain heavy, with a further drop to 3⅛. Labour apprehensions. Iron, steel and armaments are mostly dull. Brush ordinary has put on 5 points at 115, and the stock is in good demand.

Undergrounds hold their ground, thanks to the fare-raising expectations. Bus "A," as the shilling shares of the company are called, have hardened to 7s., and the income bonds retain their 5 points gain at 74. Mexican transport issues continue depressed. Brazil Tractions moved back to 50, but may recover, as the strike on Brazilian railways is settled, and there is more disposition to look favourably upon the country's securities. With the rise in American exchange, the various "dollar" stocks are lower in most departments. Further evidence of demoralisation in the Paris exchange is an unfavourable factor to many of the Stock Exchange markets. Talk of an early improvement in the price of raw rubber helps to steady rubber share quotations. The expected inrush of buying orders to all the markets has failed to materialise, and the pre-Easter optimisms are, so far, distinctly disappointed.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1918.	Dividend 1919.	Price April 6, 1920.	Rise or fall.	Yield p.c.
Home Electricity Companies.					
Brompton Ordinary	8	12	6¼	—	£9 4 8
Charing Cross Ordinary	4	7	8¾	—	9 6 8
do. do. do 4½ Pref.	4½	4½	2¾	—	8 8 6
Chelsea	3	4	3xd	—	6 3 4
City of London	8	10	13¼xd	— ⅛	7 12 4
do. do. 6 per cent. Pref.	6	6	9¾xd	—	6 9 8
County of London	7	8	9¾xd	— ¼	8 15 4
do do. 6 per cent. Pref.	6	6	8¾	— ½	6 17 2
Kensington Ordinary	6	7	5	—	7 0 0
London Electric	Nil	2½	1⅜	—	5 2 6
do. do. 6 per cent. Pref.	6	6	8½	— ¼	9 4 8
Metropolitan	5	6	3⅝	— ⅛	8 5 6
do. 4½ per cent. Pref.	4½	4½	2¼	—	8 0 0
St. James' and Pall Mall	10	12	6⅝	—	8 16 10
South London	5	6	3⅜	—	7 12 8
South Metropolitan Pref.	7	7	19/6	—	7 3 7
Westminster Ordinary	8	10	5½	—	8 13 10
Telegraphs and Telephones.					
Anglo-Am. Tel. Pref.	6	6	8¾	—	6 18 9
do. Def.	33/6	1½	19	—	7 18 0
Chile Telephone	8	6	6½	—	*4 13 2
Cuba Sub. Ord.	7	7	10	—	*7 0 0
Eastern Extension	8	10	15½	—	*6 10 1
Eastern Tel. Ord.	8	10	154⅛	—	*6 9 5
Globe Tel. and T. Ord.	8	10	15	—	*6 18 4
do. do. Pref.	6	6	9¼	—	6 6 4
Great Northern Tel.	22	—	22½	—	9 15 6
Indo-European	13	—	48⅛	—	6 13 4
Marconi	25	—	8⅞	+ ⅛	6 13 4
Oriental Telephone Ord.	10	—	2½	— ⅛	4 0 0
United R. Plate Tel.	8	—	7⅞	—	*5 8 3
West India and Panama	1/8	—	1⅛	—	5 19 0
Western Telegraph	8	10	15xd	—	*6 13 4
Home Rails.					
Central London Ord. Assented	4	4	47⅛	—	8 8 6
Metropolitan	1	1½	21¼	—	5 16 8
do. District	Nil	Nil	18⅛	—	Nil
Underground Electric Ordinary	Nil	Nil	2⅜	—	Nil
do. do. "A"	Nil	Nil	7/-	+6d.	Nil
do. do. Income	5	4	7¼	—	5 6 8
Foreign Trams.					
Anglo-Arg. Trams. First Pref.	Nil	Nil	3⅜	—	—
do. do. 2nd Pref.	—	—	8½	—	—
do. do. 5 Deb.	5	5	62½	—	7 15 0
Brazil Tractions	—	—	50	—1½	—
Bombay Electric Pref.	6	6	189	—	3 8 0
British Columbia Elec. Rly. Pfce.	5	5	59⅛	—	8 5 4
do. do. Preferrred	2½	5	50⅛	—	9 18 0
do. do. Deferred	Nil	3	42½	—	7 1 2
do. do. Deb.	4½	4½	57	—	7 9 1
Mexico Trams 5 per cent. Bonds	Nil	Nil	35½	—3	Nil
do. 6 per cent. Bonds	Nil	Nil	26	— ½	Nil
Mexican Light Common	Nil	Nil	17⅛	—	Nil
do. Pref.	Nil	Nil	27⅞	—	Nil
do. 1st Bonds	Nil	Nil	46¼	—1	—
Manufacturing Companies.					
Babcock & Wilcox	15	—	3⅛	— ⅛	*4 16 2
British Aluminium Ord.	10	10	1⅝	—	5 5 0
British Insulated Ord.	12½	15	1⅛	—	7 14 8
Callenders	25	—	8¼	— ¼	7 5 10
,, 6½ Pref.	6½	6½	4½	—	6 16 10
Castner-Kellner	20	—	4	—	—
Crompton Ord.	10	—	21/6	—	9 6 0
Edison-Swan, "A"	10	—	1⅛	—	8 17 10
do. do. 5 per cent. Deb.	5	5	79½	—	6 5 9
Electric Construction	10	—	23/-	—	8 13 10
Gen. Elec. Pref.	6½	6½	18/6	—	7 0 6
do. Ord.	10	—	1⅛	—	*5 10 4
Henley	25	15	2⅛	—	6 6 4
do. 4½ Pref.	4½	4½	3⅜	—	6 4 2
India-Rubber	10	—	14	—2	*7 2 10
Met.-Vickers Pref.	—	8	2⅞	+ ⅛	5 16 5
Siemens Ord.	10	10	2-/6	—	*7 0 4
Telegraph Con.	20	20	24½xd	—1	*4 18 0

* Dividends paid free of Income Tax.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Tuesday, April 6th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Oxalic	per lb.	1/5	...
a Ammoniac Sal	per ton	£100	...
a Ammonia, Muriate (large crystal)	,,	£92	...
a Bisulphide of Carbon	,,	...	...
a Borax	,,	£42	...
a Copper Sulphate	,,	£52	...
a Potash, Chlorate	per lb.	11d.	...
a ,, Perchlorate	,,	1/3	...
a Shellac	per cwt.	£42	...
a Sulphate of Magnesia	per ton	£18	...
a Sulphur, Sublimed Flowers	,,	£28	...
a ,, Lump	,,	£25	...
a Soda, Chlorate	per lb.	6d.	...
a ,, Crystals	per ton	£12	...
a Sodium Bichromate, casks	per lb.	...	...
METALS, &c.			
g Babbitt's Metal Ingots	per ton	£118 to £345	...
c Brass (rolled metal 2" to 12" basis)	per lb.	1/-½	½d. dec.
c ,, Tubes (solid drawn)	,,	1/6½ to 1/6½	½d. dec.
c ,, Wire, basis	,,	1/3½	½d. dec.
c Copper Tubes (solid drawn)	,,	1/9	½d. dec.
g ,, Bars (best selected)	per ton	£166	£4 dec.
g ,, Sheet	,,	£166	£2 dec.
g ,, Rod	,,	£166	£4 dec.
d ,, (Electrolytic) Bars	,,	£117	...
d ,, ,, Sheets	,,	£156	...
d ,, ,, Wire Rods	,,	£142	...
d ,, ,, H.C. Wire	per lb.	1/4½	...
f Ebonite Rod	,,	3/-	...
f ,, Sheet	,,	2/6	...
n German Silver Wire	,,	3/-	...
h Gutta-percha, fine	,,	13/-	...
h India-rubber, Para fine	,,	2/3½	1d. dec.
i Iron Pig (Cleveland Warrants)	per ton	Nom.	...
l ,, Wire, galv. No. 8, P.O. qual.	,,	£57	...
g Lead, English Pig	,,	£43	£3 dec.
g Mercury	per bot.	£26 10/- to £27	...
e Mica (in original cases) small	per lb.	6d. to 4/6	...
e ,, ,, ,, medium	,,	5/- to 10/-	...
e ,, ,, ,, large	,,	12/6 to 25/- & up	...
g Phosphor Bronze, plain castings	,,	1/7 to 1/11	...
g ,, ,, rolled bars and rods	,,	2/2 to 2/6	...
g ,, ,, rolled strip & sheet	,,	2/3 to 2/9	...
d Silicium Bronze Wire	per lb.	1/11½	...
r Steel, Magnet, in bars	,,	1/8	...
g Tin, Block (English)	per ton	£339 to £340	£2 dec.
n ,, Wire, Nos. 1 to 16	per lb.	5/5	...
White Anti-friction Metals	per ton	£90 to £345	...

Quotations supplied by—

a G. Boor & Co.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
r W. F. Dennis & Co.

Electrical Power Engineers' Association.—The Dundee Section held a successful smoking concert at Broughty Ferry on March 26th, as the closing event of the winter session.

Mr. David Hynd, of the Dundee Electricity Department, ably filled the chair, and opened the proceedings with a short address, in which he expressed appreciation of the good work done by electrical engineers in the past, and felt the future was safe in their hands. The E.P.E.A. had loyally carried on in spite of much adversity, which, however, had a power for good by its stimulation for greater efforts. He hoped there would be many such gatherings, and wished the Section every success.

An excellent entertainment of songs and recitations was given by various artists.

Replying to the vote of thanks to the visitors, Major Harry Richardson, M.I.E.E., general manager and engineer, Dundee Electricity Department, remarked that we had won a great war, and as a result had a broader outlook on life, and consequently he was pleased to see that night not only departmental men, but all other electrical men in the district, which showed the good the E.P.E.A. was doing. He took this, his first opportunity since his return from the war, to thank his staff especially for their loyal efforts during his absence.

An Electrical Turn Indicator.—An electrical turn indicator for use on aircraft, which depends on measuring the difference in air speed at the two wing tips, is described in the *Zeitschrift für Flugtechnik und Motorluftschiffahrt*. Two Venturi tubes are used, one over each wing tip. Each Venturi contains three resistance thermometers, one in the throat, one in the entrance section, and one in the exit section. The temperature difference between the throat and the entrance and exit can thus be obtained for each Venturi. By combining two instruments differentially, the difference in temperature between the two throats can be measured. This temperature difference will depend on the rate of turning. It is claimed that the electrical recorder has very little lag.—*Technical Review.*

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Exports and Imports of Electrical Goods for January and February, 1920.

The official returns of electrical exports and imports for the months of January and February, 1920, show as regards the exports totals of £864,320 and £761,973 respectively, which compare with the two previous months as follows:—November, £906,035; December, £849,149. The values of electrical exports for January and February, 1919, were £309,210 and £326,658. The exports for January and February, 1920, included submarine telegraph cable to the value of £81,323 and £39,814 respectively. The total weight of electrical machinery exported in January is given as 942 tons, as compared with 1,002 tons in 1919, and 2,528 tons in 1913. The electrical import totals for the first two months of 1920, have been January, £176,871, and February, £188,026, as against £90,374 and £330,987 for the two previous months, November and December. The re-exports of foreign and colonial electrical material fluctuate considerably, the figures for January and February being £13,522 and £9,798, as compared with £7,333 for November, and £12,765 for December.

Values of Electrical Exports and Imports for January and February, 1920.

	January.			February.		
	£ Exports.	£ Imports.	£ Re-exports.	£ Exports.	£ Imports.	£ Re-exports
Electrical goods and apparatus unenumerated ...	101,296	34,606	9,301	107,476	45,354	2,706
Insulated wire	250,106	3,800	—	225,051	11,823	—
Glow lamps	10,496	4,117	119	11,070	1,054	120
Arc lamps and parts	727	2,618	—	2,090	1,641	—
Batteries	35,829	1,544	—	26,331	4,010	—
Meters	20,657	4,051	143	19,073	6,026	763
Carbons	2,322	16,605	556	11,337	11,316	2,094
Electrical machinery—						
Railway and tramway motors	2,911	—	—	2,900	—	—
Motors and generators	108,187	—	—	66,236	—	—
Electrical machinery unenumerated	62,828	100,001	1,920	63,590	89,320	1,922
Switchboards	12,047	956	—	4,129	—	—
Telegraph and telephone cables and apparatus ...	256,914	9,573	1,483	222,690	17,482	2,195
Totals	864,320	176,871	13,522	761,973	188,026	9,798

REPORT ON THE ELECTRIC LAMP INDUSTRY.

(*Concluded from page* 428.)

9. We find that the Association does not control the output or sale of lamps for export, except for the U.S.A., Japan, and Mexico, to which countries the sale of Association lamps is prohibited; the reason for this being, we understand, that there is an arrangement with the American patent holders whereby these three markets are left to American manufacturers, or their licensees, conditional on the British market being left to British manufacturers.

The Association stipulates that as lamps sold for export do not come under its rules, every precaution should be taken to prevent the use of such lamps in the United Kingdom. The explanation for this, as already indicated, is that lamps are sold by British manufacturers for export at considerably lower prices than for sale within the country. The arguments sometimes adduced in favour of such a course—that export orders are of larger volume and entail lower manufacturing and selling costs—do not apply here, and we find it difficult to endorse a "dumping" policy of this nature which penalises the home user in favour of the foreign user. We are also of opinion that if lamps can be sold for export at such low prices and sold at a profit to the maker, it should be possible to reduce prices to that extent in the home market, irrespective of reductions on other counts.

10. The problem of trade combination in the electric lamp industry and the effective monopoly secured thereby is complicated by the fact that lamps of certain types are manufactured under patents which in themselves afford a monopoly for a term of years. Between these two forms of monopoly it is not always easy to make a clear distinction. The British Thomson-Houston Co., one of the leading Association firms, claims, for example, the sole right to manufacture drawn tungsten filament wire under its patent rights. This particular patent monopoly was one of the basic patents on which the Association was built; but when the British Thomson-Houston Co. took proceedings against Messrs. Duram, Ltd., a non-Association firm, for infringement, they lost their case in the High Court of Justice, the Court of Appeal, and in the House of Lords, so that the manufacture of drawn tungsten filament has since 1917 been no longer restricted by patents in this country.

Another important patent is the gas-filled half-watt lamp. The associated firms claim the sole right to manufacture this lamp in England under American patents acquired by them. An action brought by one of them against a non-Association manufacturing firm for alleged infringement of their half-watt patents—which is regarded as a test case—is at present proceeding.*

It has been alleged by witnesses that some of the patents held by members of the Electric Lamp Manufacturers' Association are of doubtful validity, but that their claims under these patents go undisputed because of the great financial resources at the command of the Association. We are not competent to pass an opinion on this, but might cite the case of Messrs. Duram, Ltd., previously mentioned, in which the Association patent claims concerning drawn tungsten wire were contested, and judgment was given against the proprietors of the patents. We are informed that this action cost Messrs. Duram, Ltd., the party in whose favour judgment was given, the sum of £10,000. It has been put to us that the consequence of this judgment was the release of the industry from restriction based on claims which turned out to be invalid, and it has been contended in evidence given before us that the Association claims other exclusive rights under patents which, if brought to the test, would prove equally invalid. In this connection a case has come to our notice in which, owing to litigation threatened by the Association, the chief client of a non-Association manufacturing firm producing lamps containing drawn wire, was constrained to cease purchasing further drawn-wire lamps from the firm. This resulted in a considerable loss to the manufacturer and necessitated the re-equipment of the factory to produce another type of lamp. The patent under which this client feared that proceedings would be taken was three years later held by the House of Lords to be invalid.

We may state here that notwithstanding the judgment given in the Duram case, the firms comprising the Electric Lamp Manufacturers' Association are under agreement not to dispute the patents of the licensors, and must buy their drawn tungsten wire only from the Association firm whose patent was declared invalid. The manufacturers who won the case are consequently prevented from supplying drawn tungsten wire to any of the lamp makers in the Association, and 90 to 95 per cent. of the home market for their product is therefore closed to them. They have consequently to rely on the export trade for the sale of the bulk of their output.

11. The history of the Electric Lamp Manufacturers' Association, as we have briefly indicated, is closely connected with patent rights; the Association having been originally formed to avoid litigation between leading lamp manufacturers who held overlapping patents. We have also mentioned that the principal patent-owning firms in the Association grant licences to manufacture under those patents to other firms in the Association, who pay to the licensors a royalty of 5 per cent. on net selling prices in the home market and 2 per cent. on export, in the case of standard vacuum lamps; and in the case of gas-filled half-watt lamps of 7½ per cent. and 3 per cent. respectively.

We have now to state that the granting of these licences has been accompanied by a condition limiting the number lamps which the licensee is permitted to manufacture for home consumption under the licence. The condition usually imposed has been that the licensee should not increase his output by more than 10 per cent. per annum, although one case has come to our notice where the patent holders proposed to a manufacturer a form of licence which permitted an annual increase of only 5 per cent. on existing output.

During the war this limitation has been in some cases waived, and the restriction of output raised to a considerable extent. The licensors contend that inasmuch as they are manufacturers as well as the proprietors of the patents, they

* The result is reported in our "Legal" columns to-day.—Eds.

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would be well within their rights in retaining the monopoly granted under the patents, and are even more within their rights in imposing their own limit upon the number of lamps to be produced under licences by manufacturers, who are in practice their rivals. It is further explained that no limit is imposed upon the licensees as regards any lamps manufactured for export, and further, that the three licensor firms are under no agreement to limit their own output. We admit the technical correctness of those arguments, and commend the action of the patent-owning firms in the Association in relaxing the output limitation clauses of their agreements with their licensees during the war; but we have no assurance that these restrictions will not be reimposed. The licensor firms would be well within their technical rights in limiting the expansion of all associated firms in the British electric lamp industry except themselves, but we should have difficulty in harmonising such a policy with the declared desire of the Association to see the British output of electric lamps increase until it is equal per head of population to that of the United States or Holland. The system adopted by some other trade associations of limiting each firm in the Association to a percentage of the total output of the combined firms, whatever that output may be, is not free from objection from a public standpoint; but it is far preferable to the restriction imposed by the licensors of these patents upon some of their licensees and might well be adopted by them. We are, of course, aware that patents are granted with the double object of encouraging invention by granting to the patentee a monopoly of manufacture for a term of years, and of ensuring that the manner of working the invention shall be made known to the public for general use when that term has expired. We do not question the desirability of granting such limited-period monopolies to inventors or developers of inventions, but it is undesirable that patent rights should be made an instrument for enforcing a monopoly wider than that afforded under the patents themselves. We are, moreover, of opinion that it should be possible to challenge the validity of an oppressive master patent without incurring such expenditure as that already mentioned in the case of Messrs. Duram, Ltd., and that there should be an effective supervision and control of the terms on which licences to work patents are granted. In view of the modifications in the law contained in the Patents and Designs Act, 1919, designed to provide a remedy for abuses of patent monopolies, we reserve any recommendations we might otherwise have made under this head.

12. We have referred in paragraph 2 to the purchase of Dutch half-watt lamps as a condition of the sale of an argon plant by Philoips, of Holland. We now have to state that during the first seven months of 1919 licences for the importation of Dutch half-watt electric lamps were issued by the Board of Trade, on the recommendation of the Ministry of Munitions, to the following firms:—

	Lamps.
The British Thomson-Houston Co., Ltd. ...	250,000
Siemens Bros., Ltd.	500,000
The General Electric Co., Ltd.	500,000

At that time the Dutch half-watt lamp was bought in Holland, we understand, at about 3s. per lamp. These lamps bought in Holland at 3s. were sold to the user in this country at 12s. 6d. We have inquired as to how and by whom the great margin between these two figures was absorbed. We are informed, on behalf of the three importing firms, that the cost of these lamps delivered into purchasers' store in this country was 4s. 1d.; that the selling expenses per lamp (including carriage, packing, storage, &c.) were 2s. 1¼d.; making a total cost to the importing and selling firms of 6s. 2¼d. The average price realised from the trade is stated to have been 8s. 6¼d., which gives a net profit to the importers of 2s. 4d. per lamp. These lamps were sold to the public at 12s. 6d., which gives an average trading margin to the distributing trade of 3s. 11¾d. per lamp. These figures apply up to September 30th, 1919, when the price to the public was reduced to 10s. 6d.

The figures furnished to us for that later period show an importers' cost of 4s. 1d., and selling expenses of 1s. 8¼d., making a total first-sellers' cost of 5s. 9¼d., an averaged realised price of 6s. 10¼d., giving an importers' profit of 1s. 0¾d., and leaving a margin of 3s. 7¾d. for the distributing trade.

We have not been able to check these figures or to determine the costing basis on which they have been compiled, but we understand that the figures of 2s. 1¼d. and 1s. 8¼d. per lamp for selling expenses are not figures arrived at by actual costing, but represent the percentage customarily allocated for selling expenses by these firms. In view of the fact that the 1919 selling expenses on standard vacuum lamps are put by the Association at 5.1 pence, we are forced to the conclusion that the figures given for the half-watt lamp are far larger than the selling expenses actually incurred on these lamps. In confirmation of this view we have a statement from a reliable witness of considerable experience in the electric lamp import trade to the effect that 50 per cent. on imported cost would be an ample margin for both selling expenses and profit. We believe that under conditions of unfettered importation and free competition between importing merchants, a far lower margin even than 50 per cent. would have been found adequate. We are of opinioin that those imported Dutch half-watt lamps might well have been sold to the public at not more than 8s. instead of 12s. 6d., lavish margins still being left to the importers and the distributing trade. We arrive at the conclusion, therefore, that the public paid something like £280,000 more for these lamps than they need have done had their importation and sale been properly organised and controlled. We have inquired of the Ministry of Munitions why the issue of licences was confined to these three firms, but owing to the partial demobilisation of the department concerned we have been unable to obtain sufficient information to give any account of the circumstances or reasons. We have also inquired of the Import and Export Licences Section of the Board of Trade whether in issuing these licences any stipulation as to price or conditions of sale was imposed, and learn that the licences were issued without any such conditions attached.

We recognise that the three firms to whom licences were granted, holding as they did patents on the half-watt gas-filled lamps, and relying on the validity of those patents, believed themselves within their rights in requiring a monopoly of the importation of those Dutch lamps. We also recognise that, inasmuch as British manufacturers could not at that time turn out half-watt gas-filled lamps nearly as cheaply as could Dutch manufacturers, to have offered the public Dutch lamps at considerably lower prices than the home product would have been to prejudice seriously the British manufacture of these lamps at a difficult and critical time. We cannot but think, however, that some means of diverting the greater part of the £280,000 from importers and distributors to the public revenue should have been found.

13. It has been urged upon us, on behalf of the Association, that only by mass production can the manufacture of electric lamps be carried on in this country in successful competition with Holland, Switzerland, and Germany, and that herein lies one decisive justification of the policy the Association is pursuing. We venture to remark on this point that if economy of production were directly related to the volume of output in one unit of plant, the progressive policy would be a policy of concentration in a few large factories, and the policy of the Association should be aimed in that direction. But we are not convinced, from the evidence laid before us, that in the actual making of lamps the big factory has any great advantage over the small factory. We have, indeed, shown that the smaller factories are able to produce, or do at any rate sell, at lower prices than the larger factories. Where mass production is essential to economy appears to be in the manufacture of glass bulbs and of brass caps, and we consider that any effort directed towards concentrating the manufacture of bulbs into one highly-efficient establishment, and of caps into another, would be advantageous as placing the British industry on a footing of efficiency and of independence as regards foreign supplies of components. The Association is at present, we believe, pursuing such a policy, and since we are assured that in so doing they will not discriminate between associated and non-associated manufacturers, we look upon this as a movement of great promise to the electric lamp industry of this country.

14. We have inquired to what extent non-Association firms have been in the past handicapped in their competition with the associated firms in the matter of materials and in lamp manufacture, and are informed that as regards both bulbs and caps they have been at some disadvantage owing to the influence exercised by associated firms on the manufacturers of component parts in other countries. The best and cheapest glass bulbs, we are informed, are produced in other countries and largely imported by lamp manufacturers in this country. One of the leading foreign makers is Messrs. Libby, of U.S., and for certain types of lamps it is advantageous to use Libby bulbs. But Messrs. Libby are connected with the General Electric Co., of America, and that company is financially connected with the British Thomson-Houston Co. We are informed that as a result of these interconnections it was difficult, if not impossible, for any non-associated firms in this country to obtain bulbs made by Messrs. Libby. Satisfactory bulbs were obtained from Holland and Sweden, and the home supplies were improving, but the sources of supply to non-associated manufacturers in this country were narrowed by reason of the international connections described.

15. We have not in our investigation dealt with the question whether combination in the electric lamp industry is desirable or otherwise, but we think it well to record the fact that some non-associated manufacturers have declared to us their belief that combination would be beneficial to the industry and country alike provided it were a combination of firms associated on a basis of equal status, with common obligations and privileges. The objections advanced against the Association as at present conducted are that it is worked in the interests of three licensor firms, who impose upon the licensee firms onerous conditions, in particular those requiring the recognition of patent claims even when they are declared invalid in the Courts, and those limiting the output of licensees.

It has been put to us by the responsible heads of the Association that the Association enabled the lamp manufacturing industry to resist at a critical time the invasion of the British market by German lamps, and kept intact in this country a lamp industry which, when the war came, was able at short notice to turn out many special types of valves and lamps urgently required for the prosecution of the war.

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We agree that without some form of combination the British electric lamp industry would not have been able to resist so successfully the competition of foreign-made lamps, but we cannot agree either that the form of combination established by the Association was indispensable for the purpose, or that the Association has secured to the industry as a whole all the advantages which a more equitable form of combination could have ensured. In view of the great importance of research and experiment to an industry, the development of which is so much dependent upon science, we consider that one important objective should have been that of concentrating research and experiment in such a way as to get maximum results from the sums expended, and to place these results at the disposal of the industry as a whole. We have been informed of the very large sums devoted to research by the three principal firms in the Association, and have been asked to take account of this in considering the profits made, but we have no means of knowing how much of this expenditure was devoted specifically to lamps or of relating that expenditure to profits. We agree that the profits made by the industry should be such as to afford an adequate margin for experiment and research; but until the Association reconstructs itself on a more equitable basis and subjects costs and expenditure to open and impartial cost-accountancy, we see no means whereby the public can judge that the margin so allowed is not excessive, and that it is being efficiently used for that purpose.

16. Whereas we have shown that a trade combination controls practically the whole electric lamp industry in this country, we now have to call attention to the strong possibility of an international trade combination, embracing the leading manufacturers of America, Holland, and Great Britain.

The General Electric Co., of America, have a majority holding in the British Thomson-Houston Co., Ltd., in England, and have recently joined interests with Philips Glowlamp Works, Ltd., a very important lamp manufacturing concern in Holland, recently Philips, of Holland, acquired about one-eighth of the Edison-Swan Electric Co., Ltd. (in England), shares, and two Philips directors have joined the Ediswan board. Such an international "community of interests" might be able to dominate the world's lamp market, fix prices, regulate output, and allocate markets.

There is already an arrangement between America and England whereby the respective markets are allocated, and British associated manufacturers are prevented from exporting to U.S.A., Mexico, and Japan. Moreover, the British Association manufacturers control, through the General Electric Co., of America, the best American glass bulbs, and have prevented non-associated manufacturers from obtaining supplies of that particular bulb.

The British lamp consumer should, in our opinion, be safeguarded against the possible maintenance of price by such a powerful world combine.

17. We think it pertinent to record the fact that several of the witnesses whom we summoned to appear before us were obviously reluctant to give evidence reflecting adversely on the Association lest the fact of their doing so should become known, and their businesses suffer in consequence. Notwithstanding the compulsory powers delegated to us under the Act, we felt it necessary to give these witnesses an assurance that their names should be deleted from all circularised records of the Committee, whereupon they made their complaints without hesitation. These fears may have been entirely unwarranted, but the reluctance evinced was in itself an indication of the restraint that a powerful combination can impose upon that section of the industry which is outside the combination.

THE ELECTRICAL EQUIPMENT OF ARTISAN DWELLINGS.

By LEONARD MILNE, M.I.E.E.

(*Abstract of paper read before the* Institution of Electrical Engineers.)

If electricity is to be employed in artisan dwellings for lighting and other purposes, it would appear essential that the installation costs should be very much reduced from those to which we are now beginning to become accustomed. The argument that, since the present cost of building is so great, and the cost of an electrical installation such a small percentage of the total figure, economies in installation costs are of small importance appears to be entirely fallacious. Dealing first with an installation for the supply of lighting only to an artisan dwelling, I find from examination of various plans that, on the average, the house contemplated would require nine lighting points, and I have had estimates prepared for the internal installation work on various methods at present in vogue, with the following result*:—

Cost of 9-light installation in screwed enamelled welded tube with 600-megohm grade C.M.A. cable of sizes conforming to the requirements of the Institution, including main switch and main fuses, distribution board, plain fittings, lamps, and switches, £19 13s. 8d.

The same in close-joint conduit with continuity fittings, £14 1s.

The same in wood casing, £16 3s.

The same with wires carried on porcelain cleats and unprotected except where they rise through floors and pass through walls, £11 4s. 8d.

Examining the points where it would seem possible to effect a saving, I would first suggest that a main switch in these small dwellings, when lighting only is provided, could quite well be eliminated, substituting therefor two replacement fuses. From examination of the estimates previously given, I am of opinion that some form of uncased cleat wiring must be used, on the grounds of economy. With regard to the wires themselves, it appears quite unnecessary to use such costly material as 600-meghom grade cable on the neutral side of those systems where one pole is directly and permanently connected to earth, since at the outside we could only be dealing with differences of pressure of a very few volts between this conductor and earth; the insulation of the braiding of the wire, and of the porcelain cleats would, I submit, be amply sufficient for the neutral side.

There are to-day an enormous number of installations in which the insulation on the neutral side is practically nil, and yet I cannot find any case in which it has been observed that the occurrence of a fire was coincident with the development of a fault between the outer and neutral on the system.

As to the size of wire employed, at the present time a No. 18 S.W.G. is the smallest wire permitted by the wiring rules. The considerations on which this rule is based are undoubtedly mechanical, not electrical. I would suggest that, in the case of twin wires, the minimum size permitted should be reduced from No. 18 to No. 20 S.W.G., since the mechanical strength of a twin 20 S.W.G. wire is at least equal to the mechanical strength of a single 18 S.W.G. A twin wire might be used, made up with one core of No. 20 S.W.G. insulated to 600-megohm grade with a bare No. 20 S.W.G. laid in long spirals around this, and the whole braided over all. Such a twin conductor, compared with two separate conductors of No. 18 gauge, effects a saving of 50 per cent. in the cost of wire.

I would propose to dispense with switch drops, to place a combined switch and ceiling rose (or a switch and ceiling rose mounted together on the same block) on the wall near the ceiling level, and to operate the switch by a cord or rod attachment. The position of the combined switch and ceiling rose can generally be chosen so as to be close to the door of the room. From this ceiling rose I would run a twin flexible wire, passed over an insulated hook, directly to the point where light is required. This twin flexible I would again construct of one insulated wire and one semi-insulated wire. In this way a saving of 40 per cent. would be effected in the cost of flexible cords.

Where conductors run through floors, they should be protected up to the skirting level or possibly above hand reach, preferably in ⅜-in. insulating tube. They should also be protected in a similar manner where passing through walls. Such protection, primarily mechanical, would, with the braiding, provide for the otherwise bare conductor sufficient insulation to prevent electrolytic action.

The total result of the economies suggested is that the cost of a 9-light installation as described would amount to £7, as against a sum varying from £19 13s. 8d. to £11 4s. 8d. for the cost of a similar installation on the recognised methods before referred to. In each case my estimates are based upon the perhaps somewhat haphazard methods at present in vogue, in which there is practically no co-operation between the architect, the builder, and the electrician. I hope that we shall see closer co-operation, so that wood fixing blocks will be built in at all positions where fixings are required, and that passage ways will be left where necessary in all walls and ceilings. These fixings can be provided practically without additional cost as the building proceeds, whilst the labour of cutting away, and making good, amounts to approximately one-third of the total labour on the installation.

Doubtless one service would be arranged for a group of houses, and I would suggest that the supply from house to house of the group should be made by means of bare overhead wires carried on insulators attached to the chimneys of the buildings, and that the supply should enter at the top of the house and not at the bottom, the supply authority's apparatus being fixed on the upper instead of on the lower floor. This arrangement has the further advantage of pro-

* All estimates in this paper are based on the prices ruling in the autumn of 1919 and the sizes of wires then in common use. Recent variations do not, however, materially alter the comparative figures.

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viding the driest position for fixing the supply authority's apparatus.

A meter for each separate consumer is a heavy charge for the anticipated revenue, and where lighting only is installed consumers might be charged a fixed annual rate and a meter eliminated. The objections to such a fixed charge under a contract for lighting only is that it leads to extravagant consumption and to the dishonest use of lighting points for electric kettles, irons, and all the various appliances which can be utilised with the lamp-socket adapter; or, on the other hand, to the use of electricity for domestic purposes other than lighting being hampered.

For houses built under the housing scheme, which will to a large extent be of exactly the same size and type, the difficulty of improper use of energy supplied under a contract for lighting only could be met by installing one meter for, say, every dozen or 20 houses, charging a fixed rental sufficient to cover the most extravagant use of energy for lighting purposes, and allowing a quarterly rebate to each consumer when the meter reading showed a consumption below the predetermined estimated figure. By this means, it would be to the interest of each consumer to economise, and the improper use of current for purposes not included in the contract would probably be at once notified and stopped. The other objection, that development is hampered, still remains.

It is highly desirable that a supply of electricity should be available for all purposes—for heating, for cooking, house cleaning and washing, and for small power for labour-saving devices. For a general supply a separate meter for each house appears to be essential, but the anticipated revenue would be sufficient to justify this expenditure.

To avoid installing two meters, one for lighting and one for power, the system of charging a fixed annual sum plus a small charge per unit used for any purpose has distinct advantages. The ideal system, which should be free from complication, easily understood by the consumer, adapted to promote the general use of electricity for all purposes, and equitable, has, I think, still to be found.

As regards heating, I do not think we can anticipate the elimination of fires from the room, or rooms, where heat is constantly required. In bedrooms, where artificial heat is only required on rare occasions, electric stoves are eminently suitable. The suggestion has been made that considerable economies in building would be effected by completely dispensing with chimneys and grates; and, with the one exception of the main living room, I think this could be done with great advantage. The saving in cost of building by dispensing with chimneys and grates in all rooms but the living room, and by substituting for them efficient forms of ventilation, would amount to approximately £25 per house and would further provide an additional 15 sq. ft. of available floor space.

The cost of wiring with twin wires as previously described for the heating plug in each room from which a fireplace has been removed would only amount to approximately 18s. per point, or £4 10s. for the house with five power points. I have not included in this figure the cost of the electric stoves themselves, for it seems quite unnecessary that these should be provided by the landlord for each room in each house. Electric stoves and other electrical apparatus which are only occasionally used, should be available on the estate for hire by the tenants.

With regard to electrical cooking, by reason of the complete control and lower average temperature required, the resultant saving in food wastage alone should cause the adoption of electrical cooking on grounds of economy. There are on the market several satisfactory kitchen outfits suitable for a working-class family, and the cost of such an outfit, consisting of an electric oven 18 in. by 15 in. by 15 in. with four controls, boiling plate 18 in. by 10 in. with three controls, a grill 9 in. by 8 in. and a two-pint kettle, would amount to about £14 at present prices, and the daily consumption for cooking for a family of five would average about 7¼ units per day. In the United States the average figure is stated to be under 1 unit per day per person.

It will pay the electricity supply undertaking to quote preferential rates for cooking in an artisan dwelling, since the range will be used chiefly for the midday dinner at or near the time of minimum daytime load on the station. The stumbling block to electrical cooking is the question of domestic hot-water supply. In the majority of cases this is inadequately provided from a saddle-back boiler in the kitchen fire. This is not satisfactory. The alternative, of using a separate stove burning anthracite, is more convenient and more economical than keeping a kitchen fire alight to provide hot water. Taking anthracite as costing at the present time £3 5s. a ton, the daily cost amounts to approximately 7¼d. Roughly, this will provide the equivalent of 50 gallons of hot water at a temperature of 104 deg. F.

Another alternative is to obtain the hot-water supply from a gas-heated geyser. To obtain the same quantity of hot water at the same temperature would require a consumption of 75 cu. ft. of gas, to which must be added, if the arrangement is to be convenient, the amount consumed by a pilot burner, which would be alight for, say, 12 hours a day and consume five or six cu. ft. per hour, making the total gas consumption 135 cu. ft. per day. Taking the price of gas as 4s. 6d. the cost would be, say, 7¼d. per day.

There are several electric water-heaters on the market for which an efficiency of 90 per cent. or over is claimed when the apparatus is used to its full capacity over a period of 24 hours, and I am of opinion that such an efficiency should be obtainable. A still higher degree of efficiency could doubtless be obtained without thermal storage, but it appears essential that some form of thermal storage be employed if electric heating of water is adopted. To give a convenient supply of bath water, 18 gallons of water at a temperature of 104 deg. F. should be available within 10 minutes; and to provide this without thermal storage, even with a heater of 100 per cent. efficiency and assuming a temperature of 55 deg. F. for the inflowing cold water, would require over 15 kw. for 10 minutes. Such a load is not one that supply engineers would be prepared to take on at the low price which is essential if the electrical heating of water for domestic purposes is to come into general use. With thermal storage and a load factor of practically 100 per cent., a supply is even to-day obtainable at 1d. per unit; and with arrangements which would ensure that the water-heater load was off at times of peak load, I should anticipate that a rate of ½d. per unit or less would be quoted.

The objections to thermal storage by means of a heated cast-iron block are the weight and bulkiness of the apparatus. The objection to thermal storage in the hot water itself is that either a large cistern is required for adequate storage, or that the water has to be stored at a high temperature, increasing the thermal losses and, moreover, rendering the water unpotable and liable to deposit scale.

Although a domestic hot-water supply may be obtained more cheaply electrically than in any other way—6d. against 7d. to 8d. a day—the price is still somewhat high for an artisan family. The direction in which the final solution of the problem lies is to fit a small boiler in the parlour grate, to store tepid water at, say, 80 deg. F. or 90 deg. F. in winter time, and to employ an electrothermic booster to raise the tepid water to the required temperature. In summer time when there is no parlour fire, a little more electric power will be necessary; this, combined with arrangements ensuring that the peak load is not overlapped, gives a most desirable load to the supply station.

A further investigation on the subject of thermal storage is urgently called for. Possibly good results might be obtained by making use for thermal storage of the latent heat of fusion of some metal, alloy, or salt, such as nitrate of soda, or the latent heat of crystallisation of the solution of a salt, such as acetate of soda, which has already been used for thermal storage. The subject is the key to the extensive introduction of electric cooking. Solve the domestic hot-water problem and electric cooking will necessarily follow.

From figures previously given, it will be seen that, leaving out of consideration on both sides of the account the provision of a hot-water supply, the capital cost of the complete electrical equipment of an artisan's dwelling, including cooking apparatus, is practically covered by the saving on the building by dispensing with chimneys and grates.

Various other labour-saving devices which are on the market will be extensively used in the artisan's house when a cheap electricity supply is available in every room, and I would call attention to one piece of apparatus which should be, but, as far as I know, is not, on the market, namely, an electrically heated airing cupboard. Most small houses are at present very inadequately provided with airing facilities, and an electrically heated airing cupboard, properly ventilated to the outside, is an inexpensive convenience which will do much to promote the health of the people.

EARTHING.*

(*Abstract of paper read before the* Institution of Electrical Engineers.)

The sub-committee was asked to "consider the whole question of earthing (including the time element of circuit-breakers, the heating of conductors, the current-carrying capacity of the apparatus earthed, the drop of pressure in metal sheathing, and the number of earth wires required)."

In accordance with these instructions the sub-committee first proceeded to determine experimentally the heating of earth wires, *i.e.*, bare conductors of various cross-sectional areas, having in mind that rule 34 in the seventh edition of the I.E.E. Wiring Rules requires one No. 14 S.W.G. wire, or conductor of an equivalent cross-sectional area, to be provided for every 50 amperes or part thereof of working current, and that rule 98 (*b*) allows the use of a fuse which will permanently carry any current less than three times the normal for working currents not exceeding 10 amperes, and twice the working current for larger conductors. Fig. 1 shows the rise in temperature for bare conductors of various sizes carrying twice the working current allowed by the Institution rule for the same cross-sectional area of insulated conductor, *i.e.*,

* Report of the Earthing Sub-committee of the Wiring Rules Committee. The sub-committee consisted of Mr. G. S. Ram (chairman), Mr. J. Frith, Mr. G. H. Nisbett, and Mr. A. L. Taylor.

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the current which an earth wire may have to carry indefinitely under the present rules.

The temperatures arrived at are much higher than will be considered safe.

The considerable cooling effect obtained by attaching a wire to a brick wall will be noted, but the sub-committee does not consider it safe to calculate the sizes of earth wires for a given current, except on the assumption that the wires will be entirely surrounded by still air.

An earth wire should be so designed in size that, assuming the correct operation of the fuse, the temperature can never rise to that of the melting point of tinman's solder, i.e., about 392 deg. F., in order to ensure the permanency of the

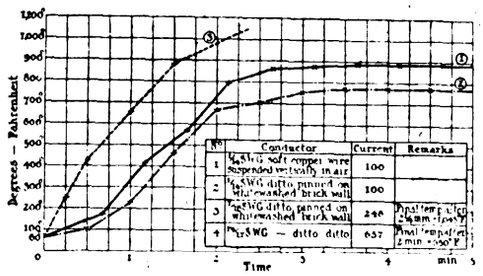

Fig. 1.—Temperature Rise of Bare Soft Copper Conductors.

connections and to avoid fire risk. Apart from the question of danger to life, the whole object of an earth wire is to enable the fuse to open the circuit.

The Institution rule dealing with fuses, No. 98 (*b*), does not specify a time limit; therefore, a fuse that will permanently carry, say, 200 per cent. or 199 per cent. of the working current (depending upon the size of conductor) will comply with the Institution rule provided it opens the circuit at respectively three times or twice the working current. A fuse designed for these limits would permit of a serious overheating of the conductors if we are correct in assuming that the "maximum current permissible" given in the wiring rules table refers to the working load of the cables, but the limiting conductor temperatures are laid down in rule 44 as 130 deg. F. for rubber and 176 deg. F. for fibre. As a help towards meeting the difficulty we suggest that the rules should be altered so that the allowable working current stated in the appendix to the rules should be based on a maximum atmospheric temperature of 80 deg. F. instead of 100 deg. F. as at present. If this were done, we should then have for the operation of the fuse a margin between the working temperature and the maximum allowable of, in the case of rubber cables, 30 deg. F., and for fibre, 46 deg. F., instead of at present only 10 deg. F. for rubber cables and 26 deg. F. for fibre cables.

Copper fuses as now commonly used are unsuitable for the purpose we have in mind, as the margin between the safe working load and the fusing current is a wide one compared with other metals available. Fig. 2 shows the temperature curve for a typical copper-wire fuse. If such a fuse is to open the circuit at all with an overload of, say, 50 per cent., it would be so hot (500 deg. F.) at the working load that

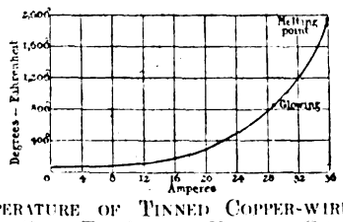

Fig. 2.—Temperature of Tinned Copper-wire Fuse (3-in. Break; Open Type) with Various Currents.

it would be in a state of instability and would, owing to oxidisation, ultimately open the circuit when it was not required to do so. Moreover, a copper fuse set to these limits would not comply with the Institution rule 98 (*a*) reading: "No over-heating of any part must take place when the full current flows continuously." This rule should be maintained. A copper fuse involves the need for setting it to break the circuit at a higher value of the current it will permanently carry.

Pure tin wire seems most nearly to meet our requirements; the melting point is low, the metal is strong and not too ductile, and it is practically free from deterioration at temperatures below the melting point.

In order to admit of the ready testing of a fuse, we consider it advisable to specify the current at which the fuse will melt in one minute from the application of the current, starting from cold, rather than the present practice of specifying the current at which it will eventually melt.

Figs. 3 and 4 show some characteristic curves for tin fuse wire 0.064 in. diameter with different typical mountings. Fig. 3 shows the fusing currents up to 3-minute intervals from the application of the current, and fig. 4 the fusing currents up to one hour and the probable maximum carrying capacity. A sufficient allowance for determining the working current is to deduct 33⅓ per cent. from the one-minute fusing current, which will make the fusing current 50 per cent. above the working current. This gives with a tin fuse wire a sufficient margin over the working current to allow for variables, such as size, &c., for all types except dust fuses. This type of fuse, not being generally used in connection with wiring work, can be provided for by making

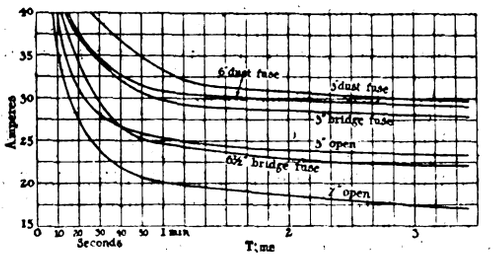

Fig. 3.—Fusing Currents of a 0.064 in. Pure Tin Wire up to 3 minutes.

the working current 50 per cent. of the one-minute current for this type of fuse, which would then give a sufficient margin between the working current and the current at which the fuse would ultimately open the circuit with a prolonged load.

It will be seen from figs. 3 and 4 that the environment of a fuse has a marked effect both on its ultimate carrying capacity and on the value of the current at which it will break circuit in a given time. It is, therefore, desirable that any new rules should make it clear that a standard fusing current for a given size of wire cannot be stated unless both its environment and length are known. The Institution rules should specify the use of pure tin fuse wires only, and these should be so proportioned to their type of mounting, for all sizes of fuses, that they will interrupt the current in one minute from the first application of a current 50 per cent. above the maximum working current allowable by the rules to be carried by the smallest section of cable protected by the fuse.

Where mechanical circuit breakers are used they shall be so designed that the conductors protected by them cannot exceed the limits of temperature allowable with wire fuses, that is to say, a circuit breaker can safely operate with an increasing overload the shorter its time element; in round figures 250 per cent. if the circuit is to be opened in 10 seconds from the time of the overload and 400 per cent. if in 5 seconds, but 400 per cent. should be the extreme limit of overload however much less than 5 seconds the time element may be.

We have investigated the carrying capacities of conduits and the lead coverings of cables, and particulars are given in the original paper.

Theoretically, for each size of cable sheathing or conduit a different length can safely be worked with one earth, but as the minimum length of 150 yards for any one size at the

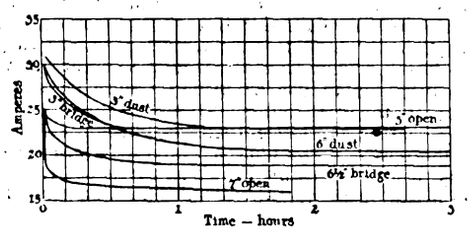

Fig. 4.—Fusing Currents of a 0.064-in. Pure Tin Wire up to 1 hour, and Probable Maximum Carrying Capacity.

lower voltage is well within the limits of practical requirements in all but very exceptional cases, we suggest that it be adopted as the maximum length allowable. As the wire armouring when used on rubber-covered cables has a carrying capacity in excess of that provided by lead covering if used, we suggest that the same rule should apply. The rules should clearly state that tape armouring must not be used for earthing purposes.

Particulars are also given in the original paper of the sizes of earth wires required for various sections of working conductors, paper and rubber insulated respectively. In the case of paper cables, owing to the larger working current allowed, the earth wires need to be larger than for rubber-insulated cables, and even larger than the working conductor itself in the smaller sizes. Earth wires for both types become progressively smaller relatively to the working conductor as the size of the latter increases.

A specified size and number of earth wires should be named for each size of main conductor, and the particulars given in the form of a column to be added to the particulars of carrying capacity, &c., of conductors given in the appendix to the I.E.E. Wiring Rules.

Upon the assumption that the foregoing suggestions are adopted, we recommend that:—

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1. Earthing conductors must be of the numbers and sizes set forth in the tables attached to the rules for each size of working conductor.

2. That they should be of high conductivity copper, tinned or otherwise protected against corrosion, and protected against mechanical injury.

3. That the smallest allowable size of earthing conductor should be 1/14 S.W.G., and the largest individual conductor should be 19/17 S.W.G., and that all conductors larger than 1/14 S.W.G. should be stranded.

4. When a larger section of earthing conductor than 19/17 S.W.G. is necessary, separate conductors must be used, and if earth plates or cylinders are employed, separate ones for each conductor must also be used.

5. Buried earth plates or cylinders must have an earth contact of not less than 4 sq. ft., and be surrounded on all sides by not less than 12 in. depth of finely broken coke. They should preferably be of cast iron or other durable metal and the place selected for burying them must be permanently wet or, at least, damp.*

6. Wherever an earth wire is connected to a pipe, or conduit, or cable sheath, or armouring, a substantially designed clip must be used. Sweating sockets also must be used at each end of the earth conductor for all sizes larger than 1/14 S.W.G. For armoured cables substantial clamps must be used, so designed as to grip firmly the whole of the wires of the armouring without damage to the insulation.

7. Where special earth plates are not provided, extreme care must be taken to see that only such earths are used as are easily capable of carrying the maximum current which can be allowed to flow by the largest fuse used in the circuit in question. From this point of view water pipes directly in connection with the street water-mains make excellent earths. Steel frameworks of buildings must not be used as earths.

In conclusion, the sub-committee strongly recommends that rule 2 (*b*), providing for the need of earthing all metal other than the conductor on circuits where medium pressures are used, be extended to include low-pressure circuits also, and that it also be extended to prescribe the earthing of all metal liable to be electrically charged, such as constructional steelwork.

Discussion in London.

The discussion was a joint one on the electrical equipment of artisan dwellings, with an introductory paper by Mr. L. Milne, and on the report of the Earthing Sub-committee of the I.E.E. Wiring Rules Committee.

Mr. J. W. Beauchamp opened the discussion on the paper, and said that the figures it contained of the cost of wiring such dwellings would be of much value. He had found great diversity in such figures when supplied by various contractors. It was his opinion that an attempt should be made to spend a greater proportion of the cost of such installation in the factory instead of on site; by that he meant everything it was possible to do in the factory should be done there so that the resulting product would be, so to speak, a form of cable which only required to be nailed to the wall. They had been promised 100,000 houses before the end of the year (500,000 were needed), and he emphasised the importance of wiring the houses immediately; if that was not done at once they would probably have to wait ten years before they could get them all wired. They should not wait to ascertain whether the tenants intended to use electricity before putting in the installations; if tenants found the houses already wired it was an easy matter to induce them to become consumers of electricity; moreover, if the houses were not wired for electric lighting they would certainly be piped for gas. In this connection the actual cost of the installation was not of much account. It was the difference between the cost of wiring for electricity and that of piping for gas with which they were really concerned. The wiring of artisan dwellings would result in benefit to all concerned; every branch of the electrical industry would stand to gain much both from the monetary and business points of view. It was his opinion that the rent-paying capacity of the present-day artisan had not been fully appreciated, if really good houses were provided tenants would be prepared to pay good rents for them. They should at least make an attempt to find some means of educating the public to the benefits to be derived from the use of electricity in the home. However, the first thing to be done was to get the houses wired, and when that was done he was confident that an increasing use of electricity, not only for lighting, but also in connection with all forms of labour-saving devices, would follow as a matter of course.

Mr. G. Scott Ram, in opening the discussion on the Earthing Sub-committee's report, explained how the committee came to be appointed. In the course of inspecting factories in different parts of the country he had been struck by the large number of earth wires installed (many of which had fused) that were very much too small to carry the current they were intended to do. It appeared to him that the sizes of earth wires had not been considered from a scientific point of view, and he accordingly wrote to the Institution on March 12th, 1918, pointing out the facts, and suggesting that an inquiry should be made. The Committee had subsequently confirmed a number of observations that he had made in the letter referred to. After enumerating the chief recommendations of the Committee, the speaker said that most of the credit was due to Mr. G. H. Nisbett, who had carried out all the hard work connected with the inquiry.

Mr. H. H. Berry agreed that some form of cleat wiring was necessary if small houses were to be wired cheaply. He would encourage members to write to the Institution Wiring Rules Committee about the subject under discussion; the Committee was always ready to consider suggestions that were likely to be of help. He believed that some of the wiring rules were not observed because they called for plant which was not forthcoming, some did not exist, and it was only with the assistance of others that the committee could successfully overcome such difficulties. He called attention to a lamp adapter which was very useful in preventing the illegitimate use of electricity for such devices as heating and cooking apparatus where the fixed price system of charging was in force. This adapter allowed only certain devices to be used and no others. The double installation cost of a separate lighting and heating installation was undoubtedly a very great disadvantage. He had considered the problem carefully, and had come to the conclusion that the installation of electricity in artisan dwellings was within their economic reach to-day. His system was to use one primary source of heat to heat the water supply of the house, both for washing and heating purposes, and by the aid of radiators and "magicoal" fires the "topping up" of the room temperature could be done electrically. With regard to the fixed-price system of charging for a hot-water supply leading to its extravagant use, there was now a device on the market designed to check any such extravagant use.

Mr. J. Frith thought that the metering problem could be entirely solved by the maximum demand system of charging for energy used. Referring to earthing, he thought it essential to consider the question of earth wires together with that of fuses. An earth wire must first carry the current which would blow the fuse or trip the circuit breaker, and secondly, it must serve as a preventative against shock. He agreed that tin was the only suitable metal that met the required conditions for fuses, and considered it desirable that the earthing rules should apply to all apparatus, irrespective of the pressure used.

Mr. W. R. Rawlings did not agree that some form of cleat wiring was necessary; any such system would cause endless trouble, as the wire was extremely liable to be damaged or even pulled down entirely, especially in artisans' dwellings. He considered that any form of wiring that allowed an air space between the wall and the wire was not to be encouraged. There was no reference in the paper to metal-covered wire such as the Henley, Stannos, &c., systems, neither was there any reference to the fixed price system of charging. The latter system would, in his opinion, solve many of their present troubles. After explaining the method, and that it was only suitable for alternating current, he remarked that four to six lights would be all that would be necessary in the proposed artisan dwellings. He agreed with Mr. Beauchamp that it was essential to introduce electric lighting at all costs into the houses now being built, and he was confident that such introduction would bring with it much work for both the contractor and supplier. The cost of separate installations for lighting and heating was altogether prohibitive. The Earthing Sub-committee deserved credit for the information given in its report; such information was difficult to obtain in the usual way, and was not given in text books. It had shown that the wiring rules were not what they should be, and he thought they were deeply indebted to the committee for bringing the points home. The proposition to reduce the capacity of fuses to an overload of 50 per cent. was not adequate, there would not be sufficient margin to allow for overload.

Mr. H. J. Cash congratulated the authors on their papers, they were very interesting, and contained much information. He admired the boldness of some of the suggestions made in connection with the wiring of artisan dwellings. He agreed that there were numerous installations in which the insulation on the neutral side was practically nil; many faults that existed were not known of, and it was interesting to hear the author state that he had not been able to find any case in which it had been observed that the occurrence of a fire was coincident with the development of a fault between the outer and neutral of the system. He agreed that they should get the houses wired at all costs, and also with the author's suggestion that they should attempt to reduce the cost of wiring rather than spend the money on propaganda. He did not think any existing method of wiring was as cheap as that suggested by the author, who did not advocate open wiring, as it appeared to have been assumed. The cleat wiring would not be exposed, it would all be under the floor, &c. He agreed that a combined switch and ceiling rose was desirable, and thought it would help to reduce the cost enormously. Such a switch need not be placed near the door, as was advocated in the paper; it should be located as near as possible to the lighting point, so as to reduce the wiring, but if desirable it could be operated by a cord so placed as to hang near the door. He did not favour running flexible wires across the ceiling, such runs were much too long and unsightly. The principal difficulty in

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* We have deleted the requirement of the present rule to the effect that the coke used must be free from sulphur.

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the problem of heating water could be solved to-day, although not on a sufficiently large scale as yet as to be generally applicable. A point that appeared to have been overlooked was a hot cupboard for airing clothes. Such a thing was essential in every house, although they were hardly ever provided, and the electrically-heated airing cupboard was an exceedingly economical device. He did not think the fixed-price lamp holder adaptor mentioned by a previous speaker would be of much utility, because any artisan of to-day was quite capable of substituting an ordinary holder.

Mr. W. Cross did not favour the author's system of partly insulated twin wire; he had known cases where there was a potential difference of 50 volts between the neutral and earth, and in his opinion some system of metal-covered wire was desirable; he was not in favour of introducing any form of cleat wiring into the type of house under consideration. A separate meter for each consumer was the most satisfactory method of charging, unless the generation costs could be considerably reduced from what they were at present. He did not think they could eliminate the coal fire altogether, but that made little difference; they should make use of central heating and endeavour to introduce more labour-saving devices. In America, where such apparatus, including electric cooking and kitchen outfits, were extensively used, the consumption worked out at about 1 unit per person per day. What they were in need of was more co-operation between builders, contractors, electricians, and all others concerned.

Mr. Retford was of the opinion that most faults occurred at the point of application of the apparatus, and not in the wiring. He thought that the 50 per cent. overload fuse was a practical impossibility; the fuse should be placed between the wire and the apparatus, and not between the switchboard and the wire, because the wire could always carry more current than the fuse. He could not agree that tin was a suitable metal for fuses, copper was much to be preferred. With regard to the sizes of earth wire, he thought that too large a number of wires was suggested.

Mr. S. Pooley was favourably disposed towards the use of cleat wiring, and said that the comparative costs and figures given in the paper were correct. He did not like the suggested partly-insulated wire, it might not always be put on the neutral side, and such thin insulation would be very liable to be damaged. He thought that more co-operation between the builder and the wiring contractor would overcome the difficulties at present encountered with cleat wiring; he favoured the method of treating a group of houses as a unit for the purpose of supply, and predicted that the hot water problem was well on the way to solution.

Mr. P. Rosling agreed that the wiring should be completed as far as possible in the factory so that it could be installed in the shortest possible time, and the work that had to be done on site should be reduced to a minimum. Some form of metal-cased double wire was to be preferred because the cost of upkeep was an item of considerable importance. He protested against the proposed discontinuance of tinned copper fuses.

Mr. G. C. Burnand did not think that cleat wiring was desirable in the class of house under consideration. The fixed price system had been adopted in a number of towns, and had worked quite satisfactorily; he had not found that the system led to wasteful use of energy, and there was no tendency to leave lamps burning unnecessarily as was supposed. The lamp holder adaptors mentioned by a previous speaker had been used with success, and he had found that they were not interfered with or removed. The fixed price system would work equally well for charging for heating and cooking as for lighting.

Mr. S. W. Melsom, referring to the Earthing Sub-committee's report, said that he had made experiments, and had found that when two earth plates were buried 15 ft. apart in what was practically running water, there was a resistance between the plates of from 60 to 70 ohms and no resistance between the plates and the coke in which they were buried, yet sufficient current would not pass between the plates to heat up the wires, as was suggested in the report. He was dubious about the wisdom of using water pipes for earthing purposes, and thought that the earth wire of each building should be connected to the earth wire of the supply system. It would be quite useless to rely on buried plates or water pipes if they were going to pass such currents as were contemplated in the report. With regard to dielectric deterioration under high temperatures, it was a very much slower process than was usually supposed; he had known cables work at a temperature of 100 deg. F. for years, and be none the worse for it.

Mr. C. A. Baker was of the opinion that the wiring installation in houses should be fire and fool proof, and it was, therefore, necessary to employ screwed tubing. His method would be to bring in a supply from the nearest point available to the centre of the house. He would then install a skeleton system of tubing before the house was completed, all such tubing to be cut, bent, and prepared as far as possible in the factory for easy erection on site. When the house was completed the wires could be drawn into the tubes, and the fittings installed to the requirements of the tenant. It was not necessary that heating and cooking apparatus should form part of the initial installation, such devices could be added by the tenant at his leisure. He had not found it necessary to place the switches near the doors; the chain switches referred to by previous speakers were well known, but not now obtainable. He had yet to find the contractor who was willing to make any difference in prices when chain switches were used. He was of the opinion that they would have to resign themselves to the use of one meter at least.

On account of the lateness of the hour, the authors reserved their replies for publication in the I.E.E. *Journal*.

ELECTRIC TRANSMISSION OF ENERGY.

At the Conference of the I.M.E.A., at Felixstowe, last year, Mr. S. L. Pearce read a paper on the subject of the relative merits of overhead lines and underground cables in connection with the supply of electricity to populous centres, of which we gave an abstract in our issue of July 4th, 1919. The paper elicited from Mr. G. V. Twiss a critical article which appeared in our issue of August 15th, 1919, and now we are enabled to publish some notes by Prof. Alfred Still (of Purdue University, Indiana, U.S.A.), obtained as the result of an interview by Mr. E. V. Pannell, the resident engineer in New York of the British Aluminium Co., Ltd.

Prof. Still said it was not his intention to discuss or criticise the figures and curves given in the paper. These were the result of much thoughtful labour on the part of a man admirably qualified to do the work. It was, however, doubtful if any foreign engineer, or any engineer who had lived many years out of England, could fail to be struck by the attitude, not only of Mr. Pearce, but also of the majority of those taking part in the discussion, regarding the transmission of energy by overhead conductors.

At the close of his paper Mr. Pearce had expressed the hope that the resulting discussion would assist in a truer appreciation of the problems of electric transmission; yet, in his reply to the discussion which his paper evoked, he seemed to regret that "unfortunately it tended to develop into a 'battle of systems.'"

Prof. Still was of opinion that if there was any question regarding the best and most economical method of transmitting electrical energy over long distances, it could not but be appropriate to discuss it, especially after Mr. Pearce had expressed himself as favouring underground cables for long-distance transmission.

It was true that distances rarely exceeding 10 to 15 miles appeared to be understood when speaking of long-distance transmission, and if such lines ran through populous districts the advantages of underground transmission might overbalance its disadvantages; but it seemed probable that, even in England, the so-called super-stations which were now under consideration might be able to transmit energy economically up to 40 or 50 miles, or even greater distances. The cost of coal had been taken at about 20s. per ton, which seemed an enormous price to pay near the pit's mouth, where the proposed super-stations would presumably be erected. With cheaper coal, the economical distance of transmission would be very greatly increased, and if the comparison were then made between overhead and underground transmission for main lines, the advantages would nearly all appear to be in favour of the former.

Both Mr. Wordingham and Mr. Burr mentioned some of the more obvious advantages of overhead transmission. Without advocating one system rather than another, Prof. Still believed that other British engineers would do well to study Continental and American practice in this connection, before deciding in favour of underground cables for *main* transmission lines. Branch lines and connecting networks were of less importance. It was true that first cost was not the all-important factor in arriving at a decision. Much had been said about reliability and continuity of service, also about the number of interruptions that the British people were likely to tolerate. It was, however, probable that they would tolerate just so many interruptions as might occur on the best designed system of transmission; it was the business of the engineer to ascertain which was likely to be the most reliable system in each particular case. Mr. Chattock seemed to think that if British engineers were prejudiced in favour of underground mains, they were rightly so prejudiced, because he believed a less reliable supply would be obtained with overhead conductors. But why be prejudiced? Why not draw conclusions from facts and data actually available from all parts of the world? If the comparison were made between overhead transmission at whatever might be the economical voltage (not necessarily the highest), and existing underground cables working at 30,000 volts (or hypothetical cables working at 60,000 volts), armoured and buried direct in the ground, Prof. Still believed that, in the matter of freedom from serious service interruption, the overhead system was preferable. He did not give his reasons in detail, but observed that the statements made by several speakers to the effect that fewer interruptions occurred on underground systems than on overhead transmissions were not supported by arguments or figures. The damp atmosphere of the British Isles, and its corrosive effect in the vicinity of manufacturing centres, had been referred to; the problem was of importance, but it was mainly an economic one. It was, however, difficult to understand why wind, ice, falling aeroplanes, and the discharge of shot guns should affect the operation of overhead lines more adversely in Great Britain than in other countries.

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Mr. Welbourn had referred to the B.O.T. regulations which, if not deliberately framed to discourage the electrical transmission of energy, had for many years retarded development. Mr. Pearce also referred to the "attitude of the G.P.O. towards E.H.T. lines." If comparisons of costs were going to be made on the basis of factors of safety which the majority of engineers in all countries (including Great Britain) considered unreasonable, then the resulting figures would hardly be fair to the overhead system; but had the time not come when the engineers as a body should decide upon what they desired in the matter of regulations by the B.O.T. and the attitude of the G.P.O., and then take whatever steps might be necessary to obtain what they wanted?

Prof. Still concluded his communication with a reference to the Thury system of continuous-current transmission. This little-understood system had much to recommend it in connection with straight long-distance transmission, especially in a country where overhead conductors were looked upon with suspicion, because it lent itself admirably to transmission by underground cables, which were not so perfectly adapted to the transmission of alternating currents, especially at the higher voltages which would probably be necessary in the near future.

NEW PATENTS APPLIED FOR, 1920.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. Sefton-Jones, O'Dell and Stephens, Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

8,388. "Electrically-operated hoists, lifts, &c." T. Dewhurst, A. Ernell, H. J. Gatley and J. Gatley. March 22nd.

8,403. "Device for testing sparking plugs or electric circuits therefor." B. J. Pitt. March 22nd.

8,420. "Magneto locking cover." L. J. Young. March 22nd.

8,421. "Apparatus for electric welding and cutting." J. A. V. Morse. March 22nd.

8,424. "Electrically-heated soldering-irons." H. N. H. Cobbold and G. F. Joseph. March 22nd.

8,428. "High-frequency alternator." O. Billieux. March 22nd. (France, November 27th, 1917.)

8,435. "Current-collecting devices for electric traction." L. Vallino. March 22nd. (Italy, March 20th, 1919.)

8,438. "Electric switches." H. C. Hodges. March 22nd.

8,440. "Electric ship propulsion systems." British Thomson-Houston Co. (General Electric Co.) March 22nd.

8,444. "Electric furnaces." Soc. Metallurgique du Fravol. March 22nd. (France, January 7th.)

8,450. "High-frequency alternator." O. Billieux. March 22nd. (France, January 24th, 1918.)

8,460. "Sparking plugs." G. E. Lemoine. March 22nd. (France, July 7th, 1919.)

8,484. "Electrical musical instruments." C. E. Hugoniot. March 22nd. (France, April 30th, 1919.)

8,488. "Magneto-electric machine." L. N. Reddie (Camillo Olivetti & Co.). March 22nd.

8,491. "Electro-medical treatment of the human body." J. Myers. March 22nd.

8,497. "Electric pocket lamps, &c." E. W., G. S., and H. E. Holland. March 23rd.

8,503. "Safety electric globe for miners' lamps." F. T. Barrow and L. A. Dayley. March 23rd.

8,507. "Means for producing hot water and distilled water from waste heat of rheostats, &c." G. C. Shankster and A. E. Smith. March 23rd.

8,518. "Terminals for electric cables." J. E. Barrows. March 23rd.

8,519. "Sparking plugs." J. E. Barrows. March 23rd.

8,526. "Electric incandescent lamps." E. Schattner. March 23rd.

8,563. "X-ray apparatus." British Thomson-Houston Co. (General Electric Co.). March 23rd.

8,579. "Electric heating apparatus." W. H. Allan and J. A. Engelbach. March 23rd.

8,587. "Voltage regulation of transformers." V. Martinetto. March 23rd. (Italy, February 21st, 1919.)

8,589. "Railway signalling apparatus." F. V. Russell, W. R. Sykes Interlocking Signal Co. and E. S. Tiddeman. March 23rd.

8,625. "Portable electric lamps." C. E. P. Gabriel. March 24th.

8,657. "Amplifying systems." Western Electric Co. March 24th. United States, March 28th, 1919.)

8,662. "Electric motors." W. S. Dennet. March 24th.

8,683. "Thermionic devices." W. A. E. Quilter. March 24th.

8,693. "Condenser systems." British Thomson-Houston Co. (General Electric Co.). March 24th.

8,694. "Means for measuring electric current." Landis & Gyr. Akt. Ges. March 24th. (Switzerland, March 25th, 1919.)

8,711. "Automatic control mechanism for electric furnaces." Scovill Manufacturing Co. March 24th. (United States, June 26th, 1918.)

8,715. "Electric fuses." V. E. Joyce and Park Royal Engineering Works. March 24th.

8,719. "Production of metals in electric furnace." G. J. Stock. March 24th.

8,755. "Electric switches, ceiling-roses, &c." A. Davis, F. R. Hudson and Davis, Hudson & Co. March 25th.

8,768. "Telephones." J. Jennings and J. Kay. March 25th.

8,769. "Ignition magnetos." E. A. Layton-Smith. March 25th.

8,778. "Magneto-electric apparatus." A. Burlat and A. Renaudin. March 25th. (France, March 26th, 1919.)

8,780. "Means for electrically lighting motor-cycles, &c." L. W. Appleton. March 25th.

8,782. "Planet gear." Landis Gyr Akt. Ges. March 25th. (Switzerland, March 25th, 1919.)

8,793. "Electric arc welding systems." C. J. Holslag. March 25th.

8,806. "Selector switches for telephones." H. J. Palmer and The Telephone Manufacturing Co. March 25th.

8,807. "Protective devices for electric circuits and apparatus." British Thomson-Houston Co. (General Electric Co.) March 25th.

8,823. "Electric fluid heating apparatus." E. Fredriksen. March 25th.

8,829. "Electric heaters." A. Terry. March 25th.

8,833. "Thermionic valve circuits for wireless telegraphy and telephony." A. K. Macrorie and G. Shearing. March 25th.

8,837. "Electric switches." L. and L. J. Norton. March 26th.

8,840. "Case for electric-lamp bulbs." J. C. N. Eastick. March 26th.

8,868. "Electric motors and dynamos." A. M. Young. March 26th.

8,878. "Electric signalling systems." Western Electric Co. March 26th. (United States, November 14th, 1914.)

8,882. "Electric switches." A. C. Smith. March 26th.

8,886. "Telephones." H. J. Palmer and The Telephone Manufacturing Co. March 26th.

8,897. "Means for controlling transmission of electrical impulses." W. R. Sykes Interlocking Signal Co. and R. W. Tarrant. March 26th.

8,914. "Alternating-current machines." Siemens-Schuckertwerke. March 26th. (United States, March 29th, 1916.)

8,918. "Protective devices for electric circuits and apparatus." British Thomson-Houston Co. (General Electric Co.). March 26th.

8,919. "Electric, &c., locomotives." British Thomson-Houston Co. and F. W. Carter. March 26th.

8,923. "Apparatus for manufacture of copper cable tubes, &c., by electro-deposition." S. O. Cowper-Coles. March 26th.

8,970. "Electric washing-machines." J. L. Coffield. March 26th. (United States, October 9th, 1917.)

8,988. "Transmission and distribution in alternating-current systems." A. M. Taylor. March 27th.

8,993. "Voltage-regulator and rectifier for electric circuits." J. Hetherington and J. E. Thornton. March 27th.

9,023. "Power-limiting systems." Western Electric Co. March 27th. (United States, September 3rd, 1915.)

9,030. "Automatic telephone station." G. A. Long. March 27th.

9,045. "Starting mechanism for motor-vehicle engines." C. L. Breeds and H. W. F. Ireland. March 27th.

9,046. "Commutators or electric current distributors of electric ignition systems." J. H. Rusbaken. March 27th.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1918.

6,247. Electric pocket lamp with a mechanical electric generator. A. Luzy. October 15th, 1917. (120,027.)

13,870. Acoustic or compressional-wave directive signalling. R. A. Fessenden. August 16th, 1917. (139,530.)

14,239. Electro-magnetic speed-controlling device. Remy Electric Co. September 1st, 1917. (119,454.)

1919.

919. Telephone systems. H. G. Shrivell. January 13th, 1919. (139,554.)

1,635. Electric fittings. J. Y. Fletcher and C. W. Saunders. July 2nd, 1919. (139,557.)

1,753. Telephone systems. B. S. Cohen. January 23rd, 1919. (139,560.)

1,848. Electric lamps or torches for carrying in the pocket. H. Rottenburg. January 24th, 1919. (139,563.)

1,905. Guard chambers for holding electric heating elements. J. Nolan. January 25th, 1919. (139,564.)

3,684. Electric heating elements. R. K. Hearn. February 14th, 1919. (138,581.)

4,637. Construction of dynamo-electric machinery. D. D. Rayner. February 25th, 1919. (139,594.)

4,794. Electric ignition systems for internal-combustion engines. H. Woodgate and A. Main. February 26th, 1919. (139,598.)

5,524. Electric hand lamps. M. J. Railing. March 6th, 1919. (139,616.)

7,598. Wireless signalling systems. British Thomson-Houston Co. (General Electric Co.) March 26th, 1919. (139,640.)

8,083. Electric motor control systems. British Thomson-Houston Co. and A. A. Pollock. March 31st, 1919. (139,647.)

8,550. Electric storage batteries. P. D. Ivey and A. J. Salisbury. April 4th, 1919. (139,652.)

9,297. Time-limit overload electric relays. R. Brooks and Metropolitan-Vickers Electrical Co. April 11th, 1919. (139,660.)

10,393. Device for instructional and other purposes for demonstrating the difference between the true pole and the magnetic pole and for like purposes. E. K. Brown. April 26th, 1919. (139,676.)

10,737. Means for supporting the shade of an electric incandescent lamp. L. G. Flory. April 30th, 1919. (139,679.)

12,955. Electrical condensers. E. A. Bayles, H. Higham and British Insulated & Helsby Cables, Ltd. May 23rd, 1919. (139,694.)

13,015. Electric-welding electrodes. British Thomson-Houston Co. (General Electric Co.) May 23rd, 1919. (139,695.)

13,152. Semi-automatic telephone systems. Siemens Bros. & Co. and T. Pettigrew. May 26th, 1919. (139,696.)

13,738. Automatic or semi-automatic telephone systems. Automatic Telephone Manufacturing Co. (Automatic Electric Co.). May 30th, 1919. (139,701.)

14,782. Means for preventing the manipulation of electric motor-vehicles. H. Crochat. June 11th, 1919. (139,710.)

18,305. Dynamo-electric machines. J. W. Burleigh. July 23rd, 1919. (Addition to 116,481.) (139,718.)

21,219. Casings for electric storage batteries. M. Arosio. August 28th, 1918. (131,917.)

22,068. Electrodes for electric furnaces. Norske Aktieselskab for Elektrokemisk Industri-Hypotekbank. January 17th, 1919. (137,811.)

26,356. High-frequency alternators. E. F. W. Alexanderson and S. P. Nixdorff. December 6th, 1918. (136,147.)

28,880. Wireless signalling systems. J. H. Rogers. January 10th, 1919. (137,511.)

32,713. Rotors of electrical machines. Maschinenfabrik Oerlikon. January 30th, 1919. (138,320.)

Royal Warrant.—Messrs. C. A. Vandervell & Co., Ltd., of Acton, the well-known electrical engineers, have been granted the Warrant of Appointment as manufacturers of electrical equipment for motor cars to His Majesty the King with authority to use the Royal Arms.

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THE

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VOL. LXXXVI. APRIL 16, 1920. No. 2,212.

ELECTRICAL REVIEW.

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THE WORK OF THE TRADE COMMISSIONER.

As we have on several occasions expressed here our conviction that the Trade Commissioners who, as representatives of the British Government, are stationed at important outposts listening for overseas trade information, will be able to render invaluable assistance, it will be as well if we refer to the functions of these gentlemen as they are set out in the official "letter of appointment" which they receive upon proceeding to take up their duties. We do this in order that manufacturers and traders who intend to avail themselves of such assistance should know at what point in their operations they may reasonably ask for it.

First, the Commissioner is instructed to give reasonable help to British traders *who seek his services*. It is not unreasonable to assume that those who don't ask, don't want. There is plenty of experience to prove that such a branch of public service may become more valuable if it be given an opportunity of demonstrating and adding to its usefulness. Nothing is so discouraging as want of appreciation, and we hope that the electrical and allied trades will not fail to avail themselves of efforts made on their behalf, both by these Commissioners and by the Department of Overseas Trade under which they work.

The second instruction to the Commissioners is to report upon Tariff Laws and Customs regulations and legislative proposals of interest relating to the sphere in which they operate. As times goes on, such information will become increasingly important in connection with the building up of a large export trade. Certainly not the least essential of the outlined duties is covered in part of the third instruction which is "to watch the imports . . . furnish reports on the best methods of meeting foreign competition." We need all the expert observers—whether officials of the D.O.T. or of trade associations—who can keep the Government and the traders fully informed respecting the methods, new and old, wise and otherwise, honest and dishonest, that are employed by foreign competitors, of whatever nationality, to undermine our commercial influence or defeat our legitimate aspirations. There is a danger that while trade is very active the foreign penetration methods that have been revealed to the general public during the past five or six years will be forgotten or lightly regarded. Because Germany is suffering from industrial indisposition at present we must not imagine that her schemers are asleep or have abandoned pre-war economic aims and intentions. It will be useful if capable Government Commissioners can keep their ears wide open for all movement of this kind and dispatch immediate intimation for publication here. We are not forgetting that in pre-war days readers of this journal were kept informed continuously respecting the operations of Continental electrical export traders. Our firms could not complain of want of knowledge then—somebody failed to take appropriate action to counteract the influences that were at work. We are differently placed to-day, and private trading organisations, as well as Trade Commissioners, will probably be alert for news and prepared for action. Let us hope also that if the Commissioner shows that Government action is necessary the State will not leave private action unsupported. The Commissioners through being in touch with British traders in their sphere of influence, will be able to pass on the views of these commercial men regarding the best methods to be employed to meet foreign competition.

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The fourth function of the Trade Commissioner's Office is to forward early information as to contracts open or in prospect, probable extensions of public works, and the opening of new industries. Already the D.O.T. is performing useful service in this way, but it can, and we believe will, do a great deal more, using the channels afforded by the Press to secure publicity among all British traders interested. Needless to remark, telegraphic means should be employed in order to avoid the waste of valuable time in the transmission of information which can only be of service if it is received in good time.

There are many other functions of the Commissioner, such as the preparation of reports on trade conditions, available supplies of raw material, labour and economic conditions, and last, but by no means least, the furnishing of details as to the cost of living. In this last matter there is not likely to be stability for a long time to come, but many men will be going abroad to take up technical and trading situations during the next few years, and the possession of tolerably reliable information respecting local conditions, including the cost of living, is very necessary when they are fixing up the terms of their engagement.

Electrical Development.

"During the war, the Society for Electrical Development was obliged to restrict its activities, although it continued throughout to do all its curtailed budget permitted, and carried on sufficiently to justify the subscriptions of those members who supported it. During the past three months so many of the big companies have resumed their membership . . . that the funds available for the Society's work are over 50 per cent. greater than at the time of the November meeting of the board of directors.

"Greater activities will be undertaken as justified by the increased revenue, and it is now desired to line up the entire industry in support of the very important work being carried on and contemplated. This work has for its main feature the education of the public to an appreciation of the uses of electricity for domestic and power purposes. No other organisation is equipped to render this important service, the value of the continuation of which is far greater than the cost to the industry."

We quote from a circular recently issued by the Society which has done such wonderful work in the United States, and we wish to emphasise the fact that after all the years that it has been engaged in educating the public "to an appreciation of the uses of electricity for domestic and power purposes," it still finds abundant scope for its lively propaganda, and, far from relaxing its efforts, is embarking upon a still broader programme of activity.

If this is the case in a country where, for various reasons, the popular use of electricity has been developed far beyond the stage attained in any other, what are we to say of this country, which has only recently awakened to the possibilities and advantages of the electrical way of doing things? We believe that here we have only scratched the surface of what is practically a virgin field; the prospects before the electrical industry are of the rosiest hue—provided the field is tilled with skill and energy. To carry out that purpose the British Electrical Development Association was formed less than two years ago, and under the guidance of Mr. J. W. Beauchamp it has already made its influence felt in many directions—but, as in all such cases, its capabilities are in strict proportion to the funds at its disposal. We therefore urge our readers to take their cue from the American Society, and to provide ample ammunition for the use of E.D.A.

U.S.A. Transport Problems.

The *Electric Railway Journal* for February 21st, 1920, prints a piece of publicity literature issued on behalf of the motor-'bus interest, and entitled: "The Street Car Trust Co." It is urged on behalf of the 'bus that it means faster service, since the failure of one vehicle does not mean holding up all the others that are behind it; while the stopping-places can vary, so that one 'bus can load up at one street-corner, and the next can pass it and load up at another convenient spot.

It seems recently to have been discovered by those responsible for the regulation of the traffic in London, that it is desirable to have fixed stopping-places for 'buses as well as for tramcars. This fact, as well as several others facilitating the navigation of the streets, had been recognised in Berlin long ago. The convenience of optional stops is largely a theoretical consideration, and in actual practice it is apt to be discounted by the Nelsonian tactics of the driver, who will invariably pass those who seem unable to help themselves, and will endeavour to avoid stopping to pick up the more self-assertive.

The reprint also claims cheaper operation for the motor-'bus, and on this point our contemporary has some very pertinent observations to make. "Even in places where they fit, 'buses cannot make any profit on a 5-cent fare, except on a very short haul. Even at a 10-cent fare the margin of profit is not what would induce a stampede of would-be investors. Nor do any of these estimates of cost take into account that in some future day the municipalities are going to get tired of paving streets for the benefit of a private 'bus corporation."

We have before expressed the opinion that the whole system of flat fares is wrong, and that our British standard method of differentiated fares (called in America the "zone" system) is right; and we believe that trans-Atlantic street-traffic operating companies will never get out of the morass that their technical Press shows them to be in until a general change in their fare system is brought about. But, as we have also pointed out, it is entirely unfair to saddle a tramway with the upkeep of the whole of the roadway between the tracks—which it does not use, since the cars run on the rails—while the 'buses get off scot-free.

Bath-room Dangers.

The tragic fate of a woman who used an electric hair-drier in the bath, which we recently reported, serves to emphasise the importance of circumspection in the choice of electrical equipment for the bath-room, which is the subject of current correspondence in our columns. It is the proud and justified boast of electricity that it is by far the safest illuminant with regard to fire and life, and the conditions which usually obtain in dwelling-houses are fortunately such as to render the possibility of a fatal, or even an alarming, shock exceedingly remote: it would be difficult to collect the records of as many as five fatalities in private houses in the past 20 years.

The bath, however, is the one spot in the household where the conditions are highly favourable to shock, and it is impossible to exercise too much care in the selection and installation of electrical apparatus in the bath-room; the water in the bath is always well earthed by the drain pipe, and often by the water-supply pipes, and the occupant of the bath is ideally situated to receive a fatal shock if contact is made with a faulty metal switch-cover or an electrical appliance which is in contact with the circuit.

In the case at St. Anne's, it was indeed doubtful whether electricity had played any part in the tragedy; the victim was known to be liable to fainting fits, there was no evidence that she received a shock at all, and the verdict was death by drowning; but the fact remains that she had been using an electrical device, which was found lying in the water. In our issues of February 18th, 1916, and September 5th, 1919, we recorded cases in which there was no question that the cause of death was electric shock in the bath, and on February 25th, 1916, we drew attention to the dangers of experiments in the bathroom. By using suitable fittings, keeping all switches, &c., out of reach from the bath, and warning householders not to use electrical devices in the bath, the risks can be practically eliminated.

Electricity Supply.

As we go to press, we learn that the promised—or threatened—Bill to provide the District Boards and Electricity Commissioners with compulsory powers, which were dropped in the House of Lords last year, has been introduced into the House of Commons by Sir Eric Geddes. There is no doubt that the measure will meet with fierce opposition.

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THE NEW BAKERLOO ROLLING STOCK.

That new rolling stock for the London Underground Electric Railways has been on order for some considerable time is a well-known fact, and the various reasons that have prevented delivery need no elaboration. It will suffice to record that certain new stock has recently been put into service, and that it is hoped to receive delivery of more in the near future.

Not long ago we were privileged to inspect some new London and North-Western and London Electric Railway joint stock, of which details and illustrations are given below. One of these new trains was put into service on the Elephant and Castle-Watford line of the Bakerloo Railway shortly before Easter. A second train is now also completed, and it is anticipated that others will be ready for running at frequent intervals until 10 complete trains are in operation.

The trains in question were designed and ordered in 1914, but, owing to the war and subsequent labour troubles, delivery from the makers, the Metropolitan Carriage, Wagon, and Finance Co., Ltd., of Birmingham, is only now being made. This fact accounts for the retention in the trains under discussion of certain features in the electrical equipment which it has been decided to dispense with in subsequent designs of new stock. We refer more particularly to the control gear, a new type of which, we understand, has been in experimental use for some time past, and has shown promising results.

We were recently afforded an opportunity of travelling on one of these trains during trial runs, the object of which was to heat up the electrical equipment prior to the high-pressure tests being applied at the Ealing Common Works. Although the train with which we are concerned had never before run under its own power, a very creditable performance was made and everything worked perfectly. The train is capable of attaining a normal speed on the level of 48 miles per hour. A feature of the train is that it has three motor cars, one being central, and one at each end. This gives more even haulage and acceleration up to full

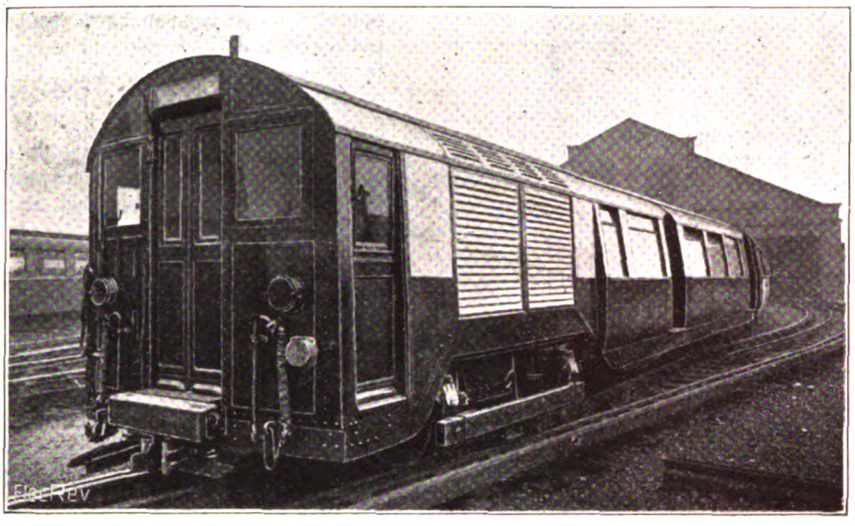

Fig. 1.—New Bakerloo Motor-car.

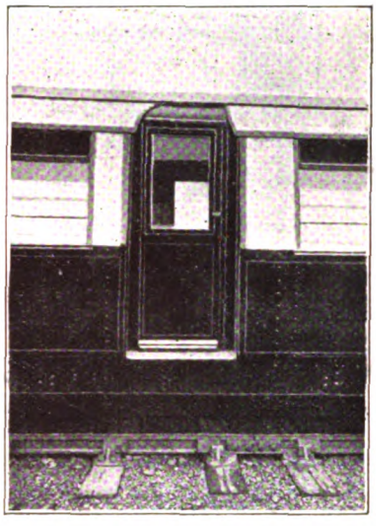

Fig. 2.—Side Door.

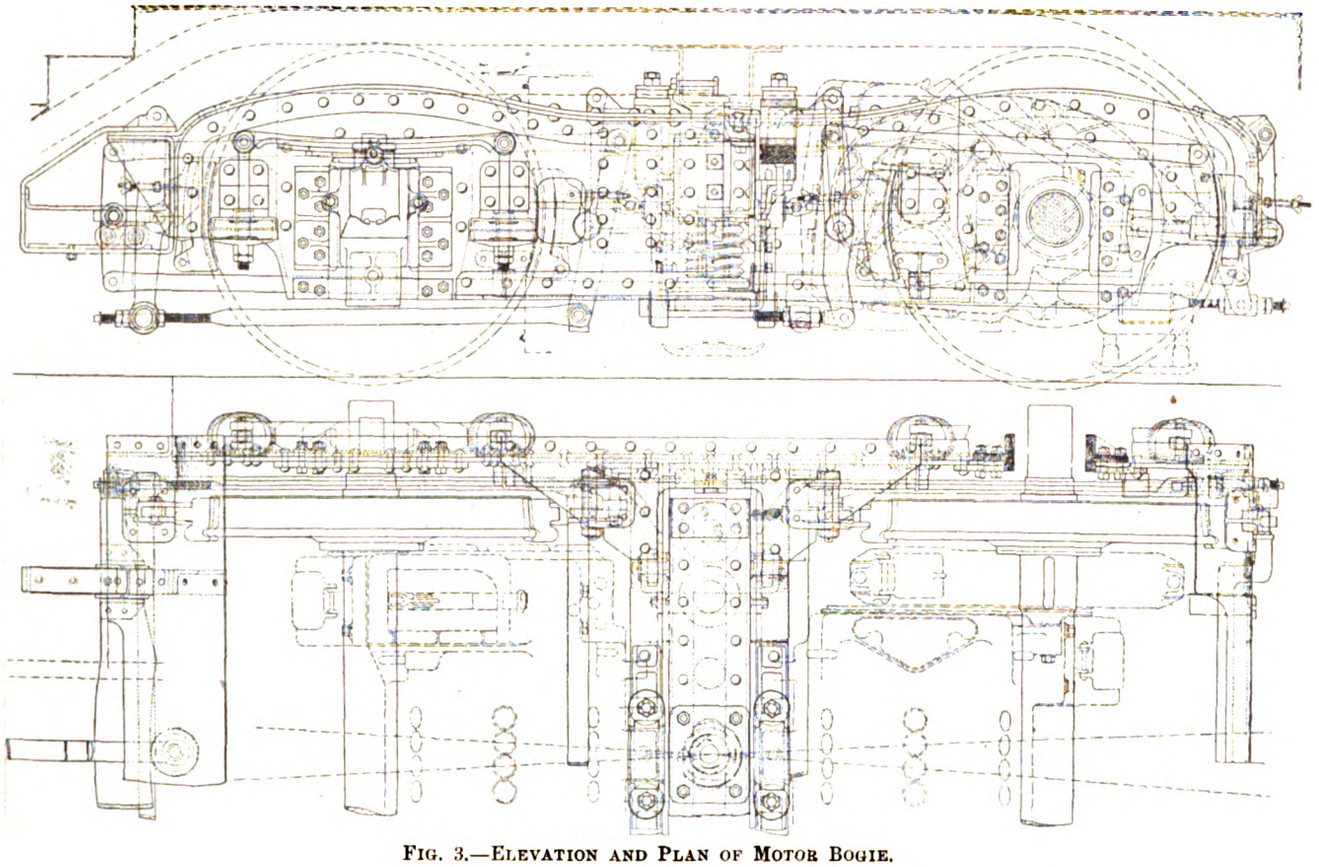

Fig. 3.—Elevation and Plan of Motor Bogie.

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speed a few moments after starting. Another improvement is the enlargement and strengthening of the buffers between coaches, so that they are made to take up all pushing strains, leaving only the pulling strain to be taken by the draw-bars; formerly the latter took up both pushing and hauling strains.

The train consists of six cars—three motor-cars, and three trailers—in place of five on the old trains; the motor and trailer trucks are built up on the angle-iron and plate

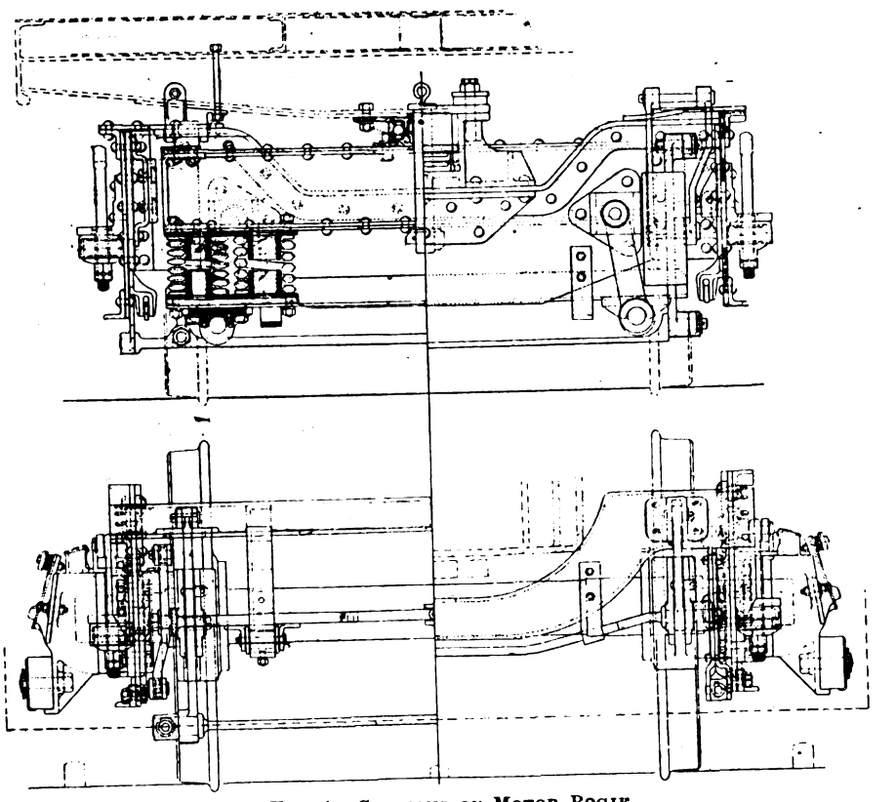

Fig. 4.—Sections of Motor Bogie.
Above: Section through Bolster, and at A B, fig. 3; below: Inner and Outer Headstocks.

principle, with laminated side and coil bolster springs. The general arrangement of the motor-car and truck is shown in figs. 1, 3, and 4, while a view of the trailer-car is given in fig. 5. The cars are constructed throughout of steel, with a minimum of wood interior finish. The leading dimensions are as follows:—Length over all, 50 ft. 10 in.; width over body, 8 ft. 8 in.; total height from rail, 9 ft. 5·25 in.; centres of bogies, 34 ft.; wheel base of motor bogie, 7 ft.; and wheel base of trailer bogie, 6 ft. The diameter of the motor wheels has been increased by 6 in. to 42 in., and that of the trailing wheels by 2 in. to 32 in. The total weight of a six-car train when unloaded is 161 tons 2 cwt.

The air compressor is of the C.P. 30-A type, manufactured by the British Thomson-Houston Co., Ltd., and the brake equipment is of the Westinghouse pattern with quick-acting triple valves. The brake blocks are of unchilled cast-iron, and the brake rigging on the trucks is of the clasp type. It is noteworthy that this is the first rolling stock on the London Underground railways that is fitted with double brake blocks.

Each car has a vestibule, and to facilitate quick exit and entry, in addition to the end doors, each has a central door, as shown in figs. 2 and 5, which is locked by an electrical contrivance as soon as the gateman operates his levers. The locking and unlocking of the centre door is under the control of the gateman, the door itself being an ordinary swing one, checked by a standard design of door check mounted under the car floor. Embodied in the pedestal which holds the mechanism for operating the end car door, fig. 6, is a switch which controls the circuits governing the electrical lock of the centre door. When the gateman opens the end car door, he automatically unlocks the middle door, and this fact is made plain by a red lamp, A fig. 6, in the pedestal supporting the end door mechanism, becoming illuminated. When the end door is again shut, it closes the circuits which lock the middle door, and a green lamp in the pedestal becomes illuminated. Should, for any reason, the end door be shut and locked before the centre door has been properly fastened, the red lamp in the pedestal will continue to burn until the door has been properly locked.

It will be noticed from figs. 2 and 5 that the car doors have been built to conform to the curvature of the roofs of the cars. This fact necessitated the use of a door that opens inwards in place of the usual sliding type, because the latter would have allowed too little head room, and would have had to be placed further back, thus leaving a large outside step. We understand, however, that a new type of sliding door is being experimented with, by the use of which it is hoped to overcome some of the difficulties referred to above.

The number of seats in each motor-car is 36, and that in each trailer car 48.

In order to provide for the difference in heights between the Bakerloo and London and North-Western stations, the floors of the cars of the new trains have been raised 4·5 in. higher than those of the old stock. Consequently, at first sight the cars appear to be cramped for space, but ample head room is provided inside the cars, and the interior has been so arranged and decorated as to make it appear as large as possible.

(To be concluded.)

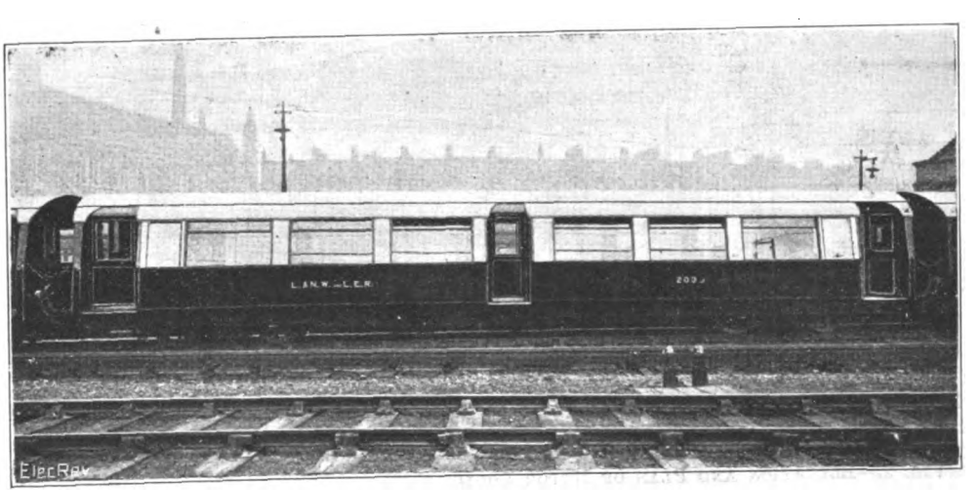

Fig. 5.—New Bakerloo Trailer Coach.

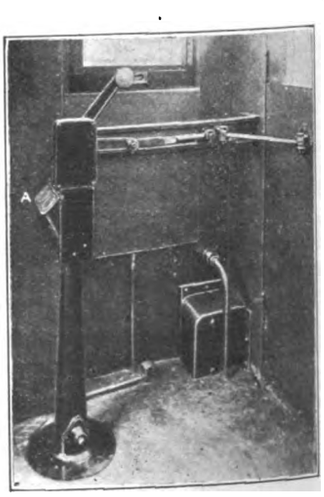

Fig. 6.—Electric Door Control Mechanism.

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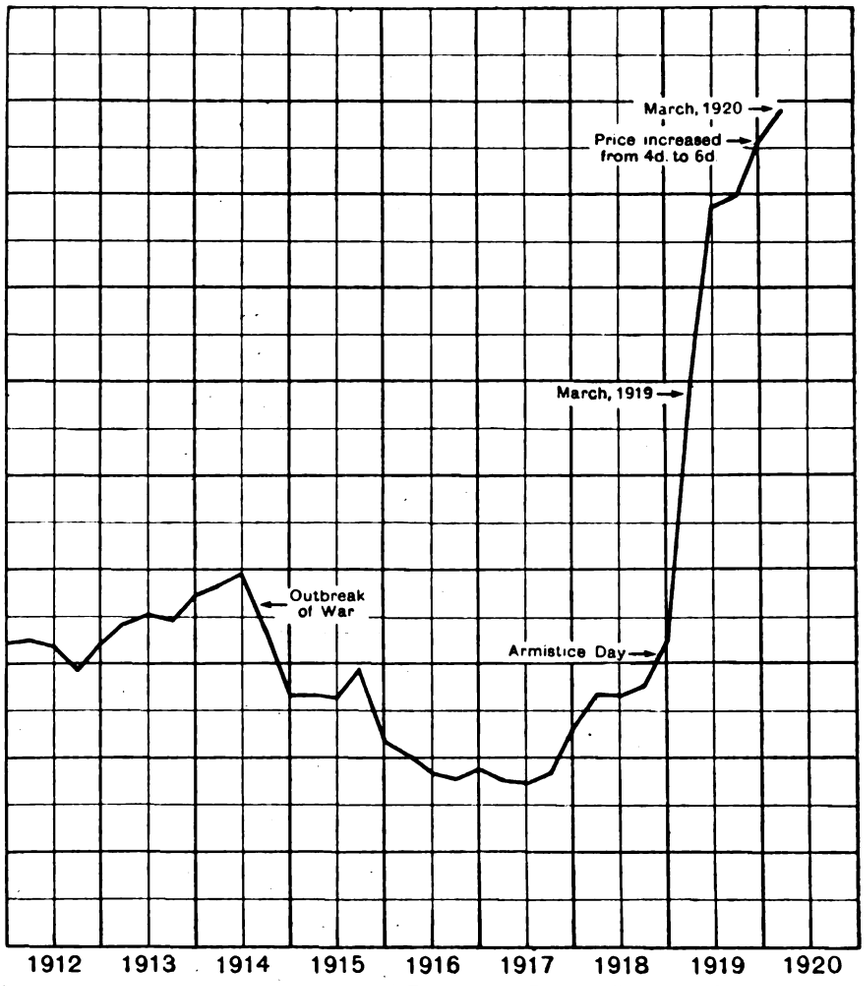
THE "ELECTRICAL REVIEW" PROGRESS CURVE.

PAID CIRCULATION ONLY.

LAST year, under the title "The ELECTRICAL REVIEW and the War," we published a curve showing how the monthly sales of the journal varied, and gave an account of our experiences during the war.* At that time the "paid circulation" of the REVIEW (the *net paid* circulation, exclusive of all exchanges, voucher copies, &c.) was increasing at a phenomenal rate, and showed signs of running off the map.

We now reproduce the diagram, covering the same period, with the addition of the past 12 months.

In this instance, for convenience, the quarterly figures are given, instead of the monthly ones, but in all other respects the data are identical, and the same base-line has been used. It will be seen that the steepness of the curve was maintained up to June, 1919, when, as always happened in the summer in pre-war days, there was a lull in the demand; in the winter, however, the curve again became steep, and the long-deferred, but unavoidable, increase in price hardly affected the slope at all, for there is always, in normal times, a slight break of line at the New Year (*cp.* 1912-13 and 1913-14). The drop during 1914-16 has been made up for 3½ times since 1917.



PROGRESS CURVE OF THE "ELECTRICAL REVIEW," 1912-1920.
The curve is drawn to scale, but the lower portion of the diagram is omitted.

* ELECTRICAL REVIEW, April 4th, 1919, p. 372.

CAPITALISTS ALL!

By H. R. TAUNTON.

(*Continued from page* 454.)

So far, indeed, we have not gone beyond a point on which most modern thinkers are agreed, in principle. But when it comes to practice, your capitalist shirks the logical conclusion, and your labour man jumps to illogical ones. Your capitalist proffers bonuses, and grudging schemes of profit-sharing—always with a limit. Sops to Cerberus! He would give a little, but not too much. He is desperately fearful lest his employé's share of the profit should be in any way comparable with his own. "So much you shall earn," he says in effect, "and if you work very hard (and increase my earnings tenfold) so much more. Not too much, of course—just a little more." Always a limit!

At the other extreme your Labour man wants nationalisation, with its attendant waste and inefficiency; socialism; communism. He would ignore money, and drive it out of the country, throwing away a useful and essential tool. For the rest, share and share alike; the muscles of the labourer, whose job could be done by a thousand others, are to be valued at the same figure as the trained and experienced brains of the manager, one in a thousand.

The capitalist would give unequal reward to equal merit; the Labour man, as unjustly, equal reward to unequal merit. The happy mean is obviously to make the reward proportionate to the merit. So obvious, so elementary! And yet so difficult to translate into workaday practice!

Let us attack the problem in the light of that one bright little maxim—reward proportionate to merit—which crystallises the whole issue between Capital and Labour. Harking back to our typical firm of dynamo manufacturers, consider the different members thereof in their new aspect of shareholders, capitalists all, whatever shape their contributions to the common stock may take. Our first task is to assess the value of their respective contributions; that is to say, the proportions in which they are to share in the profits.

Take first—first because he is most easily disposed of—the preference shareholder. His contribution is simply money. He takes no part in the use of it, for good or ill; he sits passively waiting for his dividend. He uses ordinary common sense in his original selection of an industrial investment, and he knows he is almost as sure of getting his dividend as if he had invested in a gilt-edged security. The little more risk is fully compensated for by the higher rate of interest. The directors of the company naturally fix that rate at the lowest figure which will attract the necessary money, having regard to the special factors of their particular case. We may take it, therefore, that a preference shareholder is fairly compensated for his contribution

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to the common stock of the company by the payment of the agreed rate of interest. However the company may flourish, he deserves no more, for he does nothing to help to make it flourish. In practice, of course, he gets no more; and he is the one class of shareholder who is, at present, paid strictly according to his merits.

It will be convenient, therefore, to take his remuneration as a standard by which to compare the remuneration received by, or due to, the other members of the firm. To take the concrete example of our dynamo manufacturing firm, that remuneration will be at the rate of, say, 8 per cent. per annum (which seems to be a favourite figure nowadays) on each member's capital, whether cash or its equivalent.

Dealing next with the ordinary shareholder. Like the preference holder, he contributes nothing but money. True, he may attend the general meeting, but his part there in moulding the policy of the company is negligible. He may criticise, but his criticism is rarely constructive, and still more rarely effective.

But he differs from the preference holder in this, that he takes a risk. If the company does badly, he receives a small or no dividend; and in the case of the company failing he loses a part or all of his capital. He is willing to take that risk on the chance of receiving dividends bigger than those of the preference holders, and obviously it is only common justice that he should have that chance. And, of course, without it, his contribution to the common stock would not be forthcoming.

The ordinary shareholder, then, should be remunerated for, first, the use of the money he invests. For this he should receive the standard rate received by the preference holders; *i.e.*, in the present case, 8 per cent. per annum. Secondly, he should be remunerated for the risk he is willing to take of receiving less than that standard rate. His extra remuneration under this head can be more conveniently considered later.

We now come to the directors. They are generally large shareholders, and in that capacity are entitled to the same remuneration as other shareholders. But they are also salaried employés of the firm, contributing capital other than their money—their brains and energy, their knowledge and experience—all those qualities, in a greater or less degree, which go to make the successful business man. In this respect they resemble every other paid employé in the firm; and the problem, therefore, of their due remuneration for the higher form of capital which they introduce into the common stock, is one with the general problem, the essential problem, of the fair remuneration of the employé as distinct from the shareholder.

We will leave the directors for the moment, and descend to Brown, a fitter in the engineering shop. He shall be our typical employé. Brown is a healthy young chap, steady and straight, strong, intelligent, with a certain amount of technical knowledge, and specialised skill in the use of certain tools for certain purposes. Without that skill and knowledge, without his character, his health, strength, and intelligence, he could not earn his living. They are his capital. With it he can always earn a dividend, though he start without a penny in his pocket. In which, of course, he has the advantage over the man whose only capital is money, which will never earn him a penny without the aid of his own, or someone else's brains or muscles.

Brown, therefore, blessed with this valuable capital, takes it to the best market, and gets a job in our firm of dynamo makers. He invests his capital in that firm; and he receives a dividend on it, drawing his pay, pretty accurately fixed by ruling labour conditions.

Let us say he makes an average of £200 a year. The company is paying him £200 per annum in money, the lower form of capital, for the use of the higher form of capital he has contributed to the common stock.

Now, if it be agreed that his capital is at least as valuable and essential as that introduced by the shareholders—we have in fact shown that it is more so—it is obvious that for the use of it he is entitled to remuneration at not less than the standard rate paid to the shareholders for the use of theirs. This we are assuming is 8 per cent. per annum. On this basis, therefore, it is clear that if he is worth £200 a year to the firm, the value of the capital he has invested in it, and for the use of which they pay him, is not less than £2,500.

He is a capitalist, an investor, a shareholder in the firm to that amount; quite as much so as the holder of £2,500 of 8 per cent. preference shares.

Here we can leave Brown in his unexpected glory; for what is true of him is true of every other employé. Capitalists all! All shareholders in the firm to the extent of their annual earnings capitalised at 8 per cent. The office boy at 10s. a week is a shareholder of £325; the manager at £500 per annum is another, at £6,500; and the managing director at £1,500 per annum is interested to the extent of nearly £20,000 more than the value of his ordinary shares.

(We are assuming, of course, that each is paid what he is really worth to the firm, which is not always the case. But of that more anon.)

That this is no false or exaggerated estimate of the value to the firm of its individual employés can be sufficiently proved. Suppose a firm were given the opportunity of dispensing with their managing director, making shift without any head to their organisation; and instead, using the salary they would save in paying the interest on, say, £20,000 of new capital. Would they do it? Of course not! They know full well their £1,500 a year is far better spent on the services of their managing director than in paying the interest on that amount of capital. To take the other extreme. What reasonable firm would elect to pay the interest on £300 of new capital rather than pay 10s. a week to an office boy. The inconvenience of doing without even his small services would not be worth the use of the £300. In other words, his capital value to them is at least that.

To emphasise the point, at the risk of tediousness, let us suppose the good old days of slavery returned. Would our firm of dynamo manufacturers not congratulate themselves on a good bargain if they could buy a skilled fitter for £2,500, body and soul, for the rest of his useful life, without any further payment of wages? Or an experienced manager for £6,000; or a junior clerk for £700 or £800?

Admitted then that each employé is a shareholder in the firm to the extent of at least the capital value of his services, we are confronted with the fact that by far the larger portion of the firm's working capital, and that the more important kind, is held by the employés, and not by the nominal shareholders. In different kinds of businesses the proportion varies. But a firm with a nominal capital of £250,000 may easily have a pay roll of £80,000 a year. Capitalising this at 8 per cent. we arrive at the conclusion that for every £1 of the lower form of capital, money, contributed to the undertaking by the shareholders, the employés contribute £4 worth of the higher forms of capital: enterprise, energy, experience, skill, strength, and so on.

Our firm is a prosperous firm. At the end of the year it finds itself, after payment to the preference holders, and a prudent allocation to reserve, in a position to declare a dividend of 20 per cent. on the ordinary shares. The ordinary shareholder gets, therefore, £20 for every £100 he has invested. Agreed that he is entitled to £8 for the simple use of his money, the standard rate paid to the preference holders, he is clearly receiving £12 in consideration of the slight risk he takes of receiving less than that rate.

That is his sole additional merit, his only claim for special consideration, as compared with the preference holder. But what of the merits of the employés? What of their claims?

(To be continued.)

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NOTES FROM CANADA.

(From Our Special Correspondent.)

Water Power Statistics.

The latest estimate of the total available Water Powers of this country as given in the annual statement of the Committee on Water Power of the Commission of Conservation is 18,832,000 H.P., of which Quebec has 6,000,000, Ontario 5,800,000, British Columbia 3,000,000, Manitoba 2,797,000, while the remainder is credited to other parts of this Dominion.

The estimated possible powers in populated areas amount to 9,781,400. In this section Ontario heads the list with 3,800,000, Quebec is next with 2,500,000, and British Columbia is third with 1,300,000. The total horse-power so far developed is 2,383,240, with Ontario again in the lead with 1,000,000, then Quebec with 900,000, and British Columbia with 310,000.

More than 85 per cent. of the total electric generating station capacity in Canada is derived from water power, the remainder being nearly all steam power, but even of this a considerable proportion is in the form of steam plant installed in conjunction with hydroelectric plant, and used merely for stand-by or auxiliary purposes. Forty-one per cent. of the total capacity is in plants of 100,000 H.P. or more, and 43 more is in plants ranging in size from 10,000 to 100,000 H.P.

Last year there was completed, in various parts of the Dominion, the installation of plants aggregating 64,000 H.P., and plants at present under construction total over 370,000 H.P., and other developments definitely contemplated for the near future will add some 750,000 H.P. Thus there will soon be available, within the next two or three years, over 3,000,000 H.P., or about one-third of a horse-power for each inhabitant of the country.

In Ontario and Quebec two very different methods have been developed for dealing with the water powers, but each appears to be working out well in its own area. In Ontario the Hydroelectric Power Commission of Ontario has jurisdiction over all water powers so far as future developments are concerned, and controls nearly all the existing ones; the Commission has adopted the policy of carrying out its own developments and operating them subsequently.

In Quebec, the Quebec Streams Commission is building dams, and taking all necessary steps to make water power available for use by private companies, but these latter obtain leases for the use of the water, build the necessary generating plants, and operate them.

The report, referred to above, from which these details are taken, remarks that it has recently been stated in connection with the Gouin Government reservoir on the St. Maurice River, which stores 160,000,000,000 cu. ft. of water, that the capacity of the Shawinigan and Grand Mere plants is soon to be raised from the present 330,000 H.P. to about 600,000 H.P.; this is in the Province of Quebec. In Ontario there is the Queenston-Chippawa Department of the Hydroelectric Power Commission, where 200,000 H.P. will be available in 1921, and the necessity for providing more power than this is already apparent so that the question of increasing the capacity of this great development to 1,000,000 H.P. is already under discussion; the existing station is being designed for a capacity of 450,000 H.P., to be obtained from 10 50,000 H.P. units, one being spare.

It was stated not long ago that Representative Clarence MacGregor, of New York, had made a proposal to the State Department of the United States for a new treaty to be made between the U.S. and Canada to provide for the diversion, for power purposes, of an additional 60,000 cu. ft. per second of water from the Niagara River. At present the allowable diversion is 56,000 cu. ft. per second, 36,000 for Canada and 20,000 for the U.S. Mr. MacGregor proposes that each country should have 30,000 cu. ft. more than its present allowance.

Power or Scenery?

It seems likely that before long there may be a stiff fight in regard to the amount of water that may be diverted from Niagara, between those who argue that the scenic beauty of the falls is the paramount consideration, and those who with no less emphasis declare that the demand for power is becoming so insistent that it will have to be met, scenery or no scenery. The proposal of Mr. C. P. Steinmetz, of the General Electric Co. in the U.S., that all the water that it is possible to take for power purposes should be so utilised, and that the falls should be available as a spectacle for visitors on Sundays, when the load on the generating plants would be light, although it was looked upon as a sort of joke at the time it was made a few years ago, is now being considered as a possibility of the future.

Telephone Developments.

Telephones, as most electrical men know, are used much more extensively on this continent than in England, and the shortage of materials has compelled the Bell Telephone Co., of Canada, to state, at any rate with reference to some of the larger towns, that in future only two-party lines will be installed. Under this system, of course, while each subscriber can be called separately, either can overhear the conversations of the other, so that strict privacy cannot be secured. At the same time there are many instances where neighbours are sufficiently well acquainted not to mind such conditions very much. A recent newspaper report of a meeting of the Engineering Institute of Canada, quotes one of the engineers of the Automatic Electric Co., of Rochester, New York State, as saying that his company has an order from the Bell Telephone Co., of Canada, for $25,000,000 worth of equipment, and that New York, Boston, Buffalo, Calgary, Vancouver, Winnipeg, and many other places are now using the automatic telephone.

Sir Adam Beck Back.

Sir Adam Beck, chairman of the Hydroelectric Power Commission of Ontario, is back again in Canada after a holiday of two months or so in England. He has recently stated that when the Queenston-Chippawa scheme at Niagara Falls is completed in 1921 there will be available 165,000 H.P. from three generators of 55,000 H.P. capacity each. Later, there will be nine generators altogether having an aggregate capacity of 500,000 H.P. An order for 15 15,000 K.V.A. transformers, 12,000 to 110,000 volts, has just been placed by the Commission, as well as for two more 55,000 H.P. generators, making five in all of the latter now on order.

REPORT ON THE ELECTRIC LAMP INDUSTRY.

The following reply to the Report of the Board of Trade Committee on Trusts has been received from the Electric Lamp Manufacturers' Association of Great Britain, Ltd. A copy of it has been sent to the Prime Minister. The statement is dated March 31st, 1920.

Electric Lamp Industry.

The manner in which the findings of the sub-committee appointed by the Standing Committee on Trusts in connection with electric lamps have been reported in the public Press, conveys an erroneous impression. We therefore think it desirable to call attention to certain findings of the committee which are in danger of being overlooked, and to point out some actual errors in the report.

The committee states, on page 15 of its report: "Since the beginning of the war, the price to the public of the standard vacuum lamp has been increased by about 26 per cent. As the general retail price of all necessaries has risen during the same period by 125 per cent., it follows that the price of electric lamps has been advanced much less than the price of commodities generally."

It further states: "It must be agreed that, had the price of lamps been uncontrolled by any association, or had the association so desired, a much higher retail price could easily have been obtained. We are satisfied that during some periods of the war, in view of the limitations of imports, the association had a stabilising influence on electric lamp prices in the United Kingdom."

The committee also admits that the average profits of the Association firms per standard lamp have dropped from 9.5d. in 1913 to 4.7d. in 1919.

The following table extracted from the report shows the great increase in cost of production of the four original Association firms. The prices received by manufacturers for the same years are also shown.

	1913 (pence).		1919 (pence).
Labour cost	1.9	...	4.0
Materials cost	3.6	...	9.9
Overhead factory charges	1.9	...	2.2
Selling charges	3.7	...	5.1
Total factory and selling costs ...	11.1	...	21.2
Average price received by manufacturers	20.6	...	25.9

It appears then that in spite of greatly increased costs of production our prices have only risen about one-fifth as much as the general rise of retail prices, while our rate of profit has decreased by more than 50 per cent., and this in spite of the fact that much higher prices could have been obtained.

In further amplification we append here a list of retail prices from the beginning of the metal lamp industry, showing the reductions made in the price to the consumer as and when it was found that, through some improvement or new process, the cost of production had dropped.

Standard Lamps.

	High voltage. s. d.		Low voltage. s. d.
1907	6 0	...	4 0
September, 1908 ...	4 9	...	3 6
June, 1909	4 3	...	3 0
March, 1910	4 0	...	2 9
September, 1911 ...	3 0	...	2 6
September, 1913 ...	2 8	...	2 2
April, 1917	3 0	...	2 6
December, 1917 ...	3 6	...	3 0
April, 1920	3 6	...	3 0

What, then, are the committee's charges?

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Trading Agreements.—The principal charge of the committee is that the trading discounts received by factors and retailers are considerably higher than is necessary; that by means of these discounts the Association controls factors and retailers, fixes prices at all stages, and regulates output; that the prices so fixed become the standard prices for all lamps sold in this country, and that although non-Association makers sell to the trade at a lower price than Association firms, the advantage on these low-priced lamps goes merely to the distributors who sell to the public at the standard prices.

We deal with these statements one by one.

The average discount in the lamp trade to-day is not higher than the average discount on other electrical supplies.

In the second place, the committee has seriously misrepresented the effect of our trade arrangements.

The committee suggests that every trader whose net purchases entitle him to a discount of 30 per cent. or more, must sign the factors' agreement, the particular feature of which is that the trader agrees not to sell other than Association makes.

In point of fact no trader signs this agreement, it is only signed by factors who are in effect exclusive agents for Association lamps. There is nothing unusual or harmful in an agreement with a wholesaler that he shall not sell another maker's goods; moreover, there are only 54 factors who have signed this agreement.

No other agreement is entered into which forbids the sale of non-Association makes.

With regard to the price of non-Association lamps to the public, there is nothing to prevent the trader buying non-Association lamps, should his customers desire them, and selling them cheaper than Association lamps.

Manufacturing Licences.—The second main charge against the Association is, that it has been created primarily in the interest of three large firms who have imposed onerous conditions upon other firms, *e.g.*, limitation of output in regard to licences granted under their patent rights, and stipulations that the validity of their patents should not be disputed.

It should be remembered that the Association business is mainly founded upon patent rights. The patent is a legal monopoly which is granted for reasons of public policy, and the patentee should not be attacked on the ground of this monopoly, provided that he puts it to reasonable use.

We maintain that there is nothing unreasonable in a patentee imposing upon those to whom he grants a licence, which he is not in any way bound to grant at all, conditions as to the amount which they are to produce in competition with himself, and as to the admission by them of the validity of his patent rights.

Moreover, the committee does not seem to have considered that when the Association came into existence the resources of the three patent-owning firms were sufficient to build factories big enough to meet the demand of the country, and they could ultimately have shut down all the existing lamp works, their original patents having stood the test of litigation through the House of Lords. They did nothing of the kind, but, on the contrary, licences were offered to all the existing manufacturers. This policy proves that the founders of the Association had not the desire of crippling, but rather desired to strengthen the lamp industry of the country.

The Dutch Lamps—An Unfounded Allegation.—The only remaining charge of importance is that in respect of one and a quarter million half-watt lamps, which are stated by the committee to have been purchased in Holland by three associated manufacturers at 3s. and sold to the public in 1919 at 12s. 6d. each.

It is finally stated that the "importers and distributors between them made profits amounting to £280,000 over and above what the committee considered reasonable."

This statement is *devoid of all foundation.*

The lamps referred to by the committee were not sold to the public, but to Government departments, controlled factories, shipyards, railways, and similar places where arc lamps had to be replaced, which latter could not be used owing to the scarcity of carbons and labour.

By chance, one or two per cent. might have drifted into the hands of the public, whereas 97 per cent. or 98 per cent. went to the large consumers, not at 12s. 6d., but at a price of about 8s. 3d., which is approximately the committee's recommendation.

It will thus be seen that the £280,000 alleged to have been taken in excess from the public by importers and distributors is the outcome of the imagination of some calculator who was not aware of the actual price charged to the consumer.

It was not to the interest of British makers to import Dutch lamps; their importation was part of the price to be paid for the assistance of a Dutch competing firm in building an argon plant in England during the war, the importance of which may not be apparent to the committee to-day, but was appreciated at the time by the Board of Trade, Admiralty, Ministry of Munitions, &c., argon being the rare gas used in half-watt type lamps. Owing to the absence of such plants, the scarcity of steel and building materials, &c., British manufacturers could not develop the half-watt lamp during the war, and yet there was a great demand for them for war work.

The Dutch manufacturers made it part of the terms for supplying the argon plant that the negotiating English firm should purchase Dutch argon-filled lamps.

Considerations Overlooked.—Before closing this statement we desire to make some observations of a general character.

It should be clearly borne in mind that in the lamp industry a new discovery may (as has happened in the past) necessitate complete reorganisation of plant, with accompanying tremendous financial charges. These must be provided for, and the conditions of trading must differ from those applicable to an industry which is based on a more stable technical foundation.

It is regrettable that the committee did not accept our invitation to visit a big lamp factory, which would have better illustrated to it what are the risks connected with the starting of a new industry based on patents. Without such a study, it could not appreciate what cost was borne by the pioneer firms in research, in purchase of patents, in the building and equipment of works, in experiments with machinery (which, in six years, had to be replaced three times), in the cost of training labour, the cost of unsaleable goods turned out faulty at the beginning through want of skill and experience, the cost of experts and patent litigation, all of which costs have been borne by the three patent-owning firms.

In this country the total lamp turnover of the Associated firms to-day is only £3,000,000 per annum, or, after allowing the charges of the distribution trade, an average of 1s. 9d. per head of our population.

What the firms have spent in research alone during the last eleven years is shown by the following extract from a letter which the Association addressed to the committee:—

"The total sum expended on (lamp research only) amounts approximately to £364,000; with a present annual approximate expenditure of £50,000."

The committee specifically omits these figures, and alleges that it has no means of knowing how much of the research expenditure has been devoted to lamps.

We would also draw attention to the question of foreign competition; the committee itself admits that without some form of combination the industry would not have been able to resist so successfully this competition of foreign-made lamps.

Harmful Methods.—One point more, and it is one of national importance. The committee, which seems to have been deliberately chosen for its lack of knowledge of the electrical industry (presumably in order to secure impartial judgment), held only nine sittings. In this short time it attempted to take, to consider, and to report upon evidence in minute detail upon a large and complicated subject. It can hardly be wondered that in such haste it has ignored the economic position of the industry in the national life, and the necessity of safeguarding a vital key industry to the nation.

It is suggested that this larger question should have been at least more fully recognised in making a report which will be considered by all competing lamp manufacturers in foreign markets as well as by the home consumer. Ill-considered judgments of this kind, when issued under the authority and direction of a Government department, cannot fail to have the most mischievious results.

I am, Sir,
Your obedient servant,
J. E. Edgecombe,
Director.

CORRESPONDENCE.

Letters received by us after 5 P.M. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Discounts in the Lamp Trade.

Through your journal we call the attention of electrical shopkeepers to the insidious preparation of the lamp distributors to exclude the shopkeepers from their legitimate dealings in lamps.

Taking up the *Drapers' Record*, we find the three advertisements, enclosed. No. 1 is quite in order, but the others are decidedly not, as they are solely intended to get the consumer's trade direct, and consequently the shopkeepers' profit; such advertisements should only be found in the public Press and the electrical trade papers.

Speaking to a large manufacturer of electrical plant on the subject, he frankly admitted that the electrical business was not organised; it had grown rapidly, and thus haphazard, whereas in other trades there existed a definite demarcation as to supplying consumers and those who bought to sell at a profit.

Take for instance the case of an important electrical shop adjacent to a drapery emporium; the proprietor of the former required a large quantity of casement material. He went to the emporium, as it would not have been possible for him to get it from a wholesale firm (or distributor); had he in some way, however, been able to get the material from a wholesale house and the proprietor of the emporium got wind of the fact it would have been promptly put on the agenda for the next meeting of the Drapers' Chamber of Commerce, and the offending wholesaler would be threatened with the direst consequences.

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Why not an Electrical Shopkeepers' Trade Council? The electrical shopkeeper in turn approaches the proprietor of the emporium re lamps; he is promptly informed that all lamps are bought direct (although the lamps are no part of the business, and are not to sell again). Now if lamps are to be sold to drapers direct, why not to jewellers, confectioners, chemists, &c., and, another step forward, to private houses? Doubtless the lamp distributors give a discount to the draper according to the size of their wants; this could be done equally by the electrical shopkeeper, with the proviso that the lamps must be delivered to the draper direct by the lamp distributors. This would not violate the agreements that exist with the Electric Lamp Association. Thus the shopkeepers would be properly organised and secure the profit that results from the transaction.

It is manifestly unfair that the shopkeeper should hold a stock to catch the minnows whilst the distributor takes the sprats and herrings.

An organisation should be formed to protect legitimate business, and the Electric Lamp Manufacturers' Association would appear to be the body for effective control.

Retailer.

Floating Power Stations.

My attention has been called to a letter by "Worried" under heading "The Ship as a Power Station" in your issue of December 28th, 1919.

I enclose a short paper by the writer on the same subject, and a small map showing the largest tin-producing areas in the world. It does not seem to have occurred to you when "Worried" wrote, that warships, though out of date for fighting purposes, may still contain serviceable and economical machinery, while not of use to passenger or merchant service. There is probably sufficient plant in Scapa Flow to supply all the tin mines and rubber estates in the world with power. I have proposed seriously to the Government that floating power stations be used at Port Swettenham, the Dindings, and Port Weld, and am shortly to interview the Government electrical expert who has just arrived to report on electric power and lighting for this country. Our coastal foundations (mangrove swamps) would be very bad for ordinary power stations; and another reason why power stations should float is that they could be moved about as demanded. Like "Worried" I do not know much about it, but I am an engineer, and some mining friends of mine have said that they cannot see anything against the scheme. I think the matter will be found worthy of serious consideration by those with close knowledge of naval vessels and electric power plant. Information about this country may be obtained from the Information Bureau of the Federated Malay States, London. As regards the electrical aspect of the country, Messrs. Hutchinson & Wayte have lately read a paper in London on the application of electricity to tin mines in the Federated Malay States.

C. E. Cumming.

Ipoh, Perak.
March 2nd, 1920.

[The strongest point in favour of the proposal, in this case, appears to be the swampy nature of the ground. We doubt whether the mobility of the floating station would prove advantageous, and the cost of the station cannot be ignored—old warships have a scrap value comparable with the cost of a new power station of moderate size. The idea might serve very well as an emergency measure—as, in fact, it did, during the war—but not, we think, as a permanent arrangement.—Eds. Elec. Rev.]

Radiators for Bathrooms.

With reference to "Radiator's" letter dated March 15th, which I saw on my return from abroad last week, an inspection of our glazed earthenware fires will convince "Radiator" that the heat control switches are adequately protected, inasmuch as they are sunk flush in the earthenware housing, the china switch handles being the only projection, and quite safe to operate with wet hands.

With regard to "Radiator's" suggestion that the elements should be protected so that drops of water cannot fall on the glowing wires, it would be difficult, and I might say impracticable, to make a completely effective water guard without obstructing the glowing effect of the fire; however, it is quite unnecessary in our fires, drops of water or even a fine stream of water would have little or no effect on the elements. It will be understood that the voltage difference between the turns is so small, about ½-½ a volt, that there is no risk of short-circuiting, and the fact that the elements are wound on a fireclay insulating material base which in turn is mounted upon and within a glazed earthenware casing precludes the possibility of "earths."

If "Radiator" is interested in a watertight heater for bathrooms, then our electric hot-water radiators or rather convectors, towel rails, or gown airers meet the case. See enclosed pamphlets.

The General Electric Co., Ltd.
C. C. Nobbs,
Manager of Heating & Cooking Dept.

London, E.C.
April 9th, 1920.

Tumbler (?) Switches.

We have a distinct impression, although we cannot now trace the source, that the correct name for these switches is "Tumler," being the name of an individual who possibly was the inventor of the switch motion, in spite of the fact that the word "tumbler" seems to be almost invariably used.

If you can verify that this is the case, we should like to see this common error corrected in your columns.

E. Fowler Clark.

Messrs. Rolls-Royce, Ltd., Derby.
April 10th, 1920.

[Messrs. A. P. Lundberg & Sons inform us that the movement was invented by Mr. A. B. Blackburn, of the Edison Swan Co.; it is sometimes called "Tumler," but "Tumbler" is the correct form.—Eds. Elec. Rev.]

The Tucker Microphone.

In your issue of April 2nd an article by Mr. G. E. Moore makes a reference to my microphone. The suggestion is that the invention is not new, and reference is made to microphones of Dr. Eccles and Prof. McGregor Morris. The examination of patent 13,123/16 which has recently ceased to be a secret patent, will show that there is a fundamental difference between this microphone and others previously in use, and this difference formed the basis of the Royal Commission award of £4,000.

Unfortunately, I am prevented from publishing an account of its work, as the latter is still regarded as "secret." Although, therefore, there is every prospect of the hot-wire microphone developing as a scientific instrument of extended use, it will probably continue to be considered as an interesting "gadget" hurriedly improvised to cope with very exceptional war conditions.

W. S. Tucker.

Woolwich.
April 10th, 1920.

Wages in Kinemas and in the Electrical Industry.

I was interested to note Mr. Albert J. Cutler's remarks anent my letter of the 26th ult. under above heading. I think he has an idea that I have an animus against kinema operators. This is not so. *Skilled* operators are entitled to all they can get, and personally the writer is of opinion that, in view of the fact that they are mainly responsible for the successful running of kinema shows and that the "trade" is so ostentatiously wealthy, a wage of £10 per week should not be out of the question.

Mr. Cutler's assurance that the E.T.U. insists on five years' experience as a qualification is welcome. Apparently my information was incorrect. I find that a recent agreement in respect of the London area stipulates four years as the qualifying period for a chief operator.

Your correspondent admits that there are many "handle-turners" masquerading as kinema operators. These men (and boys) are a latent menace to *bona-fide* operators, and to the safety of kinema patrons. Yet, in spite of their existence, the number of outbreaks of fire per year is ridiculously small. Surely this disproves Mr. Cutler's assertion that we must admit the possibility of fire with "the best and coolest of men"?

Mr. Cutler is inclined to question my knowledge of the kinema machine, and he wonders whether I have experienced operating-box conditions. Some years ago I held a position as chief operator-electrician, and some of my practical notes were published at the time in a trade journal. I must again insist that the design of projection equipments is so efficient as practically to preclude any chance of fire. Small wonder, as I have pointed out before (and this is apart from the wages question), that projection work does not appeal to the average electrician.

G. E. Moore.

London, N.
April 12th, 1920.

Mr. F. E. Heal is requested to send us his address.—Eds Elec. Rev.

Engineering Labour.—The Labour Correspondent of the *Financial Times* writes as follows:—"The second ballot of the 46,172 members of the Amalgamated Toolmakers' Union has given the required majority for amalgamation with the Amalgamated Society of Engineers. Of the votes recorded 28,052 were in favour of amalgamation, and 2,309 against. The surprising feature of the ballot is that nearly 16,000 members, or practically one-third of the whole, had not sufficient interest in the matter to record their vote either for or against the proposal. The nine Unions forming the Engineering Unions' Amalgamation are the Amalgamated Society of Engineers, the Machine Workers, the Smiths and Strikers, the Steam Engine Makers, the Associated Brass Workers, the Scientific Instrument Makers, the North of England Brass Workers, the London Metal Workers and the Tool Makers. The National Brass and Metal Mechanics are also going to take a ballot as to joining forces with the Engineering Amalgamation. Altogether it will be an exceedingly powerful combination."

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ELECTROLYTIC IRON.*

Despite the numerous experiments and researches made by various investigators extending over more than half a century, it is only within the last few years that the electrolytic manufacture of iron on a large scale has reached a commercially successful stage. The earlier attempts were purely of a technical nature, and mainly in the direction of the electrodeposition of iron for stereotypes from either ferrous sulphate or ferrous chloride solutions.

Seamless iron tubes, analogous to the copper cylinders manufactured by the Elmore process, were made by Cowper-Coles about 1908.

The electrolyte preferably used by Cowper-Coles, and considered to yield the best results, was a 20 per cent. solution of sulfo-cresilic acid saturated with iron.

In 1909, Franz Fischer, a Berlin chemist, succeeded in producing considerable quantities of electrolytic iron with highly concentrated solutions of iron chloride and calcium chloride, working at a temperature of 110° C., and with a current density of 20 amperes per square decimetre. The Langheim Pfanhauser Works at Leipzig attempted the direct industrial production of sheet-iron having a thickness of 5 mm. The purity of the metal reached 99·99 per cent.; it was easy to weld, suitable for autogenous welding, and melted at 1,600° C.

But the first patents for the electrolytic manufacture of iron on a really industrial and commercial scale were taken out in 1910 by the Société "Le Fer," of Grenoble. In principle, the method used depends upon the employment of a rotating cathode and a neutral solution of ferrous salts kept in the neutral state by the circulation of the liquid on iron filings. Regular additions of a depolarising agent, such as oxide of iron, are given to the bath to eliminate as far as possible the hydrogen formed on the cathode which, if present in large quantity, would be detrimental to the iron deposited.

Very high current densities can be worked with, about 1,000 amperes per sq. metre, and a metal of excellent quality is obtained which can be at once utilised industrially. This iron successfully competes with the fine irons, and the Swedish irons so well known for their purity. The Saint-Marie and Gravigny Foundry, and the works of Bouchayer & Viallet, also produce sheet-iron and tubes in a great variety of weights and shapes in the finished state directly by electrolysis.

For the commercial production of electrolytic iron practical experience has shown that heavy current densities must be employed for the best quality product and maximum output. In general the electrolyte consists of a solution of ferrous chloride or ferrous sulphate, or a mixture of the two salts. To obtain a smooth, dense, homogeneous deposit, and one which can be utilised after simple annealing, the electrolyte should be preliminarily treated, as otherwise the bath which is greenish in colour only gives a metallic deposit of very irregular form, and having no commercial value. The electrolyte is first agitated in a small cell by simply rotating the anode for example, so as to produce an oxidising action of the air at the same time as the electrolytic action. The salts of iron being very easily oxidisable in the air, a modification of the composition of the bath ensues; iron oxychloride is formed which reacts upon the hydrogen deposited on the cathode in the form of gas bubbles, which causes the bad quality of certain deposits. When the bath ceases to froth, and has a brown colour, it is in a satisfactory electrolytic condition, and can be utilised for an industrial run.

Unless the electrolytic solution is kept in a neutral condition it is found that the iron which is deposited scales, and cannot be utilised commercially. This neutral condition is attained by keeping finely-divided iron in suspension in the bath.

For the preparation of electrolytic iron for printing blocks and electro-plating, according to Muller, low voltages and low current densities should be used. He has used both the double sulphate of iron and ammonium, and the chloride of iron for the electrolytic solutions.

It appears that the higher the current density and the more concentrated the electrolyte, the denser and more homogeneous is the iron deposited.

In order to obtain the highest purity of iron, it is essential for the anodes themselves to be as pure as possible.

According to Burgess, with an electrolyte containing 40 gm. of iron as iron sulphate, and 40 gm. of ammonium chloride per litre, the electrolytic refining of iron can be conducted without interruption. With anodes of better quality commercial iron (pure iron), the electrolytic iron reaches 99·97 per cent.

It is estimated that 1 kw.-hour would be necessary to purify 1 kg. of iron, and would cost 0·05 fr. The cost of working (labour, maintenance of the electrolyte, general expenses, &c.), does not appear to be higher than the price of energy, in consequence the refining would work out at about 100 fr. per ton. With mild steel anodes at 175 fr. per ton, electrolytic iron would thus cost approximately 275 fr. per ton, and could compete with pure Swedish iron.

According to L. Guillet, the cost of raw electrolytic iron should not exceed 200 fr. to 220 fr. per ton.

Coarse electrolytic iron in the unfinished state contains a very small proportion of impurities, such as silicon, phosphorus, sulphur, manganese, and carbon. Most samples of electrolytic iron, as it comes from manufacture, also contain certain gases, carbon monoxide, carbon dioxide, nitrogen, and above all, hydrogen. The hydrogen can be eliminated by annealing. The appearance and the physical characteristics of the iron to a great extent depend upon the percentage of hydrogen it contains. Electrolytic iron containing hydrogen is also magnetic, and on being magnetised is much stronger than ordinary magnets.

Using a cast-iron containing 2·35 per cent. carbon, 1·31 per cent. silicon, 1·07 per cent. sulphur, and 1·07 per cent. phosphorus, the electrolytic iron prepared from it only showed 0·004 per cent. carbon, 0·007 per cent. silicon, 0·006 per cent. sulphur, and 0·008 per cent. phosphorus, which indicates the degree of refinement which can be attained.

The mechanical properties of electrolytic iron, such as tensile strength, bending, elongation, hardness, &c., vary according to the method of treatment. A tensile strength of 30·9 kg. to 32·8 kg. per sq. mm. was obtained with an elongation of 40·3 to 43·1 per cent. with electrolytic tubes annealed for two hours at 900° C. in magnesia. As regards hardness, the raw electrolytic iron as it comes from the bath is hard and brittle, and gives a Brinell test of 193 (diameter of ball 10 mm., pressure 3,000 kg.); reheated at 900° C., the hardness falls to 90.

The resistivity of electrolytic iron has been the subject of various researches. L. Guillet and Porterin give 9·98 microhms per cm. cube as the average of a number of measurements made on annealed rods 12 cm. long and 5·7 mm. in diameter, after allowing a correction of 0·24 microhm per cm. cube for the arsenic and phosphorus in the iron, although in minute quantities.

Similar experiments by L. Guillet and Porterin on unannealed bars 12 cm. long, and having a section of 5·1 mm. × 6·1 mm., gave 11·92 microhms per cm. cube corrected for arsenic and phosphorus.

As shown by the curves in figs. 1 and 2, electrolytic iron has low hysteresis and high permeability. Curve A is the hysteresis

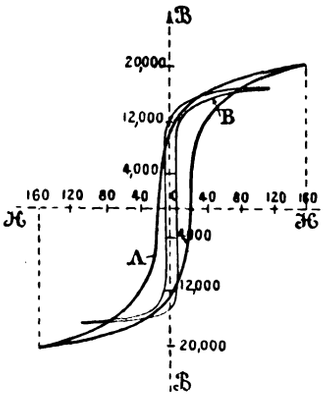

Fig. 1.

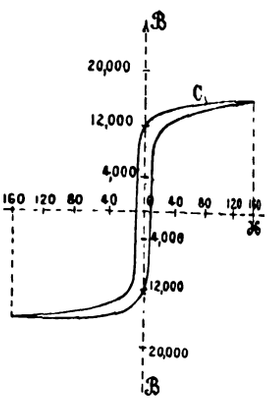

Fig. 2.

curve for the sample of electrolytic iron at ordinary temperature, and curve C is for ordinary iron. The coercive force of electrolytic iron is 20 gauss, and the remanent magnetism is about 10,800 gauss; for the ordinary iron the coercive force is 10 gauss, and the retentivity amounts to 12,000 gauss. The two samples were subjected to a temperature of 1,000° C., when curve B was obtained for the electrolytic iron sample. As the ordinary iron gave no sensible modification by the heat treatment, the corresponding curve is not shown for the sake of clearness. In the case of the electrolytic iron, the coercive force has fallen to 5 gauss, and the remanence has risen to 13,000 gauss. Under the action of heat, electrolytic iron thus approaches mild steel magnetically.

Electrolytic iron tubes are now being manufactured on a large scale, and at the works of Bouchayer & Viallet, they are being made up to 4 and 5 metres in length, 10 to 12 cm. in diameter, and from 0·1 to 6 mm. in thickness. The iron is deposited on a metal mandrel, the whole is then annealed, and immediately afterwards the tube is removed from the mandrel.

These tubes offer various advantages. It is well known that considerable difficulties are met with in the manufacture of iron tubes of uniform thickness below 6 mm., by the metallurgical processes in common use. In general, the thickness of the final product is very irregular, whereas by the electrolytic process it is uniform, whatever the diameter, thickness, and length of the tube. They are used for a number of purposes—for water pipes, steam mains, compressed air ducts, &c.—and their application has so far not given rise to adverse criticism.

Uniform iron plates are also obtained directly by electrolysis, *i.e.*, without rolling. The metal is of first-class quality, is easy to work, and can be subjected to severe strains in the cold state as in drawing plates of different sizes and thicknesses. Owing to the magnetic properties of electrolytic iron it offers advantages in the construction of transformers, dynamos, and motors. By using sheets of electrolytic iron, the weight efficiency of transformers can be increased by about 35 to 45 per cent.; in the case of alternating-current motors for the same temperature and space occupied, the capacity can be increased about 50 per cent.; and with direct-current motors and dynamos, an economy of about 16 per cent. can be effected in the weight of iron used.

As regards the use of electrolytic iron for transformer plates, it is well known that the losses tend to increase with the time of service of the transformer, and the deterioration of these plates takes place more rapidly as the temperature increases. Electrolytic iron, however, gives a good guarantee against ageing, as its crystalline structure is very stable. The same applies to ferro-silicon.

* Abstracted from a series of articles by Jean Escard, in *Le Génie Civil*, Vol. LXXV, Nos. 8, 9 and 10.

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REMINISCENCES OF A SUBMARINE CABLE PIONEER.

By ROLLO APPLEYARD.

In looking through some old papers, I recently came upon the following letter; it was written to me in 1909 by the late David Jenkins. Throughout his life he had been closely associated with the manufacture of submarine cables, and towards the end of his career nothing pleased him more than to recount the story of the early progress of his distinguished shop-mate, Willoughby Smith. As it is doubtful whether there is associated with the development of telegraphy and the cable a more noteworthy example of success won against adversity by hard and intelligent work than that afforded by Willoughby Smith, some of your readers may—after this lapse of beneficent time—care to read this letter. The history of the submarine cable itself has been admirably told by writers, from W. H. Russell to Charles Bright, but this brief note by David Jenkins adds something to the human side of the romance, and indicates how it struck a contemporary.

In the year 1851 I went to work for the Gutta Percha Co. in Wharf Road, City Road. They were making the core for the cable to connect Dover and Calais, and a very successful cable it was, the copper wire .064, covered with two coats of gutta percha to .300; coal tar naphtha was used between the coats to cause the coats to unite. The coils were sent to Wapping, where the cable was made and shipped. It was the first successful submarine cable that was made. Mr. Willoughby Smith was there working as examiner and jointer; he became one of the first electricians of the day. The manager of the works, Mr. Samuel Staton, offered a reward of £2 to the man that could make the best joint. Every man that wished could compete—the electrician was to be the judge. Mr. Willoughby Smith's joint was the best—a great many men competed. In the year 1854 there was war with Russia. The Russians sank a lot of ships before the harbour of Sebastopol to prevent the Allied Fleet from entering. Those ships the English Government wished to blow up. Accordingly divers and electricians were sent to do this. Mr. Willoughby Smith and Mr. Orchard were appointed. Mr. Smith did not like the job, but there was a young assistant electrician who wished that he had been appointed to go. I knew this young man by name as Mr. Henry. Mr. Smith and Mr. Henry approached the manager to allow them to change places, which was granted. Mr. Henry and Mr. Orchard went sometime in October in a ship called the "Prince." They arrived in due time in Balaclava Harbour. On November 5th a tremendous storm arose and wrecked 28 transport ships, among them the "Prince." Mr. Henry, Mr. Orchard, and the crew were drowned.*

Mr. Smith had gone a dozen steps up the ladder of prosperity. The G.P. Co. made a great many cables. Many were a success and many a failure. I think it was in 1856 they made the first Atlantic cable, the copper wire of .029 covered with three coats of gutta percha to ⅜ in. The cable was made partly at Greenwich by Glass & Elliott's, and partly at Birkenhead by Mr. Newall, and this was shipped in the "Niagara," the Greenwich part in the "Agamemnon." The two ships met in mid-Atlantic; the "Niagara" was to lay her cable to Newfoundland and the "Agamemnon" to Queenstown, in Ireland. They made two unsuccessful attempts; the third they laid the cable, and said that they got a message through, and then they could not get any more, so the whole thing was a complete failure. The G.P. Co. made a great many cables for land purposes, and gutta percha goods, and general work. In the year 1861 there was a slackness of work. I was stood off. I then went to work for Mr. Hancock at West Street, Smithfield, the next week—I think that would be in June. Mr. Charles Hancock was one of the first to bring gutta percha into use; his works was at Abbey Lane, West Ham. Not having enough capital to carry it on he took three gentlemen as partners—their names were Mr. Bubery, Mr. Gurney, and Bunson; this was sometime in 1846 or 1848, I cannot say the exact time. As time went on, trade increased, and they took another larger place in Wharf Road, City Road. They made all sorts of G.P. articles, and patented a great many. One of the chief patents was copper wire insulated with gutta percha. This patent Mr. C. Hancock claimed as his own, and Mr. C. Hancock disagreed with the other gentlemen of the company. They would not admit him in the works at Wharf Road. They instructed the gatekeeper not to admit him, and if he insisted, to put him out by main force. This the gatekeeper did, and in doing so he tore Mr. Hancock's coat. Mr. Hancock summoned the gatekeeper for assault, and I think they had to pay a small fine; this was the commencement of trouble between Mr. Hancock and the other partners of the company which lasted four years. I think the greatest battle was over the patent of insulating copper wire with gutta percha; in the end it was settled that both parties had a right to use it. The Wharf Road and West Ham were two separate firms ever after. The West Ham, owned by Mr. C. Hancock, was managed by Mr. Branscon, a very shrewd business man. Under Mr. Branscon the firm prospered. About the year 1855 Mr. Hancock left West Ham and leased a large premises at West Street, Smithfield, and there was some disagreement, and Mr. Branscon left. This was a bad job for Mr. Hancock, as the Wharf Road people took Mr. Branscon in at once. The premises that Mr. Hancock leased belonged to Galloways, boiler makers, who had removed to some place near Manchester. Galloways occupied about three acres of land in the city, which the Corporation wanted for street and meat market improvements; the Corporation bought Mr. Hancock out; this was some time in 1864. Mr. Hancock then amalgamated with the I.R.G.P. Co., of Silvertown. The company engaged Mr. Walter Hancock, who was a civil engineer, as manager of the gutta percha department. He was a smart man, and he laid the plans of the buildings and machinery, and completed the whole of the work in about two years, including the removal of the whole stock and machinery from West Street, to Silvertown. The engines stopped on or about December 7th, 1865. The new engines started at Silvertown on January 21st 1866. I was then transferred to Silvertown, January 1st, 1866. Some of the hands would not come to Silvertown, it being very unhealthy; it was badly drained; the people suffered from ague very much. The sanitary arrangements are much improved, the river bank has been raised to prevent overflow of the Thames at high tide. As for Silvertown, the inhabitants have increased I should say twenty fold. Silvertown in 1866 was quite country; they only had one policeman for Silvertown and North Woolwich. If you required his services, you had to go to North Woolwich to a small private house. He had a board over the door marked "police." Silvertown has improved of late, and there is still room for improvement. When Mr. Matthew Gray became manager of the I.R.G.P. works Mr. Gray and Mr. Hancock did not agree. Mr. Hancock resigned, and Mr. Gray engaged a clever mechanic from Wharf Road to fill up the vacancy—Mr. Gibson by name. He stayed about seven years, then he died. Mr. Ridley followed after Mr. Gibson. I may say that when Mr. Gray made his first submarine cable and shipped it on board the s.s. "Narver," Mr. Chatterton stopped the ship under the pretence the company had infringed his patent for the compound. That, of course, delayed the job for some time. The compound was patented by Mr. Chatterton, but it was the idea of Samuel Smith that worked at Wharf Road when I did. Samuel Smith asked Mr. Chatterton to remunerate him for the idea, but he would not. Smith lost his temper and called Mr. Chatterton a b—— rogue. Chatterton gave him the sack for his pains.

D. Jenkins.

23, Winchester Street, Silvertown.

* The "Prince" was caught in the hurricane of November 14th, 1854, *vide* "The British Expedition to the Crimea." W. H. Russell, p. 180.

Intercrystalline Brittleness of Copper.—When copper is heated in a molten bath of sodium chloride for the purpose of cleaning and softening, it has been noticed that the copper is embrittled. Under these conditions the copper is more or less in contact with iron or steel, either from a stirring rod, forceps for handling the piece, or the pot used to contain the salt, and a "galvanic couple" with the copper as cathode would be formed. According to the *Journal* of the Franklin Institute, experiments were made at the U.S. Bureau of Standards with small rods of copper and mild steel which were made either anode or cathode in a bath of molten salt and with an E.M.F. of approximately six volts. The brittleness of the copper rods was compared with untreated material by bending the specimens back and forth with one end firmly clamped. The copper rod which was an anode was as tough and soft as the original, and required practically the same number of bends to cause it to fracture. The cathode copper was found to be very brittle. Microscopic examination showed the anode copper to be perceptibly smoother on the surface than the original material; the structure was that of annealed copper. In the cathode copper rod the crystalline boundaries on the surface are well defined, and the intercrystalline boundaries for an appreciable depth within the metal are made wider. The probable explanation of embrittlement of the copper when it is made the cathode is that an appreciable amount of metallic sodium is formed by the electrolysis, which immediately alloys with the copper, the attack being selective towards the grain boundaries rather than forming an alloy layer of uniform thickness upon the outside.

Finsbury Technical College.—The Old Students' Association magazine, which ceased publication during the war, has reappeared. The chief aim of the present number is to organise the Association on new lines, and members are asked to vote for or against the adoption of new rules. A meeting to discuss this subject is being held at the College on May 4th, at 6.15 p.m. The annual conversazione is to be held at the College on the evening of April 30th; tickets, at 2s. each, are obtainable from the Conversazione Secretary, at the College. Old students can obtain a copy of the magazine by applying to the Hon. Sec., Old Students' Association, Finsbury Technical College, Leonard Street, City Road, E.C.

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BUSINESS NOTES.

Italian Companies.—The Italian Edison Co., of Milan, which has a share capital of 96,000,000 lire, reports net profits of 9,782,000 lire for 1919, and a dividend of 34 lire per share of 300 lire. The Tecnomasio Italiano Brown-Boveri, of Milan, records net profits of 994,000 lire on a share capital of 12,000,000 lire, and a dividend at the rate of 8 lire per share.

Dissolutions and Liquidations.—Speen Mechanical Repair Depôt, mechanical and electrical engineers, 283, Poulton Road, Seacombe.—Messrs. C. J. Savery and C. W. J. Bartlett have dissolved partnership. Debts will be attended to by Mr. C. J. Savery, who will continue the business.

E. & C. Gates, electrical engineers and advertising sign manufacturers, 56, London Street, Norwich.—Messrs. C. and E. C. Gates have dissolved partnership. Mr. C. Gates will attend to debts and continue the business under the same style.

Messrs. H. Slead and P. F. Senior, trading as Slead and Senior, electrical engineers, 103, King Cross, and 48, Peelon Lane, Halifax, have dissolved partnership. Mr. P. S. Senior will continue the business under the same style.

Sissons Bros. & Co., Ltd., Hull.—Meeting of creditors under the voluntary liquidation, April 16th.

Newall's Insulation Co., Ltd.—Winding up voluntarily for reconstruction purposes. Liquidator, Mr. F. S. Newall. A meeting of creditors was called for April 14th.

Wilson & Newton, wholesale stationers and dealers in electrical accessories, 65, Market Street, Manchester.—Messrs. A. E. Wilson and J. Newton have dissolved partnership. Mr. A. E. Wilson will attend to debts and continue the business under the same title.

Catalogues and Lists.—Messrs. Metrodes, Ltd., 87, Fargate, Leeds.—Circular giving prices of "Metrodes"—metal electrodes for use in electric welding.

The Enterprise Manufacturing Co., Ltd., Gun Street Electrical Works, Bishopsgate, E. 1.—Postcard illustrating the "Smoovit" electric iron. Priced.

Sturtevant Engineering Co., Ltd., 147, Queen Victoria Street, E.C. 4.—Catalogues No. 1014 (16 pp.) and 1052 (20 pp.). The first is an illustrated list of "Monogram" fans for various applications: it also includes hand-driven fans and accessories. No. 1052 deals with Sturtevant steel plate fans.

Messrs. Siemens Bros. & Co., Ltd., Palace Place Mansions, Kensington Court, W. 8.—Pamphlet A-710 (12 pp.). An illustrated list of loud-speaking telephones and accessories, including switchboards and boxes.

The Wilson-Wolf Engineering Co., Ltd., Bradford.—Card advertising "Wilson-Wolf" 1920 pattern ball-bearing motors—fractional horse-power sizes.

The Sun Electrical Co., Ltd., 118-120, Charing Cross Road, W.C. 2.—"The Essential Factor," "Le Facteur Essential," and "El Factor Esencial" (16 pp.). An interesting introduction in English, French, and Spanish to the company's general catalogue.

The Swift Electrical, Ltd., 25, Castle Street, Falcon Square, E.C. 1.—Booklet illustrating and describing the "Lotoc" electric bell, for which this company is the sole London agent.

The "Z" Electric Lamp Manufacturing Co., Ltd., Standen Road, Southfields, S.W. 18.—Leaflet giving an illustration and details of the "Z" electric vacuum cleaner.

The General Electric Co., Ltd., 67, Queen Victoria Street, E.C. 4.—Two illustrated pamphlets dealing respectively with electric hot-water radiators and electrical bath-room equipment.

The State of German Industry.—The Department of Overseas Trade is informed that many orders which were given at the Frankfort Fair held in October last, and also at the Leipzig Autumn Fair, are still unfulfilled, and there is no prospect of their being carried out at anything like the agreed-upon prices, nor can any satisfaction be obtained from the respective German manufacturers. German industry is absolutely distrusted at the present time, owing to (1) the difficulties in connection with obtaining raw materials, shortage of coal and the upward trend of production costs, and (2) the very questionable tactics which German manufacturers are showing to foreign buyers, particularly as regards the system of accepting contracts with the proviso "freibleibend," that is, that the terms are not binding.

Some 800 prospective buyers from Denmark attended the Leipzig Fair, but no contracts appear to have been made, although it is stated that the intention of these buyers was to purchase goods to the extent of 1 milliard kronen. The outlook had, however, frightened off all prospective purchasers.

Stolen Motors.—Charles Baden Powell, Arthur Reginald Mason, and Harold Frederick Harding, all of the Royal Air Force, appeared at Edinburgh Sheriff Court in connection with thefts from Turnhouse Aerodrome. They all pleaded guilty to stealing three motor engines, and Powell and Mason admitted stealing a quantity of tools and seven driving belts. An agent explained that there was a civilian caretaker in charge, and he believed there had been laxity in supervision, which had tempted the men to carry out the thefts. All accused bore a good army record. The Procurator Fiscal said the engines were worth £400, and the tools and driving belts about £60. Accused had sold the engines for £32, and the other material for £12. Sheriff Crele sentenced Powell and Mason to three months' imprisonment each, and Harding was sent to prison for two months.

Plant for Sale.—The City of London Mental Hospital, Dartford, has for disposal one 4-cylinder, 105-B.H.P. Thornycroft Diesel engine, direct coupled to 75-KW. Lancashire Dynamo Co.'s generator, &c.

Whitby Urban Council has for sale one 100-KW. Parsons turbo-generator and one 28-H.P. vertical enclosed steam engine. See our advertisement pages to-day.

Trade Announcements.—Messrs. Schneider & Cie., of Paris, have removed their London address to 30, Victoria Street, S.W. 1 ('Phone: Victoria 2919), which is also the address of their representatives for Great Britain and Colonies—Messrs. J. & P. Hill.

Mr. B. L. Myer who, as announced here, recently dissolved partnership, is now carrying on business as the Electric and Engineering Specialties Co., at 79, Great George Street, Liverpool. He holds the sole agency for Liverpool and Manchester district for several electrical firms, and he wishes to receive manufacturers' catalogues and terms.

Messrs. Rejax, Ltd., of 3 and 4, Percy Street, Tottenham Court Road, W. 1, are now making agency arrangements for all parts of the Kingdom for their "Rejax" lighting and power plants, which are being put in by numerous small hotel proprietors, householders, farmers, &c. Copies of their publicity literature will be sent on application.

Messrs. Goodenough & Co., electrical engineers, of Barnstaple, have removed from Rackfield, to larger premises at Trinity Works, Barbican.

The businesses of Messrs. C. & T. Cannon, of Burton and Aylesbury, and Messrs. W. Y. Green & Co., of 14 and 16, Walton Street, Aylesbury, have been amalgamated, and will be carried on under the style of Cannon, Green & Co., heating and lighting engineers.

Site for Works.—Particulars of a building site of about 9 acres, at Barrow-in-Furness, are given in our advertisement pages to-day.

New French Companies.—Among the new companies recently formed in France are the Société Le Moteur Electrique, of 18, Route de Cremieu, Villeurbanne, capital 1,000,000 fr.; and the Société Electrique de la Siderurgie Lorraine, 63, Avenue Victor-Emmanuel, Paris, capital 8,000,000 fr.

Agencies in Holland.—H.M. Commercial Secretary at The Hague, in a recent report, says:—"Many British firms with business relations of old standing with Holland are not represented here, but content themselves with sending a representative once or twice a year to book orders. The best comment on this is a reply actually given by a local firm to one of these travellers who was making his half-yearly round to book orders:—"Sir, the chances against my wanting something on the day of your visit are something like 180 to 1." Representation can be summarised in the following scale, arranged in order of merit:—

1. Branch office in Holland with or without stocks, according to circumstances.
2. Resident British representative.
3. Agency entrusted to British merchant firm established in Holland.
4. Agency entrusted to Dutch firm.
5. No local representation; traveller making periodical visits.

Numbers one and two are, of course, beyond the means of many firms, but the suggestion has been made that several manufacturers of cognate but non-competing articles might establish a selling agency in common on one or other of these bases.

It is considered above all important that no British firm should appoint a local agent without first sending a responsible member of the firm to examine local conditions, ascertain the type of article most in use, and make careful inquiries as to the capacity of the agent to cover the district entrusted to him and as to other and possibly competing agencies held.

The question of advertisement in Holland is one which would repay further study by experts, as the conditions, both material and psychological, are very different to those obtaining in the United Kingdom, and the opportunities are large, the art of advertisement here not having by any means reached the standard of Great Britain and America.

A Danish Cable Firm.—The report of the directors of the Dansk Kabelfabrik states that the company's efforts were directed in 1919 towards getting the factory in satisfactory operation. The difficulties in the way of the delivery of machinery and raw materials, which were chiefly purchased in America and England, were considerable; transport problems in connection with harbour strikes and lack of space at Copenhagen harbour delayed the arrival of the machinery for some months, as the latter was discharged in various ports abroad and in Denmark, and had then to be forwarded on to Copenhagen. Moreover, many of the machines arrived in an incomplete condition, and it was therefore necessary partly for the company to finish them and partly to procure some parts from foreign firms before the machines could be brought into use. Under these circumstances, it was only possible to begin rational working in the autumn, and get the production in proper progress. At the same time, the directors were successful in finding a technical director in Mr. T. C. Thomsen. It was expected that manufacturing would be considerably extended in the next few months, and the factory show remunerative activity.

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Catalogues Wanted.—Messrs. James Ord & Co., 38, Tyne Chambers, Newcastle-on-Tyne, wish to receive catalogues and other publicity matter from electrical manufacturers and dealers.

The Arc Electrical Co., Trevelyan Buildings, Corporation Street, Manchester, want manufacturers' catalogues and lists.

Railway Wagon Detention: Improvement. — The Ministry of Transport states that very gratifying results have followed the increase of the demurrage charges on railway companies' trucks which became operative on January 1st. The figures for February, which are now available, show that wagon detention has decreased by 42 per cent., as compared with December, representing a saving of over 150,000 wagon days.

The Holland Wire and Cable Works.—The report for 1919 of the directors of the N. V. Hollandsche Draad en Kabelfabriek, of Amsterdam, first recalls the fact that 10 years have now elapsed since the undertaking was established, and figures are given showing the course of the development during this period. The report proceeds to state that it was considered desirable to bring the social capital more into agreement with the actual capital by capitalising the undisclosed reserves formed in the course of years. As a consequence, the balance of the working account contained not only the results for the financial year 1919, but also the reserves in question, and the directors proposed to distribute a dividend of 50 per cent. in shares, and the remainder (18 per cent.) in cash. The results obtained in 1919 were favourable. This was due to a large extent to the fact that the company succeeded in the early months of the year in getting transported to Amsterdam the large stocks which had been awaiting shipment for some years, so that they no longer had to contend, as in previous years, with inadequate supplies of raw materials; and the export trade which thereby again became possible, yielded very favourable results. There was nothing unfavourable to set against these favourable factors, thanks to the maintenance of the principle during the war of keeping stocks on the level of peace time prices, and as a consequence the inevitable losses on war-time raw materials, in so far as they were still in stock on the termination of war conditions, were already written off beforehand. Concerning the future prospects, the report states that the company were favourably circumstanced as their principal raw materials—copper, rubber, and cotton—were all derived from countries possessing a sound currency. Thus, the influence of the low level of exchange in the case of other industrial countries was limited chiefly to wages and general expenses, which factors were of considerably less influence with the articles manufactured by the company. On the other hand, the company were placed at an advantage in the financing of raw materials precisely through the Dutch rate of exchange. After making provision for depreciation, the accounts show net profits of 2,090,282 florins, permitting of the payment of the dividends (68 per cent.) already mentioned. The balance-sheet contains, for the first time, an entry entitled "personnel obligations," amounting to 11,850 florins. It is explained that this is in accordance with an arrangement under which the staff is permitted to take up a financial interest in the company by means of profit-sharing obligations. The comparative statement showing the progress of the company indicates that the paid-up capital has increased from 120,000 florins in 1910, to 1,809,000 florins in 1919; and the dividends from 10 per cent. in 1912, to 12 per cent. in 1914, 15 per cent. in 1915, 16 per cent. in 1916, 17 per cent. in 1917, 18 per cent. in 1918, and 68 per cent. in 1919.

Auction Sales —Assets Auctions Co., Ltd., will sell by auction, at 119, Newington Causeway, S.E., on April 21st, the stock of an electrical goods factor. On April 27th to 30th, Messrs. Buckell & Ballard will offer for sale by auction, buildings, fittings, and electrical plant, at an Oxfordshire aerodrome. For full particulars see our advertisement pages to-day.

Book Notices.—*The Engineer's Year-Book for* 1920. Edited by H. R. Kempe, M.Inst.C.E., and W. H. Smith. Pp. 2584; figs. 2250. London: Crosby Lockwood & Son. Price 30s. net.—This is the twenty-seventh year of publication of a volume which may be justly described as an old friend; though long past its majority, it still keeps on growing, having now exceeded a total of 2500 pages, and the reference in the preface to the "growth in the literature" of industrialism is obviously appropriate. In the present issue, besides the revision or rewriting of many of the existing sections, we find a number of entirely new sections—the metering of water, air, gas, and steam, windmills, electric welding, acetylene, oxy-acetylene welding and cutting, &c.—while the matter has been in many respects rearranged and improved. Much attention is given to costs, and a useful buyers' guide is provided. By no means least of the valuable features of the work is the exhaustive index, and the system of cross references in the text, which enables the user to find with ease passages which bear upon the subject of research. The *Year-Book* contains an extraordinary quantity and variety of information, and that its value is appreciated by the engineering public is testified by its vigorous growth and mature years.

Willing's Press Guide, 1920. London: James Willing, Ltd. 2s.—This book continues to live up to its established reputation as a concise and comprehensive index to the Press of the United Kingdom.

Half-Past Twelve—Dinner-Hour Studies for the Odd Half Hours. By George W. Gough. London: Sells, Ltd. 1s.—This is a pamphlet consisting of 26 brief chapters, which are studies in simple economics. The author begins by asking: "What is Political Economy?" and he considers later, in simple and interesting language and style, such subjects as the production of goods, the division of labour, capital—what it is and what it does—industrial organisation, the wages of labour, wages in relation to output, the profits of the "boss," competition and combination, exchange questions, the principles of taxation, &c. We commend the studies to the attention of our readers, to whatever class of society they belong.

"Currency Reform and the Need for a Nickel Coinage on a Decimal Basis." By G. E. M. Johnson. Pp. 18. London: The Decimal Association.—"The working man will never agree to the tenpenny shilling" is the final word of the opponents of national progress in the shape of a reorganisation of our present involved currency. Major Johnson proves the "tenpenny shilling" a myth by explaining the system advocated by the Decimal Association. The adoption of the "pound-mil" scheme would mean that the present shilling would be actually worth 50 mils, or with a nickel coin of two mils face value (practically a halfpenny) the same value as at present. The prestige of the British sovereign, and its concomitant advantages, would in no way be damaged by the adoption of the "pound-mil" system, and thus another contention of the decimal system's opponents is refuted. The author deals with historical facts concerning decimal coinage, and compares the various systems suggested and in use in other countries. He also gives a table of the proposed components of the system, which means the introduction of two nickel coins of five and ten mils face value. The present bronze coins would be retained (for a time, presumably), their value being slightly depreciated.

"The Indicator Handbook." By Charles N. Pickworth, Wh.Sc. Pp. 134; figs. 156. London and Manchester: Emmott & Co. Price 7s. 6d. net.—This is a reprint in which the former two volumes are combined. The work, which has become a classic, is too well known to need any comment.

"Les Fiches Industrielles" is the name of a new publication giving abstracts of articles in technical journals of all kinds, classified in series so that the purchaser can choose the series most directly relating to his own business. The annual subscription for each series, outside France, is 34 fr., except in the cases of Series IV (metallurgy, mechanics, electricity) and Series V (chemical industries), for which it is 46 fr. It is published at 51, Rue de l'Hotel-de-Ville, Lyons, France, by the Société d'Editions Commerciales et de Publicité Moderne.

"Post Office Electrical Engineers' *Journal*." Vol. XIII. Part 1. April, 1920. London: The Electrical Review, Ltd. Price 2s. net.

"Whittaker's Electrical Engineer's Pocket-Book. Edited by R. E. Neale, B.Sc. Fourth Edition. London: Sir I. Pitman & Sons. Price 10s. 6d. net.

"The M. & C. Apprentices' Magazine." Vol. IV. No. 13 (65 pp.). Price 3d. The present number, like its predecessors, is full of interesting matter, and includes articles on "Darkest Russia," and Milan, as well as a record of the firm's social events.

"Notes on Gas and Oil Engine Accidents" (32 pp.). Manchester: The National Boiler and General Insurance Co., Ltd. Price 1s. net.—This publication deals minutely with such causes of accidents as broken crankshafts, failure of connecting-rod bolts, &c., with suggestions for their prevention.

"Vickers News." No. 13, Vol. 2 (20 pp.). London: Vickers, Ltd. The present (April) issue possesses many interesting features, including a description of some large horizontal gas engines constructed by the company, and notes by Dr. Chalmers Mitchell on the ill-fated flight from London to the Cape of Good Hope.

"Continuous-Current Machines." By S. P. Smith. London: Benn Bros., Ltd. Price 5s. net.

"The Use of Low-grade and Waste Fuels for Power Generation." By J. B. C. Kershaw. London: Constable & Co. Price 17s. net.

"I.E.C. Rules for Electrical Machinery." Vol. I. London: The International Electrotechnical Commission. Price 2s. 2d., post free.

"The Engineering Foundation: A Progress Report to United Engineering Society" (32 pp.). New York: Engineering Societies' Building.—A report upon the foundation administering the joint interests of the four leading American engineering societies, the objects of which are set forth, including the assistance of national research.

Australian Engineering Developments. — A Press dispatch from Melbourne, dated April 11th, states that four representatives of Vickers, Ltd., are inspecting the engineering works of the Commonwealth with a view to estimating the possibilities of an extension of the firm to Australia.

Social.— The staff of the Lea Recorder Co., Ltd., held their first annual dance and social at Smallman's Café, High Street, Manchester, on Saturday, 10th inst. The directors and other guests were invited, and a thoroughly enjoyable evening was spent. The programme included a dance and whist drive, the prizes for which were presented by Mrs. J. E. Lea.

Board of Trade.—Sir Robert Horne, President of the Board of Trade, has constituted his private office at the Board as follows:—Principal Private Secretary, Mr. Cecil Litchfield; Second Private Secretary, Mr. C. Patrick Duff; Third Private Secretary, Mr. E. W. Reardon; Parliamentary Private Secretary (unpaid), Mr. F. C. Thomson, M.P.

Fuel Research.—The Secretary of the Department of Scientific and Industrial Research announces that a licence has been issued by the Board of Trade to the Scottish Shale Oil Scientific and Industrial Research Association. The Association may be addressed through Mr. W. Fraser, C.B.E., Scottish Oils, Ltd., 135, Buchanan Street, Glasgow.

Copper and Lead Prices.—Messrs. F. Smith & Co. and Messrs. James & Shakespeare report, April 14th:—No change in copper quotations. Messrs. James & Shakespeare report, April 14th:—English pig lead, £42 10s., a reduction of 10s. on last week's prices.

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LIGHTING AND POWER NOTES.

Australia.—Tasmanian Hydro-Electric Scheme.—In order to meet the extensive commitments for power in March, 1921, principally for supplying the Electrolytic Zinc Co.'s big industrial enterprise at Risdon, work is in progress on every stage of the Government's scheme for increasing the power supply at the Great Lake, which is to be developed to a capacity of 70,000 H.P., at a total estimated cost of £2,500,000.

About 300 men are at work constructing a canal whereby to divert the River Ouse into the Great Lake, and arrangements are in train for installing a considerable amount of additional machinery. Preliminary work in connection with the raising of the dam wall at the Great Lake is well under way, but owing to the impossibility of getting cement, it seems unlikely that concreting can be started this season. The widening of the existing canal and the preparations for the new pipe lines are under way. Good progress is being made with the preparations for the extension of the power station.

Preliminary work in connection with the harnessing of Lake Rolleston, on the west coast of Tasmania, chiefly for supplying the Mt. Read-Rosebery Co. with power for the production of 50 tons of zinc per day from the Read-Rosebery ores, is well advanced, and as soon as the power contract between the company and the Government has been ratified, active operations for the construction of the scheme can be commenced.—*Times.*

Bolton.—Breakdown of Plant.—Owing to a mishap at the Back-o'-th'-Bank works on April 7th, the second recent failure, 75 per cent. of the plant was put out of action. Several mills were compelled to close down temporarily in consequence, and the tramway services were curtailed.

Cotton Mills.—Work has just commenced upon what is to be largest block of cotton spinning mills in the world. The works will be driven throughout by electrical power from the Corporation power station.

Bridlington.—Price Increase.—The Town Council has decided to increase the charge for electricity for power by 8⅓ per cent.; this brings the minimum charge to 2d. per unit. Cables are to be extended to supply works and other premises at a cost of £1,300.

Bristol.—Opposition Withdrawn. — The opposition threatened by Bath City Council to the Corporation Electricity Bill, over the supply of Newton St. Loe, has been withdrawn as the result of the latest negotiations.—*Western Daily Press.*

Canada.—Electricity Shortage.—Commenting upon the recent decision of the Toronto and Niagara Power Co. to increase its charges for electricity by amounts varying in value to 40 per cent., the *Electrical News*, of Toronto, states that the policy of the Hydro-Electric Power Commission was to keep prices as low as possible in order to attract customers. This policy has created a demand which the Commission cannot at present meet. Competing organisations are, therefore, able to raise their charges, which is detrimental to the general industrial condition.

Canterbury.—Cable Extension.—The Town Council has applied for a loan of £2,500 for a new feeder cable.

Coxhoe.—Street Lighting.—Messrs. Bell Bros., Ltd., colliery proprietors, have submitted their terms for supplying electricity for public lighting. The draft agreement stipulates that for a term of seven years the company will maintain 50-C.P. lamps at an annual charge of £5 each, and 32-C.P. lamps for £4 10s., from September 1st to April 30th each year. All installations will be carried out by the company.

Dartford.—Sliding Scale.—The Urban District Council has decided to increase the charge for power by '05d. per unit in respect of every 1s. per ton advance in the cost of fuel above 36s. per ton, from May 1st next.

Derby.—Electricity Scheme.—It was announced at a recent meeting of the Town Council, that the scheme for the supply of electricity in the East Midlands has been revised. The Derby station, which since its inception had repaid £200,000 of the money spent upon it, was to be retained. The expenditure upon the new scheme would be distributed, as follows:—Derby, £120,000; Loughboro', £130,000; and Leicester and Nottingham, £600,000 each.

Electricity Supply Act.—Amendments.—On April 13th Sir Eric Geddes presented a Bill for the amendment of the Electricity (Supply) Act, 1919, to the House of Commons.

Ellesmere Port.—Extension of Time-Limit.—The Ministry of Transport has granted the Urban District Council an extension of time until the end of the year for carrying out the Electric Lighting Order of 1913, with an intimation that unless some definite steps have been taken before that date to establish an effective distribution system, any further extension may not be favourably considered. The Council is advised to consider a bulk supply, as the provision of a generating station will not be allowed. The Council has adopted this course, and is taking steps in the matter.

Hove.—Electricity Supply.—The terms upon which the Brighton Corporation will give a bulk supply are considered excessive, and further representations are to be made to the Electricity Commissioners upon the question of additional plant. The Commissioners have intimated that the Town Council will have to prove that the installation of new plant at the works will be more economical than a bulk supply. The estimated cost of the necessary plant and works for the supply is £18,000.

Larne (Co. Antrim).—Power Station.—The Council has passed the plans for the erection of a generating station submitted by the Electric Power and Lighting Co. Larne is the point of departure of the Stranraer-London mail.

Leeds.—Breakdown.—Through a short circuit at one of the sub-stations of the Corporation electricity department, several works in the district were deprived of power for over an hour. The tramways having an independent supply were not affected.

Macroom (Co. Cork).—Stoppage of Works.—It has been found impossible to keep the electricity works running, owing to inadequate coal supplies, and the town is therefore without electric light.

Manchester.—Rate Aid.—The Electricity Committee reports that, having regard to its commitments under the scheme for the provision of a new generating station at Barton, it is of opinion that there should be no "rate aid" contribution from the Electricity Department until that scheme becomes revenue earning.

Paisley.—Extensions.—The Blackhall electricity works is being extended, and a new sub-station to supply industrial works and tramways is to be erected at West Croft.

Rochdale.—Increased Bulk Supply.—Owing to increasing demands for electricity, the Corporation is considering the advisability of taking a further bulk supply from the Lancashire Electric Power Co.

Rotherham.—Linking-up Scheme.—The Town Clerk submitted letters received from the electrical adviser to the Ministry of Munitions with regard to the proposed linking-up agreement for the supply of electrical energy from the Rotherham and Sheffield power stations, and stated that Sheffield had intimated to the Ministry of Munitions that power would be required from Rotherham as soon as the works for linking-up could be completed, and had inquired whether the Treasury would contribute one-third of the cost of the necessary works. The Town Clerk stated that he had been notified by the electrical adviser to the Ministry of Munitions that if Rotherham would waive any possible claims it might have against the Ministry under existing agreements, the application made by the Sheffield Corporation would again be submitted to the Treasury. The Town Clerk reported that he had intimated in reply that he did not consider the Rotherham Corporation would be prepared to waive any of its claims under existing agreements.

St. Helens.—Extensions.—The Electricity Committee has decided to grant several applications for power, and, to meet increased demands, to install an additional E.H.T. cable to the Burtonhead Road sub-station, and to provide a switchgear cubicle and controller panel for the power station, at an estimated cost of £5,430; also an additional E.H.T. feeder to the Sherdley Road sub-station, at a cost of £3,180; one additional E.H.T. feeder to Sutton Road sub-station, at a cost of £1,430, and additional transformers and switchgear at Victors. Ltd., sub-station, at £3,265.

On the recommendation of the electrical engineer, in view of the increased load in the Pocket Nook area, the Committee has also resolved to erect a new rotary sub-station near the L. & N.W. Railway Station, at a cost of £12,000.

Southampton.—Strike.—In consequence of the decision of the recently-promoted superintendent to resign his membership of the E.T.U. and join the E.P.E.A., the employés at the electricity works ceased work on April 13th. The shipyards and many factories had to be closed, and the tramway services were suspended. The chief engineer and a small voluntary staff maintained a supply sufficient for street and hospital lighting.

Ulverston.—Electricity Supply.—The District Council has passed a resolution advocating the institution of an adequate supply of electricity for the Furness and South Cumberland area, extending from the River Usk, in Cumberland, to the whole of the area of Ulverston. It was stated that the project was necessary for the future development and general welfare of the district.

United States.—Inadequate Water Power.—The *Journal of Electricity* states that, as a result of the exceptionally dry winter, many power companies in California have had to fall back upon their auxiliary steam plant to keep up their normal output. Under the usual conditions, only a quarter of the electrical power is produced by this means, but now the steam plants are providing half the total energy generated.

Walthamstow.—Bulk Supply. — The Council has arranged to give a bulk supply of electricity to the Leyton Council.

Watford.—Extensions.—The Urban District Council has received authority from the Electricity Commissioners to proceed with the expenditure of £18,420 upon extensions.

Worcester.—Rate Relief.—It is announced that the Electricity Committee is contributing £1,800, profit from the electricity undertaking, towards the local rates.

York.—Proposed Extensions.—The Council is considering extensions to the generating plant at the Foss Islands power station. These are expected to cost £55,800, and buildings £13,000.

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TRAMWAY AND RAILWAY NOTES.

Bradford.—Concession to Employes.—The City Council has decided to give its tramway employés an immediate increase of 10s. per week.

Burnley.—Sunday Working.—As the position of the Corporation with regard to coal supplies has improved, it has been decided to resume the running of tramcars on Sundays.

Continental.—Belgium.—*The Times* correspondent at Brussels announces that the terms under which the tramway strike was settled were a minimum wage of 12 fr. 5 c., as from March 11th, to be increased to 13 fr. 50 c. as soon as results permit. Fares are to be raised another 5 centimes as from April 15th.

Germany.—Addressing the shareholders at the recent meeting of the Berlin Elevated and Underground Railway Co., the chairman stated that as compared with the pre-war period, wages were seven times greater, coal 17 times more, and rails 22 times higher, &c. The fares which came into operation on April 1st were four times higher on the average, and it was impossible to foresee when the upward movement in wages and materials and the consequent advance in passenger fares would come to an end. A new labour agitation for further increases in wages had just been started by the Berlin transport workmen, whilst materials could only be obtained after a long delay and at still increasing prices. After a period of transition, the passengers, as a rule, had accommodated themselves to the higher fares, and a heavy decline in the traffic had not taken place, but a time would arrive when the growth in fares would exceed the paying capacity of a large number of the passengers.

Huddersfield.—Strike Losses.—The loss of revenue due to the strike of tramway employés is estimated at £4,000. No settlement has at present been arrived at.

Liverpool.—Annual Report.—The annual report for the year 1919 records the purchase of the Prescot Light Railway and several improvements. The total revenue for the year was £1,207,228, and working costs (including rental of leased lines) £1,029,443, leaving a gross profit of £177,785. This was apportioned as follows:—Interest, £49,974; sinking fund and repayment of loans, £52,326; and to reserve, renewal and depreciation account, £75,485. The total number of passengers carried was 208,251,496, an increase of 13,168,887 upon the previous year, and the average earnings per car-mile increased from 18·91d. to 21·46d., although the net profit fell from £169,322 to £75,485.

London.—Fare Concessions.—As from April 19th, passengers on the London County Council tramways who are not obliged to travel during those hours when the cars are crowded, will enjoy the benefit of cheaper fares. Beyond the 1d. stages, another 1d. is all that will be charged for the remainder of a journey of any distance on any one car, provided that passengers travel between the hours of 10.30 a.m. and 4.30 p.m. on cars arriving at central termini, and leaving central termini between 10 a.m. and 4 p.m. This will apply at present only to the tramways south of the Thames. Ordinary fares must be paid on Saturdays, Sundays, Good Friday, Christmas Day, Bank holidays, and all proclaimed national holidays.—*The Times.*

Increased Wages.—The employés on the underground railways have accepted the terms offered under the national railway settlement. The advances per week are as follows:—Conductors, 7s. 6d.; liftmen, 7s.; gatemen, 5s. 6d.; porters and signalmen, 5s.

Traffic Delay.—Owing to a tramcar leaving the rails at Burdett Road, E., on Wednesday last week, traffic on both up and down lines was blocked for some time.

Easter Traffic.—It is reported that during the Easter holidays the "Underground" combine of London—train, tramcar, and omnibus systems—carried a total of 14,500,000 passengers.

Newcastle-on-Tyne.—Rate Relief.—Although the chairman of the Tramways Committee states that the undertaking is running at a loss, the City Council has passed a resolution to take £14,000 for the relief of rates. Labour members opposed this item, as they considered that the travelling public would be called upon to make good any deficit in the working of the system.

Extensions.—At a meeting of the Tramways Committee, on the 9th inst., it was reported that an agreement had been arrived at with the Gosforth Park Co. to run a line of tramcars through the park. It was decided to seek Parliamentary powers to carry out the extensions at an early date.

South Shields.—Fare Increase.—Following upon the increased wages to tramwaymen, the Council proposes to increase the universal 1d. fare by 50 per cent. and the fares for children from ½d. to 1d., to take effect from April 12th. The manager, in his report on the financial situation, says that even with the increases the tramway fares in South Shields will still be the cheapest in the country. With regard to workmen's fares, no action is being taken, these having been increased a few months ago.

Spen Valley (Yorks.)—Fare Increase.—The tramway fares are to be increased in accordance with the findings of the Light Railway Commissioners, who sat at Dewsbury on Jan. 28th. The increase will be a halfpenny on fares above 1½d.

St. Helens.—Loan.—The Corporation has decided to apply for sanction to borrow £2,750 for pit extensions and fencing at the tramway depôt, and the purchase of a tower wagon.

Fare Increase.—The Corporation is applying for authority to increase the fares for the labouring classes by 50 per cent. on the present statutory charges.

United States.—Railway Electrification.—The recent electrification of the coast division of the Chicago, Milwaukee, and St. Paul Railroad completes a total of 647·4 miles of electrically-operated lines on this system. The newly-electrified section from Othello, in Central Washington, to Renton Junction, on the Puget Sound end, was opened on March 5th last. The locomotives used are equal to 2·7 steam passenger locomotives of the latest type, and will pull a passenger train of 12 coaches up the heaviest grade on the system at a speed of 25 miles per hour. All the current used in operation is generated from water power, delivered at 100,000 volts and stepped down to 3,000 volts D.C. for use on the locomotive motors. The first electrification of the Chicago, Milwaukee, and St. Paul lines (the Rocky Mountain division of 226 miles) was completed and put into operation in December, 1915. When the unelectrified gap between Othello and Avery is closed, there will be a complete electrification extending for over 860 miles.—*Journal of Electricity.*

Wakefield.—Report on Accident.—On January 29th last an accident caused the death of a goods guard at the Kirkgate Station. It appears that a fellow employé entangled his feet in a fallen telegraph wire in contact with trolley wires upon the route of the Yorkshire (West Riding) Electric Tramway Co.'s system, and the deceased, going to his colleague's assistance, received a fatal electrical shock. In his report to the Ministry of Transport, Major G. L. Hall, R.E., states that the accident was due to the lack of guard wiring to protect the trolley wires, and reports that since March, 1919, no less than 16 miles of single guard wire has been missing. The company asserts that conditions arising out of the war made it impossible to renew the wiring, but the report states that nearly a year has elapsed since the delivery of the necessary material, and that better precautions might have been taken by the company. A list of localities on the tramway system where there is a deficiency of guard wiring is being prepared by the G.P.O. authorities, which will be handed to the company, in order that the latter may furnish a report to the Ministry of Transport showing the full extent of the deficiencies and the date by which these will be remedied.

Wigan.—New Cars.—Sanction to borrow £26,000 for the purchase of 12 new double-decked, broad-gauge tramcars is being sought by the Town Council. These additions are necessitated by the great increase in the number of passengers carried on the system.

Wolverhampton.—Lorain System.—At the meeting of the Town Council, on Monday last, Alderman Craddock, chairman of the Tramways Committee, referring to the Lorain surface contact system, stated that the Corporation had now had 18 years' work on it. But for the war, the whole of the reserve fund would have been spent in renewals. The life of the system was only given as about 16 years. It was an open secret that the attention of the Ministry of Transport had been called to the system in Wolverhampton, and that it had been intimated to him that it stopped intercommunication. There was no doubt that the Ministry of Transport would at an early date send down to see what was the condition of Wolverhampton, and what was stopping intercommunication.

Wrexham.—Power Supply.—The Town Council has agreed with the Tramway Co. for the latter to pay as from January 1st last a minimum sum of £1,693 for energy up to 150,000 units in any year, subject to revision in April, 1921, when the present agreement, stipulating for the minimum charge of £1,016, expires.

TELEGRAPH AND TELEPHONE NOTES.

Australia.—Wireless Telegraphy.—The 16th annual meeting of the Associated Chambers of Commerce of the Commonwealth of Australia was held in Sydney on March 15th, when the following resolutions were submitted:—"That the Commonwealth Government remove the restrictions on the development and application of wireless communication in Australia, and permits private individuals or companies to operate stations for commercial purposes and for their own private use, subject to any reasonable regulations which might be necessary to protect all users against unnecessary interference."

"That the Commonwealth Government be asked to do the utmost to have the present Pacific cable duplicated at the earliest possible moment, and also that it arrange for wireless communication with both the United States and Canada."

Belgium.—The postal and telegraph services are gradually being restored. According to the *Echo de la Bourse* quoted by the *Economic Review*, there were in 1914, 44,564 km. of telegraph wires in use; in 1919, only 24,397 km. A tremendous amount of damage had been done by the Germans to the telegraph system. The present scarcity of copper wire adds to the difficulty of restoring the service to normal conditions. In 1914, 2,694 offices were in operation; in 1919 there were 2,295. The number of telegrams sent in 1914 was 4,407,906, as against 4,066,882 in 1913. The number of telephone subscribers before the war amounted to 54,691, as against 1,844 in January, 1919, and 30,383 in December, 1919. Almost all the pre-war post offices have been re-established.

Canada.—The annual report for 1919 of the Bell Telephone Co., of Canada, shows that during the year 4,835 miles of wire line were added to the company's plant. The long-distance lines of the company now amount to 9,514 miles of pole lines, and

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7,047 miles of wire in underground and submarine cables. The number of company stations in service on December 31st, 1919, was 337,476, an increase of 34,271 for the year. In addition there were 106,231 connecting and miscellaneous stations. The total miles of wire was 964,098; the number of central offices operated, 421, and the number of employés, 11,443. The number of subscriber stations was 337,476. In underground plant the company has 608 miles of conduit, 2,309 miles of single duct, 1,059 miles of cable, and 588,000 miles of wire. Since the year 1886, the company has paid regularly a dividend at the rate of 8 per cent. per annum.—*T. & T. Age.*

Mexico.—In 1918 the national telephone and telegraph system was extended by 83,229 km. There were 528 telegraph offices, 12 telephone offices, and 21 wireless telegraph stations in existence. Receipts for the 5,591,453 messages transmitted were 4,195,845 Mexican pesos.

Public Telephone Call Boxes.—It is estimated that there are 3,576 public telephone call boxes in London. When the call fee was increased from 2d. to 3d. during the early part of the war period, the use of public call boxes decreased by about 50 per cent. Since the Armistice, however, the use has steadily grown until to-day it exceeds previous records. The number of call boxes is to be increased, and also the number of attendants, who will largely replace the penny-in-the-slot system. It is intended to keep call boxes open to 11 p.m.

South America.—During the first week in March some of the submarine cables along the west coast of South America were interrupted, due to earthquakes. Cables between Iquique and the Peruvian border were interrupted for a short time, but the delay to traffic was not serious.—*T. and T. Age.*

Telegraph Convention.—There are 49 countries represented in the list of adherents to the Telegraph Convention. Of telegraph companies, there are 18 which adhere, 15 which, though not official adherents, conform generally to the Regulations, and correspond regularly with the Bureau, and five companies which generally only correspond with the Bureau through companies in the other groups. The 49 countries represent an area of 73,261,282 sq. miles, and a population of 1,114,866,650.

Wireless Speech to Rome.—Verbal messages of greeting, demonstrating the possibility of long-distance wireless telephony, were transmitted to the principal Italian newspapers on April 9th from England by several Italian journalists resident in London. The Marconi Co.'s long-distance apparatus at Chelmsford was employed for this purpose, and the several messages were received at Centocelle, about 4 miles from Rome, by editorial representatives of the interested papers.

Immediately following the demonstration, a reply was received by wireless telegraph.

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the ELECTRICAL REVIEW *in which the "Official Notice" appeared.)*

OPEN.

Auckland (N.Z.).—September 1st. Harbour Board. For the supply of electric capstans and spares. Messrs. W. & A. McArthur, Ltd., 18-19, Silk Street, Cripplegate, London, E.C. 2.

Australia. — PERTH. — May 3rd. Postmaster-General's Department. Insulators, bolts, brackets, &c. Schedule 673. (April 2nd.)

May 14th. Government of Western Australia. One 7,500-KW. turbo-alternator and condensing plant. (April 9th.)

Belgium.—May 1st. Belgian Post and Telegraph authorities at La Salle Madeleine, Brussels.—325 milli-amperemeters, 400 Morse wheels, 500 Morse receivers, and a quantity of miscellaneous telegraph apparatus. Particulars (Cahier des Charges Special No. 521) from the above address.

June 29th. Municipal Authorities of Antwerp. Two electric cranes of respectively 30 and 10-tons capacity, for one of the dry docks at the Port. Particulars, 4 fr., from the Hotel de Ville, Antwerp.

May 28th. Municipal Authorities of Antwerp. Electrical equipment of three transformer cabins at the docks. Particulars, for 2 fr., from the Hotel de Ville, Antwerp.

Canterbury.—April 19th. Electricity Department. One 1,000-KW. three-phase turbo-alternator, surface condensing plant, two rotary converters, superheater, &c. (March 26th.)

Cardiff.—April 29th. Corporation. One 5,000-KW. turbo-alternator and condensing plant. (April 9th.)

Carlisle.—April 27th. Electricity Department. One 1,000-KW. converter, switchgear for converter, E.H.T. feeder switchgear. (See this issue.)

Darlington.—April 19th. Electricity Department. One water-tube boiler. (April 2nd.)

Dartford.—April 26th. Urban District Council. One water-tube boiler and mechanical stoker; bus-bars. (See this issue.)

Dublin.—April 24th. Electricity Supply Committee. Seven truck-type switch cubicles for use on a three-phase 50-period 5,000 v. system. (See this issue.)

Ebbw Vale.—April 19th. Urban District Council. One 5-10-H.P. single-pulley endless rope electric haulage gear. Mr. Thos. Hughes, Clerk, Council Offices.

Edinburgh.—April 26th. Electricity Supply Department. E.H.T. paper-insulated lead-covered cables. (April 2nd.)

Leigh.—Lancs. Electricity Department. One 2,500-KW. turbo-alternator; E.H.T. & L.T. switchgear; one 500-KW. rotary converter. (See this issue.)

Portsmouth.—April 26th. Board of Guardians. Electrical installation at the Children's Home, Milton. (See this issue.)

Spain.—The municipal authorities of Almaden have lately invited tenders for the concession for the electric lighting of the town during a period of 10 years.

Sunderland.—April 28th. Electricity Department. Water-tube boilers, superheaters, stokers, economisers and chimneys; one 1,000-KW. rotary converter. Specifications, &c. (£1 each), from General Manager, Electricity Works, Dunning Street.

Tasmania.—LAUNCESTON.—June 7th. City Council. One 1,000-K.V.A. hydro turbo-alternator, with switchgear. City Electrical Engineer, Town Hall, Launceston.

Uruguay.—August 7th. Department of Posts, Telegraphs and Telephones. Construction of a national telephone system for the Department of Montevideo. Particulars from the Uruguayan Legation in London, 3, Elvaston Place, South Kensington, S.W.

Whitby.—Electricity Department. Replacing economiser, boiler feed pump, pipework; converting of old dry duct into cooling pond. (See this issue.)

CLOSED.

Bradford.—Electricity Committee :—

Cast-iron circulating piping for Allen's pumps and condenser—Stanton Ironworks Co., Ltd.

1½-ton overhead runway system—Vaughan Crane Co., Ltd.

Kettering.—Urban District Council. The following prices were quoted for a '6 concentric, paper-insulated, lead-covered feeder cable with feeder pillar :—

Macintosh Cable Co.	£4,310	No provisional sum included.
Pirelli Cable Co.	3,850	Plus £100 provisional sum.
Glover & Co.	3,567	
British Insulated	3,522	
Johnson & Phillips	3,518	
Callender's Cable	3,478	
Union Cable Co.	3,461	
Western Electric	3,458	
Siemens Bros.	3,350	

The Cleckheaton Council offered a '55 concentric, paper-insulated, lead-covered, double-sheathed, steel-armoured cable at 26s. per yard. Subject to certain reservations, this price has been accepted.

Maidstone.—Town Council :—

Cables for the supply to Snodland—Union Cable Co., £29,940 (subject to revision for fall in the prices of copper and lead).

Manchester.—Tramways Committee. Accepted :—

Tramcar controllers—English Electric Co., Ltd.

STORES FOR 12 MONTHS.

Motor and controller parts, &c.—British Thomson-Houston Co., Ltd.: English Electric Co., Ltd.; Metropolitan-Vickers Electric Co., Ltd.
Insulating material; siluminite, insulator—L. Andrew & Co.; Griffith Bros. & Co.
Grids for resistances—Electro-Mechanical Brake Co., Ltd.; H. Wallwork and Co.
Armatures and field cores, &c.—Manchester Armature Repair Co., Ltd.: Metropolitan-Vickers Electrical Co., Ltd.; P. R. Jackson & Co., Ltd.; English Electric Co., Ltd.
Phosphor bronze springs, &c.—British Thomson-Houston Co., Ltd.; Tierney Wood & Co.; Kay & Co.
Controller fingers, &c.—Forest City Electric Services Supply Co., Ltd.: Dyer & Young; Fairless Engineering Supplies Co.
Steel trolley poles—Brecknell Munro & Rogers, Ltd.
Electric lamps—General Electric Co., Ltd.; Drake & Gorham, Ltd.
Carbon brushes—General Electric Co., Ltd.: J. Eades.
Overhead equipment material—A. Wiseman, Ltd.
Cables—W. T. Glover & Co.
Copper cable, strip and wire—F. Smith & Co.
Brass wire strip and sheet—C. Clifford & Son.
Galv.-steel cable and wire—F. Smith & Co. (Wire Manufacturers), Ltd.
Bell wire—Macintosh Cable Co., Ltd.
Thermit welding—Thermit, Ltd.

Waterworks Committee. Accepted :—

Electrically-driven centrifugal pump—Holden & Brooke, Ltd.

Hydro-electric installation. Thirlmere :—

Turbine dynamo, &c.—Gilbert Gilkes & Co., Ltd.
Storage battery reversible booster, &c.—D.P. Battery Co., Ltd.
Motors, starting panels, &c.—Lancaster Dynamo and Motor Co., Ltd.
Cables—Macintosh Cable Co., Ltd.

Electricity Committee. Accepted :—

Two turntables for Stuart Street station—F. Theaker, Ltd.
Three three-wire balancers for Dickinson Street station—Bruce Peebles and Co., Ltd.
One traction motor-driven booster set, with regulating and starting switchgear, for Dickinson Street station—Lancashire Dynamo and Motor Co., Ltd.
One 1,500-KW. motor converter, switchgear, and resistances for Dickinson Street—Bruce Peebles & Co., Ltd.
Two 600-K.V.A. static transformers for sub-station—Metropolitan-Vickers Electrical Co., Ltd.
Two 1,200/1,590-KW. motor converters, and four 1,500-KW. motor converters for sub-stations—Bruce Peebles & Co., Ltd.
Two-ton electric lorry—Drake & Gorham, Ltd.
15-cwt. electric van—Electromobile (Leeds), Ltd.
Cable—Western Electric Co., Ltd.
Tee and tail-end boxes—Siemens Bros. & Co., Ltd.

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Electrically-operated wagon tippers for Barton—Babcock & Wilcox, Ltd.
Switchgear equipments—Park Royal Engineering Works, Ltd.
D.C. switchgear extensions—Bertram Thomas.
Fuse-boxes—Siemens Bros. & Co., Ltd.

In connection with the Barton station, the following main contracts have been placed :—

Two 25,000-kw. turbo-alternators—Metropolitan-Vickers Electrical Co., Ltd.
Two sets of main condensing plants—Richardsons, Westgarth & Co., Ltd.
Two house service turbo-alternators—British Thomson-Houston Co.
Four complete boiler-house equipments—Babcock & Wilcox, Ltd.
Coal and coke conveying plants—W. J. Jenkins & Co., Ltd.

Salford.—Tramways Committee. Accepted :—

One set hydraulic car-lifting jacks, £865—Messrs. Youngs.
Welding and retreading 1,000 joints on the tramway track (approx), £2,300—Rail Welding Co.
Five single-deck omnibus chassis, £1,240 each—Leyland Motors, Ltd.
Five single-deck omnibus bodies, £570 each—English Electric Co., Ltd.
Dry cells—Siemens Bros. & Co., Ltd.
Two Q.B.1, Form B.3, tramcar controllers, £190—English Electric Co., Ltd.
Metal-filament lamps, £213—Drake & Gorham, Ltd.
Armature and field coils, £275—Barratt & Thornton.
12 Westinghouse motors (second-hand), £1,200—Equipment and Engineering Co., Ltd.

Electricity Committee. Accepted :—

Five sets of stokers, £1,375—E. Bennis & Co., Ltd.
One 1,000-kw. rotary converter, £5,360; E.H.T. switchgear, at Pendleton, £2,525; cubicle for the potential transformer, £87; air cooler in connection with the 5,000-kw. turbo-alternator set, £1,545—Metropolitan-Vickers Electrical Co., Ltd.
300 K.V.A. transformer—Ferranti, Ltd.
Rotary screening plant, £749—Ledward & Beckett, Ltd.
Motor-driven pumping set, £1,383—Mather & Platt, Ltd.
Steam ejector and extraction pump, £786; one 500-kw. rotary converter, £3,770—Metropolitan-Vickers Electrical Co., Ltd.
Two Weir "Roto Feed" pumps and accessories, £1,149—G. & J. Weir, Ltd.
E.H.T. switch cubicle, £330—Metropolitan-Vickers Electrical Co., Ltd.

Sunderland.—Electricity Committee. Accepted :—

Service, E.H.T. and L.T. cable—B.I. & H. Cables, Ltd.
Two 250-K.V.A. transformers—Brush Electrical Engineering Co., Ltd.
Capping and cable troughing—J. Thompson & Co.
Switchgear—Ferguson, Pailin & Co., Ltd.

Watford.—Urban District Council :—

Laying electric light fittings to 40 houses. Eight points per house.—J. N. Connare, £318.

Wolverhampton.—Team Committee. Recommended.

Three 3½-ton Orwell electric vehicles—Ransomes, Sims & Jeffries, Ltd., at £1,538 each.

York.—Electricity Committee :—

Hydro-electric power works at Linton Locks—The English Electric Manufacturing Co., £53,057. (This is a revised tender showing a reduction of £11,628, owing to three turbines being included instead of four.)
Cables for Linton Lock—Callender's Cable Co., £9,445.
Turbo-alternator and condenser for electricity works, Foss Island—Oerlikon Co., £27,692.

FORTHCOMING EVENTS.

Technical Inspection Association.—Friday, April 16th. At the Royal Society of Arts, John Street, Adelphi, W.C. At 7.30 p.m. Paper on "Labour Unrest—its Causes and its Cure," by Mr. F. R. Wade.

Birmingham and District Electric Club.—Saturday, April 17th. At the Grand Hotel, Birmingham. At 7 p.m. Paper on "Electric Heating and Cooking," by Mr. F. F. D. Davidson.

Royal Institution of Great Britain.—Saturday, April 17th. At Albemarle Street, W. At 3 p.m. Lecture on "The Thermionic Vacuum Tube as Detector, Amplifier and Generator of Electrical Oscillations," by Prof. W. H. Eccles.

Tuesday, April 20th. At 3 p.m. Lecture on "Recent Advances in X-Ray Work," by Major G. W. C. Kaye.

Royal Society of Arts.—Monday, April 19th. At John Street, Adelphi, W.C., At 8 p.m. Cantor lecture "Aluminium and its Alloys," by Dr. W. Rosenham, F.R.S. (Lecture II.)

Institution of Civil Engineers.—Tuesday, April 20th. At Great George Street, S.W. At 5.30 p.m. "James Forrest" Lecture on "Coal Conservation in the United Kingdom," by Sir Dugald Clerk, F.R.S.

Institution of Electrical Engineers.—Monday, April 19th. Informal meeting. At the Institute of Patent Agents. At 7 p.m. Discussion on "Group *versus* Individual Driving," to be opened by Mr. G. H. Ayres.

(Liverpool Sub-Centre.)—Monday, April 19th. At the Liverpool University. At 7.30 p.m. Eleventh Kelvin lecture on "Modern Marine Problems," by Dr. C. V. Drysdale.

(North-Eastern Centre.)—Monday, April 19th. At the Armstrong College, Newcastle-on-Tyne. At 7.15 p.m. Lecture on "Electricity in the Western War Zone," by Major T. Rich. Annual general meeting.

Friday, April 23rd. At 7.15 p.m. Eleventh Kelvin lecture on "Modern Marine Problems," by Dr. C. V. Drysdale.

(North-Midland Centre.)—Tuesday, April 20th. At the Hotel Metropole, Leeds. At 7 p.m. Paper on "The Protection of Alternating-current Distribution Systems without the use of Special Conductors," by Major K. Edgcumbe.

(North-Western Centre.)—Tuesday, April 20th. At 7 p.m. At the Manchester College of Technology. Eleventh Kelvin lecture on "Modern Marine Problems," by Dr. C. V. Drysdale.

(South-Midland Centre.)—Wednesday, April 21st. At the University, Birmingham. At 7 p.m. Eleventh Kelvin lecture on "Modern Marine Problems," by Dr. C. V. Drysdale.

Illuminating Engineering Society.—Tuesday, April 20th. At the Royal Society of Arts, John Street, Adelphi, W.C. At 8 p.m. Discussion on "The Lighting of Churches," to be opened by Mr. J. Darch.

Industrial League and Council.—Wednesday, April 21st. At the Caxton Hall, Westminster, S.W. At 7.30 p.m. Lecture on "A National Scheme of Profit Sharing," by Mr. H. W. Jordan.

Edinburgh Electrical Society.—Wednesday, April 21st. At the Philosophical Institution. At 7.30 p.m. Paper on "The Telephone," by Mr. J. McBrown.

Institution of Mechanical Engineers.—Friday, April 23rd. At the Institution, Storey's Gate, S.W. At 6 p.m. General meeting.

NOTES.

Income-Tax.—A movement is on foot to secure for scientific workers abatements in respect of their professional expenses. The General Secretary of the British Association of Chemists, Bedford House, York Place, London, W., would be glad to receive communications from those concerned.

Prize Competition.—A prize competition, instituted by the Società Generale Italiana-Edison di Elettricita, for an electric kitchen, due for decision at the end of February, has been postponed till the end of September. The reason for the postponement is the increase of the award caused by the offer of 20,000 lire by the Compania Italo-Argentina de Electricidad towards the prize, making the total 50,000 lire. Persons desirous of further information should write Direzione della Società Edison, in Milan, Via S. Radegonda 10.

Electrical Artificers.—It is announced that acting electrical artificers drafted to sea prior to the completion of their course owing to sudden drafting requirements may be confirmed in their rating at the end of 12 months' service, notwithstanding that they have not completed their course in a torpedo school, provided they obtain from the lieutenant (T.) of their ship the necessary certificate. As occasion offers, however, these men will be required to complete their torpedo school course.

Inquiry.—A correspondent who has water-power plant available day and night invites suggestions for its utilisation, not involving much cartage of material.

The Army Electric Lighting School.—According to the Army Estimates for 1920-21, the School of Electric Lighting will cost the sum of £3,845 in the coming year, as against £18,959 last year. The school, which will accommodate 20 officers and 300 other ranks, will be staffed by one commandant instructor at £1,000 per annum, two instructors at £1,315, two assistant instructors £1,130, and the cost of the military and civilian subordinate staffs will be £400. The above figures, however, are not inclusive of travelling, accommodation, stationery, and miscellaneous expenses, which last year amounted to £7,050.

The estimate for the Anti-Aircraft Searchlight and Sound Locator School is put at £1,785, exclusive of travelling, accommodation, stationery, and miscellaneous expenses, and the cost of military and civilian subordinate staff. Last year this school cost the British taxpayer £13,200.

West African Wireless Station.—The station at Bathurst, West Africa, is to be provided with additional house accommodation for the staff maintained there at the cost of the Admiralty. This year about £8,400 will be spent out of £15,800 required to complete the scheme.

A Strike at Runcorn.—Our Liverpool correspondent writes :—"Owing to the strike at Runcorn, the Mersey Power Co., which supplies electricity to all the large chemical works and factories in the neighbourhood, has had to cut down its output to the limits of the necessities of public utility services. Works without their own generating plant were badly placed, and were compelled to stop hundreds of men. Other works carried on with the electrical generating plant they had on the premises, but, of course, this was not sufficient to supply their full needs. The Helsby Cable Works were affected, and had their small generator in commission. Some of the local places of amusement had to modify their arrangements owing to inadequacy of supplies. The ten minutes' service of the Runcorn transporter bridge had to be modified to a half-hourly service. At the time of writing the situation shows signs of improvement, and arrangements have been made by means of which the Mersey Power Co. will obtain coal on barges from Winsford, along the River Weaver, to the generating station at Runcorn, a journey of 15 miles. These supplies, if continued, will enable the company to supply the present restricted service, provided no further complications ensue."

Fatality.—At an inquest held at Newcastle on April 5th, it was stated that on 3rd inst. John Robson, a tramcar motorman, was in charge of a car on the Gosforth route, when his head was struck by a standard while the car was travelling. A pedestrian, who gave evidence, said that when he saw the car approaching, he noticed the driver was lying over the right side of the car as though he had fainted. As the car was going along, the man's head struck a tramway standard. Witness jumped on the car, knocked off the rear switch, and put on the hand brake, while the conductor rushed to the front of the car and applied the brake. There was no explanation of what had occurred to the driver prior to his being struck by the standard. Death was consequent upon a fractured skull, and a verdict of "Accidental Death" was returned.

Appointments Vacant.—Shift engineer (£220), for the Borough of Torquay Electricity Department; instructor in wiremen's work, for the Leeds Technical School; shift engineer (79s. 6d.), for the City of Peterborough Electricity Department; assistant mains engineer (£260), meter superintendent (£260), for the Walsall Corporation Electricity Department; draughtsman, for the Rotherham Corporation Electricity Department; meter tester (40s. + E.P.E.A. awards), for the Salford Borough Council Electricity Department; shift engineers, junior shift engineers, switchboard attendants, and general assistants, for the Southampton Corporation Electricity Department; mains assistant (45s. + 20 per cent. + £120), plumber jointer (district rate), switchboard improvers (40s.), for the Radcliffe Urban District Council Electricity Works; station engineer and fitter, for the Londonderry Electric Supply Station. See our advertisement pages to-day.

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I.E.C. Rules for Electrical Machinery.—We have received from Mr. C. le Maistre, general secretary of the International Electrotechnical Commission, a copy of Vol. I of the I.E.C. Rules for Electrical Machinery, Publication 34, now issued. These rules apply to rotating machines of which the terminal pressure does not exceed 5,000 volts, or of which the rated output does not exceed 750 K.V.A., or of which the stator cores do not exceed 50 cm. in length axially, and to all transformers which are not water-cooled. Copies can be had from the Secretary, 28, Victoria Street, S.W. 1, price 2s. 2d. post free. A discussion on the rules appears elsewhere in this issue.

As we go to press we have received an account of the meetings of the Advisory Committees of the I.E.C. held at Brussels, from March 27th to 31st. In addition to the secretaries, about 35 delegates were present, and were welcomed on behalf of the Belgian Electrotechnical Committee, by M. Omer de Bast, of the Institut Montefiore. Visits were paid to the Yser battlefields, and the devastated areas, including Courtrai, Nieuport, Dixmude and Ypres. The meetings dealt with Rating Rules, Graphical Symbols, Nomenclature and Standard Pressures; particulars will be published later. It is proposed to hold the next meeting of these Committees in Paris, in November.

Educational.—UNIVERSITY OF LIVERPOOL.—In a recent appeal for funds to enable it to carry out its valuable work of advanced education, the University utilises a method of publicity that cannot fail to appeal to all classes. In a publication, bearing the title "A Move for National Efficiency," the scope of the University's schemes is amply set forth, and the necessity of such an important institution as a factor of national development and progress is brought home to the reader. The position held by Liverpool in British commerce is remarked upon, and every reader is assured that he or she is greatly concerned with, and partly dependent upon, the great National port. Enclosed with the pamphlet is a subscription form affording three different methods of providing the necessary financial aid.

MANCHESTER UNIVERSITY.—The Manchester Chamber of Commerce has been asked to appeal to the business men of the city for their aid in maintaining the high standard attained by the University. A big publicity campaign is being organised for the sale of University Bonds (which are irredeemable and bear no interest), and many of the students will offer these in the City's public places. Other features of the movement are short addresses at music halls and kinemas, and a pageant organised by the students. It is hoped by these methods to raise £500,000.

KING'S COLLEGE, LONDON.—At a meeting of old students, on March 9th, it was decided to form an Old Students' Section of the Engineering Society as a branch of the King's College Old Students' Association. Mr. C. H. Wordingham, C.B.E., was elected president, and Prof. Ernest Wilson and Brigadier-General H. Mowat vice-presidents. An inaugural luncheon will be held at the Holborn Restaurant, at 12.45 p.m., on May 1st, at which the Committee's plans and proposals will be fully explained and suggestions invited from those present. It is hoped that all former students of the engineering faculty will make a point of attending. Further particulars of the Association can be obtained from Mr. A. N. Gardiner, 2, The College, Epsom.

Magnetic Field Submarine Detection.—A paper describing a series of interesting tests of the disturbance caused in a uniform alternating magnetic field by an incoming magnetic mass, in connection with the development of a device for the detection of enemy submarines, appears in the March issue, and will be concluded in the April issue, 1920, of the *Journal* of the American I.E.E. The principle of the device described, which appears to be the most promising so far proposed, will be understood from the following: An alternating magnetic field is set up by an A.C. magnet having an open magnetic circuit; a straight bar magnet so designed as to give as far-reaching and as strong a field as is practicable. In the field of this magnet, and as far away from it as is possible, is located a detecting coil. The latter may be located with its plane parallel to the lines of force set up by the magnet, in which case it will theoretically have no voltage induced in it by the magnet itself; or it may be located with its plane not parallel to the lines of force, in which case the voltage induced in it by the alternating field set up by the magnet must be balanced out by another E.M.F. exactly opposite in phase and magnitude to the voltage induced in the detecting coil. If the conditions aimed at are realised, there will, in either of these cases, be no resultant E.M.F. in the circuit including the detecting coil, and no indication thereof in such means as may be employed for detecting an alternating E.M.F. in this circuit. If, now, a submarine comes into the field set up by the magnet, it will disturb the field existing around the detecting coil, with the result that there will be an alternating voltage produced in the detecting coil circuit which will indicate the presence of the submarine, and may also indicate its location. The principal conclusions come to from the results of the tests were: That detection tests in the laboratory with submarine models 10 ft. long are in agreement with the underlying theory, and may be used as a basis for the design of larger equipment. Detection tests on steel hulls from shore equipment and from equipment installed on a wooden submarine chaser 10 ft. long, are in good accord with results predicted from a formula developed in the laboratory tests. By sufficient increases in the size of the equipment it is possible, in quiet water, to detect a steel vessel 200 ft. long, at a distance of 500 ft.; the weight of the equipment required would be about 8,000 lb. Distances of detection in the neighbourhood of 200 ft. were obtained in quiet water with equipment weighing 4,500 lb. installed in a wooden submarine chaser 110 ft. long. The reliability of the system of detection is immediately impaired by motion of the vessel, due to her engines, heavy sea, and changes of course, or speed. The results mentioned involve the use of amplifying valves for enlarging the signal. Without the amplifier the distances of detection are very short, even when a large magnet or large detecting coil and an extremely sensitive detecting instrument are used. Disturbances in the detecting system fix the limit for increasing sensitivity; these disturbances are amplified, and appear in the detecting instrument as larger than the signal sought.

Water Power in British Guiana.—The publication of the preliminary report upon the water power resources of British Guiana by Mr. Stafford X. Comber, M.Am.Soc.C.E., marks the first step of the Government in this direction. The surveys were carried out under most difficult circumstances, not the least of which was the heaviest rainfall experienced for the forty years during which records have been kept. British Guiana is extremely rich in mineral deposits which have scarcely been touched, and the advent of electricity would open up immense sources of wealth. In the coastal area the cane sugar industry is threatened by an acute shortage of labour, and the advantages of applying electricity to this and other industries in the more thickly populated areas are incalculable. Mr. Comber, accompanied by a small party of Akawais Indians, proceeded 150 miles into the jungle, and made surveys at numerous points, chiefly on the Essequebo, Cuyuni, and Demarara rivers. The variation of the flow of these rivers at different seasons is, of course, very marked, and the engineer estimates that the volume per second of the Cuyuni varies from 29,000 to 93,000 cu. ft.; of the Essequebo from 68,000 to 250,000 cu. ft., and that of the Demarara from 1,200 to 5,000 cu. ft. at the Great Falls, and from 1,700 to 6,500 cu. ft. at Mallali. The total drop of the part of the Cuyuni examined is about 73 ft. The total drop of the Essequebo between Moneri and Aretaka is estimated to be 67 ft., and that of the Demerara, between Ororu Maralli and Little Mallali Rapid, is 78 ft. These heads could be economically increased by artificial works, which would at the same time regulate the flow and provide the necessary storage. In summing up the possibilities presented by these rivers, Mr. Comber calculates that, allowing a basis of 95 per cent. at the turbine shaft, the following amounts of horse-power are available: Cuyuni river 285,000, Essequebo 475,000, and Demerara 38,000. The ultimate delivery of power within a two hundred mile radius, which, it is stated, is under-estimated if anything, would probably be 156,000 H.P. from the Cuyuni, 273,000 H.P. from the Essequebo, and 21,000 H.P. from the Demerara. In such a hasty report it is impossible to give reliable estimates of cost, but the expert says that, judging from experience, consumers on the coast should be able to receive power at from .75 to 3.75 cents per unit. In order to secure reasonably reliable estimates of the cost of the necessary plant, Mr. Comber recommends the further survey of seven specific sites, and the establishment of gauging stations at various points to enable a complete and accurate record of velocities, &c., to be compiled, remarking in conclusion that "it is impossible to emphasise too strongly the advisability of at once commencing the recording of data concerning the flow of rivers having power possibilities." The plates accompanying the report are maps of the several districts under survey, and photographs of falls and rapids, which although generally taken under difficulties are extremely good.

Electrical Development in China.—Details of a scheme for promoting the sale of energy are given in a report by the U.S. Consul at Foochow. The local lighting company purchased a number of rice-polishing machines and offered them for hire to the native rice mills. Special meters were installed, and energy was sold at less than the lighting rate. The same company was recently planning to install an electric tramway system. Intending British suppliers of material will have to face fairly firmly established competition, both from the United States and Japan. There is a local telephone company known as the Foochow Telephone Co., run by the same group as the Foochow Electric Light Co.

There are four electric light plants in the Swatow district, the one at Chaochowfu having now commenced operation. The Swatow Kaiming Electric Light Co. had another profitable year, and declared its usual dividend of 8 per cent. in addition to adding a good sum to its surplus. During the year the number of lights supplied rose from 15,000 to 19,200, due chiefly to installations in gambling houses. Four of the five dynamos are in use every night. The Hing-ning and Kaying plants have a capacity of between 2,000 and 3,000 lamps, while that of the Chaochowfu plant is five thousand 20-watt lamps.

A number of American light plants have been sold in the district, most of which are being operated on a commercial basis at a charge of 3s. to 4s. per lamp. Their small cost especially appeals to the Chinese, with whom electric lighting has become very popular, and during the next few years considerable development along this line should occur.

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Turbo-alternator Short-circuit Tests.—A series of tests are described in the *General Electric Review* of March, 1920, that were made for the purpose of rounding off the data that have been compiled on the behaviour of alternators under short-circuit conditions. The characteristics of alternators with smooth core rotors were not so well known as those of definite pole machines. The tests, carried out on a 10,000-K.V.A. turbo-alternator, were carefully conducted under numerous conditions of short circuit, with various arrangements of reactors in circuit, and with no reactors in circuit. Special precautions were taken to eliminate errors, and meter readings were taken as a check on oscillograph records. While there are not yet enough data at hand to decide finally the various points brought out in the tests, yet the following conclusions are apparently well established. (1) Within all practical accuracy the effective symmetrical initial short-circuit current I (effective amperes) of a turbo-generator equals: (*a*) $I = [100/x_g] \times I_n$ on no-load normal voltage with no external reactance; (*b*) $I = [100/(x_g + x_e)] \times I_n$ on no-load normal voltage with external reactance; (*c*) $I = [100/x_g + 1] \times I_n$ on full-load zero power factor and with no external reactance; (*d*) $I = [100/(x_g + x_e) + 1] \times I_n$ on full-load zero power factor and with external reactance; (*e*) $I = \sqrt{[100/x_g]^2 + (1)^2}$ on full-load unity power factor with no external reactance, where E = normal voltage per phase of the generator; I_n = normal current per phase of the generator; and x_e = per cent. external reactance = $R \times I_n \times 100/E$; x_g = per cent. transient reactance of the generator; R = ohms external reactance.

2. The percentage synchronous reactance, x_s, of the generator equals: $x_s = F_1/F_E \times 100$ per cent. at F_E amperes, where F_1 = field current required to give normal current on synchronous impedance tests, and F_E = field current no-load normal voltage assuming a straight line saturation, *i.e.*, air gap amperes. Then the sustained short circuit current with external reactance and F_s amperes field is $I_s = [100/(x_s + x_e)] \times I_n \times F_s/F_E$. That is, external reactance is added directly to the internal reactance of the generator in the same way as for the instantaneous values.

3. It is close enough for practical purposes to consider that the per cent. leakage reactance varies inversely with the voltage.

4. As far as the first quarter second after short circuit is concerned, it makes no difference whether the generator is regulated by hand or by means of an automatic voltage regulator.

5. Adding external reactance to a generator circuit equal to the initial reactance of the machine reduces to one-half the instantaneous short-circuit current. At the end of one second, however, the current is practically the same whether the external reactance is connected in or not, if the leakage reactance of the machine is small compared with the synchronous reactance.

6. All the foregoing conclusions apply to definite pole generators as well as to turbo-generators, except that in the former machines it is very essential that the field leakage reactance be included in the transient reactance, while on the machine tested, neglecting the field reactance did not introduce any appreciable error.

Colliery Underground Transport.—A study of underground haulage in collieries was written in 1914 by Mr. F. Defize and contributed to the *Revue Universelle des Mines*, Liege. According to the Inst. C.E. *Abstracts of Papers in Scientific Transactions and Periodicals*, the author deals with the question both from the engineering and the economical point of view, but, as economical considerations determine the system adopted, his emphasis is mainly on that side. Discussing the conditions under which the work has to be carried on, he compares costs in terms of the tonne-kilometre (t-km.)*, and points out the advantages of the different types of locomotives in common use. Experience has shown that a fair day's work for a horse, which the author takes as a term of comparison, is about 50 t.-km. This product of distance and load he calls the "traffic intensity." The benzine locomotives of 8 and 12 H.P., in common use in the Belgian collieries, have a tractive power on the level of 270 and 400 kg. respectively, and a speed, with a normal load, of 6 km. (3.73 miles) per hour. The running costs per day, which are set out in detail for each system, amount to from 23 to 32 francs a day at pre-war prices. It appears that the benzine locomotive becomes, as the traffic intensity rises, rapidly more economical than horse haulage, and that its superiority begins when the traffic intensity reaches 120 t.-km. The question of electric haulage with accumulators—a system which has never made much headway in favour—is treated with the same fullness. The speed of the accumulator locomotive under a normal load is about 10 km. (6.21 miles) per hour. It has an advantage over the benzine motor in being less in height—1 m. (3 ft. 3.37 in.), against 1.4 m. (4 ft. 7.14 in.). Compared with horse haulage it becomes superior in economical working when the traffic exceeds 240 t.-km. The compressed-air locomotive has found a wider application, chiefly because it is not a source of danger in an explosive atmosphere. Moreover its exhaust tends to purify and cool rather than to vitiate and heat the air of the mine. This locomotive possesses the merit of small dimensions, which makes it suitable for thin seams. Its speed is from 10 to 12 km. (6.2 to 7.45 miles) an hour. A compressor capable of compressing from 5 to 6 cu. m. (176·6 to 211.9 cu. ft.) a minute is sufficient to run one locomotive. The running costs, which are high for a small output, decrease rapidly as the loads to be hauled increase. Its superiority over horse haulage, from the economical standpoint, begins when the traffic intensity reaches 220 t.-km. The electric locomotive supplied with current from a power station is steadily winning a foremost position, due to the many advantages it possesses over the other systems. It is easily controlled. Its speed, up to 12 km. (7.45 miles) an hour, can be regulated with precision. For a given power it is lighter than any other. It occupies less space, and is more easily kept in good order. The current wires are simple and quickly fixed in position, and when installed may be used for lighting and shot-firing. The cost of an installation is less than half that of the compressed-air system. The electric locomotive, moreover, does not heat or vitiate the atmosphere of the mine. But the possibility of sparking makes it unsuitable for use in a fiery mine. From the economical point of view it is superior to all other forms of motor, largely because it makes possible the concentration of power in one centre. The return circuit is usually through the rails, the joints of which are connected by copper wire; D.C. is preferred to A.C. As an illustration the author describes an installation in a mine in the United States. It appears that electric haulage begins to become economically superior to horse-haulage when the traffic intensity reaches about 150 t.-km.

* 1 tonne-kilometre = 0.612 ton-mile.

"Colloil" Liquid Fuel.—It has long been realised that if a commercially practicable process could be devised for combining fuel, oil, and/or coal tar or coal dust in such a manner as to permit of their handling and use in liquid fuel burners for steam raising, &c., in the same manner as fuel oil alone, there would be a large demand for the product or process. As evidence of this the British Admiralty offered a prize of £2,000 for a combined coal tar and fuel-oil fuel which was not won. American engineers have attempted to use coal and oil, but the cost of grinding in endeavouring to obtain a perfect colloidal suspension has proved prohibitive, taking about three weeks to prepare. British railways, notably the Great Central, have likewise experimented.

The Calvert "Colloil" system provides means whereby dust fuels, especially coal or coke dusts, can be handled, stored, and burnt as readily, it is claimed, as oil fuel alone, and in a dustless and ashless manner. Further, it is claimed that the full thermal value of the coal dust is obtained, more than by burning the expensive solid coal, and without the labour of stoking, and one ton of colloil dust only occupied the space of ½ ton of solid coal.

The Calvert system treats the solid fuels in such a manner as to render them sufficiently levigated for this purpose, which can be done at a cheap rate. They are then incorporated with a liquid fuel or carrier, and tanked and handled in such a manner as to permit of their use in the same way as would obtain with oil fuel.

Broadly, the process consists of, first, treating (levigating) the fuel, secondly, simple agitation in the storage tanks by air, gas, or mechanical means, and thirdly, control of the fuel supply to the burners.

The calorific value is high, and the fuel is claimed to be dustless and practically ashless. The same applies to coke dust, gas or tar oils, charcoal from peat, brown lignite, sawdust, rice or coffee husks, which may form other components in addition to the fuel-oil-coal "colloil," or as substitute for one of the solid components. The liquid carriers may be oil, alcohol, water or mixtures thereof. The substance may be prepared in concentrated paste form, five parts coal, one of oil, and the balance of the oil (four parts or more) added by simple stirring at another place if found more convenient for transit reasons. The liquid 50 per cent. colloil can be pumped and railway tanked as fuel oil can. The paste may save in transport in other ways if 40 per cent. of the oil is available elsewhere, though the packing of the paste involves more expense in containers and handling.

Coal dust in aqueous suspension is termed "Colleau." Though, of course, the thermal value is much lower it is high in proportion to the cost of raw materials and labour of stoking. It consists of 50 per cent. levigated coal and 50 per cent. water. Taking the dust and cost of treatment at 15s. a ton and allowing for heat losses (coal consumed) in vaporising the containing water, there is still, it is claimed, a heating value equal to 15 cwt. of steam coal, value £3, per ton of "Colleau" at 15s., apart from labour saving.

In connection with internal combustion engines "Colloil" specially prepared can be used as fuel in the Diesel type of engine wherein heavy oils are injected into the cylinder, with a saving in fuel costs equivalent to the costs of the fuel used.

It is estimated that a plant capable of treating 100 tons of coal dust per week so as to enable it to be used as colloil or colleau will cost £2,000 to £2,500 complete erected; 3s. per ton is allowed for materials used, power, and overhead charges, and 2s. for labour. The costs do not include handling the product after it leaves the machine, and assume the dust delivered to the plant. The product is made in about three hours.

The fuel and system are covered by patents, and the name "Colloil" is a registered trade mark. The system patent embodies devices for storing, feeding, and burning the fuel so that the levigated system is maintained and control of the fuel flow obtained without risk of stopping.

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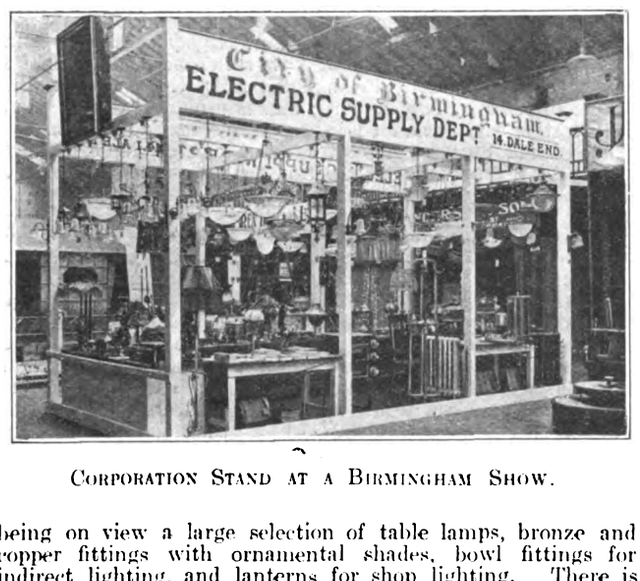
Birmingham Trades Exhibition.—We are indebted to Mr. U. Y. Anderson, commercial engineer, for the accompanying illustration which shows the stand of the City of Birmingham Electric Supply Department at the National Trades Exhibition. On this stand, which is attracting the attention of large numbers of visitors each day, are shown many examples of the latest adaptations of electricity to domestic uses, and it is, therefore, of special interest to the numerous purchasers of houses, and to architects and builders in connection with the many housing schemes now in hand. The stand contains exhibits by the following firms: Messrs. Benham & Sons, Ltd., Belling & Co., British Thomson-Houston Co., Ltd., Dental Manufacturing Co., Ltd., General Electric Co., Ltd., and Premier Electric Heaters, Ltd., there



Corporation Stand at a Birmingham Show.

being on view a large selection of table lamps, bronze and copper fittings with ornamental shades, bowl fittings for indirect lighting, and lanterns for shop lighting. There is also an up-to-date selection of electric radiators, electro-vapour radiators, fires, ovens, grills, hot plates, toasters, kettles, saucepans, irons, fans, water heaters, vacuum cleaners and electrically-heated clothes rails. Medical practitioners will be interested in an appliance for sterilising instruments, and dentists in a small electric motor, complete with attachments especially suitable for their mechanical work. Amongst the miscellaneous apparatus on view are electrically-heated glue pots, curling irons, soldering irons, shaving pots, &c.

Legal.—Lindsell *v.* Paignton Electric Light Co., Ltd.—On Tuesday, Mr. Justice Bailhache delivered his judgment in this case, which was heard on January 23rd, and reported in the Electrical Review for January 30th. The case raised the question whether electricity supplied to a kinema should be charged for as for power or as for lighting purposes. His Lordship allowed the appeal of the Supply Co., with costs, and Mr. Justice Bray concurred.

INSTITUTION NOTES.

Institution of Electrical Engineers.—Liverpool Sub-Centre.—The Sub-Centre is to be congratulated on opening to the public its meeting on April 19th, when Dr. C. V. Drysdale will deliver the Kelvin Lecture on "Modern Marine Problems in War and Peace," at the University. The event is being announced by means of posters, of which we have received a copy from the hon. secretary, Mr. O. C. Waygood, and should prove very attractive to non-members, as well as to the members of the Sub-Centre.

Western Centre.—Mr. Arthur Ellis, chairman of the Centre, presided over a record attendance of members and visitors at the fifth meeting of the present session, held at the South Wales Institute of Engineers on April 11th. The reason for the crowded audience was the delivering of a popular lecture by Prof. F. Bacon, M.A. of the University of Cardiff, on "Thermionic Valves." After referring to some of the wonders achieved by the three-electrode valve during the war, and citing various instances to show that the Allies scored over the Central Powers by outstripping them in the application of valves for naval and military purposes, the lecturer confined himself to the two-electrode valve, paying special attention to present and prospective applications of interest to those engaged in heavy electrical engineering. The characteristics of high-tension rectification with hard valves, and low-tension rectification with gas-filled bulbs and mercury arc rectifiers, were discussed at some length. The combination of hard valve, condenser, and voltmeter for reading peak voltages on tests of dielectric strength was also described and illustrated with oscillograms. The physics of hard and soft valves was dealt with in a popular manner, and illustrated by various lecture experiments in which striking use was made of the Tungar and Pointolite. The lecture was followed by demonstrations by Messrs. E Gordon Davies and F. D. Smith of a considerable variety of valves and valve apparatus kindly lent for the occasion by the Marconi-Osram Valve Co., Mr. S. R. Mullard, the Edison Swan Electric Co., the British Thomson-Houston Co., Mr. H. W. Sullivan, Dubilier Condenser Co., Power Rectifiers, Ltd., the Technical College (Cardiff), and the Physics Department, University College (Cardiff). A brief discussion followed the lecture, to which Captain Andrews, R.A.F., and Messrs. Ellis, Evans, Thomas, Chamen, jun., and C. T. Allan contributed. At the close a hearty vote of thanks was accorded Prof. Bacon for his most able and interesting lecture.

Junior Institution of Engineers.—At an informal meeting of the Institution, on April 9th, an extremely interesting lecture upon "The Development and Manufacture of Thermionic Valves" was given by Mr. A. H. Howe. The speaker commenced with a brief history of the evolution of the valve, in the course of which the principles were explained. By means of lantern slides the earlier types were illustrated, and then the various stages of improvement to the valves in present-day use were shown. The lecturer demonstrated the amplifying effects of the device by the use of three valves in cascade, and examples of many types were on view. Mr. Howe explained, as far as he was permitted, the mode of manufacture, and gave some remarkable indications of the uniformity with which thermionic valves can be produced by modern methods. The speaker referred to the use of valves by the Germans, who showed a preference for the "soft" types. Upon the conclusion of the lecture the speaker was subjected to a fire of questions, to all of which he ably replied. Many members of the audience, whose acquaintance with matters electrical was apparently not of a profound nature, evinced great interest in the discourse, but at least one gentleman did not get what he wanted. Upon entering and taking his seat he caught sight of some diagrams pinned upon a blackboard, and, turning to a friend, remarked, "I thought it was something to do with steam engines," and he *may* have meant it.

The Institute of Metals.—The position of students whose course of studies was interrupted by the war, or by special circumstances arising from the war, has been sympathetically considered by the Council. It has been decided to recommend for ballot as Student Members of the Institute candidates for election who, whilst being students of metallurgy, have passed the age limit of 25 years. Students so elected may remain in the category of Student Members up to June 30th, 1923, so long as they continue to be students of a recognised school of metallurgy. This concession represents an appreciable financial saving, as a Student Member pays only the guinea entrance fee, and guinea subscription of pre-war days. Though in operation for only a few weeks past, the arrangement, we understand, has resulted in a greater number of applications being received at the offices of the Institute, 36, Victoria Street, S.W. 1, than was the case in the whole of 1919. By a further concession, members and students elected at the forthcoming ballot on May 31st, will not only have the privilege of membership for 13 months, instead of the usual 12, but will receive an extra copy of the "*Journal* of the Institute of Metals," of which important publication volumes to the value of over £1,000 have been sold to non-members during the past 12 months—surely a unique record for a young scientific society.

Wireless Society of London.—At a meeting of the Society on March 27th, a paper was read by Capt. L. A. T. Broadwood, entitled "Harmonics in Continuous Wave Transmissions." After the paper there was an interesting discussion, in which a number of members took part, and at the close of the meeting, Capt. Broadwood was accorded a hearty vote of thanks. The President, Mr. A. A. Campbell Swinton, occupied the chair, and the business of the meeting, in addition to the election of some 15 new members, included a discussion as to the advisability of the admission of ladies to membership and associate membership to the Wireless Society. Several members spoke in favour of ladies being admitted and, on a vote being taken, the meeting was found to be unanimous. A number of members had brought interesting pieces of apparatus, and these were described and afterwards viewed with great interest. Capt. Donnisthorp was able to show and explain to the audience his recently-patented invention, in the form of a pocket-book receiving apparatus, and Mr. Powell Rees exhibited the "Polaris" receivers, which are exceedingly compact pieces of apparatus.

Diesel Engine Users' Association.—At the March meeting, the subject of insurance of Diesel engines against breakdown was considered. Some years back the Association adopted a standard form of insurance policy at Lloyds, and, as a result of experience gained in the working of this scheme of insurance with periodical inspection by independent Diesel engine experts, it was considered advisable to amend the conditions of the policy in certain respects. The new form of policy adopted by the Association eliminates from its scope claims for cracks or partial fractures, which do not in themselves result in an actual "breakdown." It was considered that not only would this alteration have the effect of eliminating in future certain difficulties and causes for dispute, but that it would be an advantage from the point of view of securing the best Diesel engine practice to make such costs chargeable to the ordinary annual maintenance account. It was pointed out that the main advantages which the user should have in mind in insuring his Diesel engine against breakdown were in the first place to secure himself against heavy financial loss in the event of an actual breakdown with, or without, resulting damage to surrounding property, and, secondly, to secure the advantages of periodic inspection by independent experts and their advice and assistance in adopting the best practice, carrying out timely repairs, and in doing everything possible to avoid the calamity of a serious breakdown.

A paper on the subject of "Obturators" was read by Mr. W. Fennell. In pointing to the advantages claimed for the use of obturators in place of piston rings in petrol engines for aeroplane

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work, the author referred to the actual power wasted in piston ring friction in many cases as being as much as 75 per cent. of the total mechanical loss in an engine. The obturator was described as a sort of "cup leather" made of thin metal. These were originally made of brass, but were now made of specially-selected phosphor bronze. They were usually placed very near the top of the piston yet they did not burn, and this was explained by their flexible nature which allowed them to keep in perfect contact with the cylinder, and consequently well cooled. The author had experimented with obturators in Diesel engines to a limited extent, and their life had been about 300 hours. Further tests were in progress, and he thought that a life of well over 1,000 hours could be expected with a new liner. With the successful use of obturators, instead of piston rings, the author considered that Diesel engine design might be considerably modified, resulting in reduced height and weight, and that this would facilitate the introduction of cross-head engines, as the question of thrust surfaces did not then come in.

Chelmsford Junior Society of Engineers.—This Society held its first annual dinner and smoking concert at the Lion and Lamb Hotel, Chelmsford, on the evening of March 31st. The President, Mr. T. E. Dann (of Messrs. Crompton & Co., Ltd.), was in the chair. The Vice-President, Mr. A. Eddington, and gentlemen who had delivered lectures during the session—Messrs. E. L. Barclay, H. Church, E. H. Field and W. C. C. Turner—were also present. The toast of "The King" was proposed by the President. Mr. E. H. Field, in proposing "The Society," said he knew the difficulties encountered in running such a Society, and thought they had done exceedingly well. In replying, Mr. A. Eddington said the Society had a membership of 43, and had held 14 meetings at which papers were read. Mr. T. Dann, also replying, said that the progress they had made by their own unaided efforts filled him with brightest hopes for the future. Mr. P. Huggins proposed the toast of "The Visitors," and Mr. H. Church replied. A smoking concert followed.

Edinburgh Electrical Society.—On April 7th the Society held an Apprentice Night. Papers on "Accumulators," "Cable Laying," and "Armature Winding" were read and discussed by apprentice members. At the next meeting, to be held on Wednesday, 21st inst., Mr. J. McEwan Brown will lecture on "The Telephone." All those interested are invited to be present at the Philosophical Institute at 8 p.m.

South African Institute of Electrical Engineers.—The *Journal* of this Institute for January, 1920, contains a report of the eleventh annual general meeting. The financial status was stated to be good—a sum of £1,500 having been accumulated and invested. The total membership increased to 355 during the year. Gold medals were awarded, to Prof. W. Buchanan for a paper entitled "The First Electric Steel Melting in South Africa," and to Mr. L. F. Botting for a paper on "Small Generating Stations and Electricity Supply Schemes." Mr. E. V. Perron was elected vice-president for 1920-21, and other members were elected to the Council. Mr. H. S. King gave an interesting lecture on "French Warfare," and a bioscope exhibition of various large constructional works concluded the meeting.

On February 19th, a paper on "Automatic Telephony" was read by Messrs. F. G. Parsons and C. Griffith, of the Post and Telegraph Engineering Department, dealing mainly with the Strowger and Western Electric systems. The authors indicated that it was intended to convert the city of Johannesburg to automatic working, up to a capacity of five figures, and ultimately to extend the system to the whole of the Reef.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

The following officials of the Bradford Corporation electricity and tramways departments have been recommended for increases of salaries by the War Wages Committee as follows: Electricity department, city electrical engineer (Mr. T. Roles) to £1,500; chief electrical engineering assistant (Mr. J. Wright) £825; mains engineer (Mr. C. A. Gillin) £132; sub-station superintendent (Mr. R. D. Spurr) £392; technical assistant (Mr. J. F. Mather) £357; mains assistant (Mr. Q. Arbuckle) £332; the general manager (Mr. R. H. Wilkinson) to £1,000; traffic superintendent (Mr. T. Stirk) and assistant electrical engineer (Mr. J. W. Dawson) £535; parcels superintendent (Mr. W. K. Fleming) £410; works superintendent (Mr. S. Pearson) £385; permanent way engineer (Mr. J. W. Foster) £460.

It is stated that Mr. J. R. Lilleker, chief assistant and deputy electrical engineer of the Rotherham Corporation electricity works, has accepted a managerial position for a large manufacturing firm in the Midlands.

Mr. H. F. Marshall, who for five years past has been on the staff of the Barrow-in-Furness Corporation as electrical engineer, is about to take up an appointment in Shanghai.

We regret to hear that Mr. J. R. Groves, general manager of the Barrow-in-Furness Corporation tramways, is somewhat seriously ill as the result of a seizure while engaged in his office.

The chairman and deputy chairman of the Manchester Electricity Committee, with the chief electrical engineer, Mr. S. L. Pearce, are to visit certain cities in America in the autumn of this year to inquire into and report on the lay-out and interworking of modern extra-high-voltage transmission and distribution systems and the most modern practice with regard to the design and operation of large generation stations for economical production. This visit was approved by the Council in 1914, but was postponed owing to the war.

Mr. F. H. Rudd, electrical engineer for Rochdale, who was one of the selected candidates for the vacancy at Peterborough, has withdrawn his application for the post. The Rochdale Electricity Committee recommends a revision of his salary, and he is remaining.

Doncaster T.C. has appointed Mr. R. H. Nuttall, of Manchester, as tram-car shed superintendent, at £275 a year.

Torquay T.C. has appointed Mr. A. J. Waring, of Walsall, as mains engineer, at £250 a year.

Mr. J. M. Keenan, deputy engineer and manager of the Torquay Corporation electricity works, who is leaving to become engineer and manager to the Isle of Thanet Electrical Co., of Margate, has been presented by the staff and employés with a silver tea service.

York T.C. is recommended to increase the salary of Mr. Sheard, tramcar superintendent, from £258 to £275 a year, and that of Mr. Peterkin, draughtsman at the electricity works, from £270 to £294.

Accrington General Purposes Committee has decided to increase the salary of the electrical engineer by £150 a year and a further £50 next April; also that of the tramways manager in a similar manner.

Saturday, March 27th, was a great day in Marylebone when Prince Albert declared the new town hall open. The Mayor (Mr. Duncan Watson, M.I.E.E.) and the Mayoress welcomed the Prince and the Princess Alice, Countess of Athlone, and entertained them, as well as the Aldermen, Councillors, and other residents, to luncheon. Mr. Duncan Watson delivered several appropriate speeches. A very fully illustrated account of the day's proceedings will be found in the *Marylebone Chronicle* for April 2nd.

The marriage took place on April 5th at St. Nicholas Collegiate Church, Galway, of Mr. F. J. Moffett, B.A., M.I.E.E., of Birmingham, to Lucy Evelyn, second daughter of Mr. and Mrs. R. B. Smith, of Galway.

Mr. R. Baker-Whittick, A.M.Am.I.E.E., at present manager of Messrs. Waring & Gillow, Ltd., electrical contracts department, Liverpool (formerly of the sales staff, British Westinghouse, Trafford Park), has been appointed chief assistant engineer to Messrs. Edmundsons' Electricity Corporation, Inverness.

A coffee set was presented to Mr. W. A. Gillott upon the occasion of his leaving the Newcastle-upon-Tyne Electric Supply Co., Ltd., after fourteen years' service, to take up the position of sales engineer to the Jackson Electric Stove Co., Ltd., who have recently purchased premises at 143, Sloane Street, London, S.W. 1, which they will shortly occupy as offices and showrooms. For many years Mr. Gillott concentrated his energies upon the development of electric cooking and heating load, which now amounts to over 10,000 kw. on the N.E. Coast network. One of his immediate tasks is to establish and organise a selling department, and he is now compiling data for the publication of catalogues, &c.

On April 8th Mr. C. Wilson, managing director of the Osram-Robertson Lamp Works, was installed in the chair as Worshipful Master of the Hammersmith Masonic Lodge. The ceremony was ably carried out by Mr. G. G. Bell, installing master and borough electrical engineer. At the banquet which followed, the new Master was supported by approximately 170 brethren and visitors, including Grand Officers Sir Newton Moore (P.P.G.M. Western Australia), P. P. Kipping, P.Asst.G.S. Wks. R. C. Collins, H. Tipper, &c. There was an excellent musical programme. Sir Newton Moore responded to the toast of the Grand Officers.

Mr. J. A. Cressey, shift engineer, at Peterborough, has been appointed charge engineer at the Barnsley municipal electricity works.

Messrs. Charles P. Sparks & Partners have taken into partnership Capt. A. C. Sparks, M.C.

On the evening of April 1st, at a Bohemian concert held in the London United Tramways club-room, Fulwell Depôt, Mr. W. M. Wright, secretary of the S. Metropolitan Electric Tramways & Lighting Co., and assistant secretary of the L.U.T., was presented, on behalf of the staff, with a solid silver tea service, upon relinquishing his appointment after 21 years' service, to take up a position in the Provinces. Mr. J. B. Mackinnon, general traffic superintendent, made the presentation.

Mr. F. H. Newman, head of the Department of Physics, University College, Exeter, has been awarded a grant of £120 by the Royal Society in order to prosecute research on a new kind of electrolytic interrupter for X-ray work, which he exhibited before the Physical Society last November.

Will.—The *Times* states that the late Mr. Claud Hamilton, managing director of Claud Hamilton, Ltd., engineers, Glasgow, Aberdeen, Ardrossan and Ayr, left personal estate of the value of £203,491.

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NEW COMPANIES REGISTERED.

Hotpoint Electric Appliance Co., Ltd. (165,887).—Private company. Registered March 30th. Capital, £100,000 in £1 shares. To carry on the business of manufacturers and importers of and dealers in domestic, industrial and labour-saving devices and electrical appliances, engineers, &c. The subscribers (each with one share) are: H. C. Levis, 83, Cannon Street, E.C.4, managing director British Thomson-Houston Co., Ltd.; A. R. Monks, 123, Cannon Street, E.C.4, solicitor. The first directors are: H. C. Levis, W. C. Lusk and J. Gray. Secretary: F. Clements. Registered office: 83, Cannon Street, E.C.

Franklin Engineering Co., Ltd. (166,122).—Registered April 7th. Capital, £50,000 in £1 shares. To take over (1) the business of an electrical, mechanical and motor engineer carried on by W. H. Franklin at Tunnel Works, Queen Street, Cardiff; and (2) the business of a bioscope and scientific instrument maker carried on by T. W. Franklin at 6, North Edward Street, Cardiff, as the Western Instrument Co. The first directors are: P. Evans, Holme Tower, Penarth, shipowner; H. G. D. Cory, Mount Stuart House, Cardiff, shipowner; F. O. Cory, Padstow, Whitchurch, Glam., shipowner; R. E. Duck, Rhosslyn, Heath Park Avenue, Cardiff, engineer; W. H. Franklin, 69, Mardy Street, Cardiff, engineer; T. W. Franklin, 6, North Edward Street, Cardiff, electrical engineer. Secretary: A. D. Jones. Registered office: 233, Cowbridge Road, Cardiff.

Aurolite Electrical Supplies, Ltd. (165,924).—Private company. Registered March 31st. Capital, £3,000 in £1 shares. To manufacture and deal in apparatus and appliances for use in connection with electricity or gas for light, heat or power, &c. The first directors are: J. A. Ward, Westness, Sutton, Surrey; A. S. Gregg, 19, Clifford Road, East Finchley, N.2; J. F. Atkinson, 58, Elgin Crescent, North Kensington, W. Solicitor: A. Glynne-Jones. Registered office: Cromwell House, Surrey Street, Strand, W.C.

Lumo, Ltd. (165,967).—Private company. Registered March 31st. Capital, £8,000 in £1 shares. To take over the business of a manufacturing chemist carried on by J. H. Piddock at 79, Lincoln's Inn, Corporation Street, Birmingham, as "J. H. Piddock & Co.," to carry on the same and the business of manufacturers of and dealers in the compound known as "Lumo Washeasy," manufacturers of and dealers in electrical appliances and labour-saving devices, &c. The subscribers (each with one share) are: D. G. Brooks, 88, College Road, Moseley, Birmingham, electrical engineer and merchant; G. C. Gray, 17, Oval Road, Gravelly Hill, Birmingham, electrical engineer. First directors not named. Solicitor: D. Cochrane, 55, Temple Row, Birmingham. Registered office: 79, Lincoln's Inn, Corporation Street, Birmingham.

Magic Sign Co., Ltd. (166,106).—Private company. Registered April 7th. Capital, £1,000 in £1 shares. To acquire from F. S. Gee the benefit of certain inventions relating to display devices, and to carry on the business of manufacturers of and dealers in advertising apparatus, plant and material, &c. The first directors are: F. S. Gee, 23, Compton Crescent, Chiswick, W.4; W. A. Dunn, 76, Amhurst Park, N.15. Solicitors: Strong and Bolden, 70, Gracechurch Street, E.C. Registered office: 13, Gate Street, Kingsway, W.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Keighley Electrical Engineering Co., Ltd.—Capital, £10,000 in £1 shares (3,000 preference). Return dated November 12th, 1919. 4,200 ordinary and 1,800 preference shares taken up. £3,988 paid. £2,012 considered as paid. Mortgages and charges, £5,000.

Cross & Cross, Ltd. (105,754).—Capital, £5,000 in £1 shares. Return dated February 23rd, 1920. All shares taken up. £4,845 paid. £155 considered as paid. Mortgages and charges, £600. Capital increased to £20,000 in £1 shares on March 10th, 1920.

Seear, Scott & Co., Ltd.—Particulars of £1,000 debentures authorised November 26th, 1919. The whole amount being now issued. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trustees. Mortgage dated March 22nd, 1920, to secure £640, also registered. Property charged: 49-55, St. Peter's Street, Coventry. Holder: C. Pace, 125, Brighton Road, Croydon.

Dood & Oulton, Ltd.—Satisfaction in full on March 24th, 1920, of debentures, dated July 1st, and October 5th, 1908, securing £5,000.

Switchgear & Cowans, Ltd.—Satisfaction in full on March 18th, 1920, of debentures dated October 27th, 1911, and June 4th, 1912, securing £3,500. Issue on June 4th, 1920, of £800 debentures, part of a series.

Frank Towey & Co., Ltd.—Mortgage dated March 20th, 1920, to secure all moneys due or to become due from company to London Joint City and Midland Bank, Ltd., charged on certain land and premises in Birmingham.

CITY NOTES.

W. T. Henley's Telegraph Works Co., Ltd.

Mr. George Sutton presided at the annual meeting held on April 9th. He said that on the debit side of the balance sheet the item of creditors and contingent reserves and reserve for special taxation showed an increase of about £148,000 over last year. That was caused to some extent by the reserve for special taxation. If the directors' proposals were adopted the reserve account would be brought up to the substantial sum of £150,000, so it would be seen that they did not anything like exhaust their reserves when they made the distribution of bonus shares. Last year he told them that they would be spending very large sums on buildings and plant, but the buildings contracted for in the early part of last summer were still very far from complete owing to labour and other difficulties. Probably some time this year they might have the new buildings earning revenue. Stock-in-trade had increased from £229,000 to £457,000. That was what they would expect from the higher prices, coupled with the fact that they were now able to make stock, which they could not do twelve months ago. Really they had about doubled their stock. The debtors were £40,000 more than in the previous year, and the cash at bankers was £118,000, as against £213,000 in the year before. Turning to the profit and loss account there was a curious similarity, the figures of the trading account differing from those of the previous year by only a few pounds. Last year the account was not subjected to as large an amount for excess profits duty as in the previous year, as the duty was reduced 40 per cent. last year. On the other side, they had written off £25,000 for depreciation on machinery, &c. The previous year they wrote off £35,000, but that was largely to deal with machinery and plant which had been acquired for the purposes of the war, and £25,000 they had written off this year was quite a large and ample sum. They were carrying forward to the profit and loss account £20,000 more than in the previous year, and after paying the dividends proposed they would carry forward £141,000 as against £122,000 brought into the account. The accounts gave them the same healthy and robust state of things which they had been accustomed to in connection with the company for many years past. They had had more orders during the past year than they had been able to carry out—that referred both to the overseas and the home trade. Although they recognised the value and the need for export trade, they had considered that the policy of the company should always be to satisfy the needs of their customers in the home trade first. They had not been able to satisfy even all their needs, although on the whole they had done very well for them. They were always behind with their orders owing to the delay in getting raw material, &c., and output had been restricted by the shortened hours of labour. He was not complaining of their workpeople in any way, but they had not got back to the output that they had before the hours were shortened. They were now working a 47 hour week as against 54. He was glad to say that their relations with their workpeople had continued to be very satisfactory. They had had no trouble during the year. The Cable Makers' Association, in conjunction with the trade unions who were interested in the people working in their factories, had established a Whitley Council, which met once a month. District Councils met more frequently, and they had had no serious differences of opinion. The Council worked very well, and he was hopeful that in the future they would be outside the turmoil that seemed to be going on with labour in many industries. As in the past year there had been an abundance of work, so in the immediate future they did not doubt that they could get more work than they wanted. Trading to-day, however, was very different to what it was in 1914, the year before the war. In some respects, such as higher rates of wages, it might be that the present rates might be considered the minimum for the future, but in regard to taxation he believed it was essential for the success of industry that direct taxation, such as the excess profits duty, should not be put upon them. In 1914, and perhaps for 20 or 25 years prior to that time, the company was subjected to taxation of about £12,000 a year. In 1919 the taxation amounted to £100,000, and that was considerably below the average taxation for the war years. They had paid for excess profits duty the huge sum of roundly £400,000. On the other hand, the dividends paid to the shareholders, prior to the war, in 1914 was £49,000, and the dividend to-day absorbed £69,000. Hitherto the company's business had relief for its extension upon its undivided profits, and the course they had adopted had been a benefit to the nation, to the company, and to those who worked for it. It might be said that they had done what they had for their own advantage, but if they took away that advantage by a severe limitation of profit, the nation, the company, the capitalist and the workman would all be the poorer. There had been an enormous demand for capital for industrial purposes since the war, and about 150 millions had been asked for since January 1st. They would naturally expect that they would want more capital in that company. The increase of profits shown in recent years did not give an accurate idea of the amount of business they had been doing. The profits tended to decrease year by year as the percentage of the turnover of the business increased. Their percentage of profits was not so great now as it was five or ten years ago, but the business itself had greatly increased, not only in value but also in quantity. He thought they would agree that that was a very healthy state of things which they would not desire to see altered, but it brought with it the need for more capital. As he had said, it had been their custom for a good many years to find the capital for the extension of the business out of their undivided profits, but at the present time that source was to a very great extent closed. They had large expenditure coming on in the immediate future—they had commitments for buildings and plant which roundly came to £150,000. On the credit side of the balance sheet they showed that they had in war loans and other securities and cash a sum of about half a million sterling. Some of that, however, had to go away in taxation. He thought it was very likely they might be able to get along without asking the shareholders for more capital. The business was showing abounding prosperity. The orders brought forward from the past year, added to those taken this year, actually exceeded the whole of last year's turnover. That all had a direct bearing upon the capital requirements of the company, and they also had the tire company to consider. They had put nearly £200,000 into that company, and the justification for it was the success which

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the company had attained. They knew that Henleys had been very successful in their trading with electric cables for the last 35 years, but there was no success which had been so quickly acquired as the success which they had attained in the manufacture of pneumatic and solid tires. The establishment of the tire company was a good thing for them, but it would require more capital. They could not stand still, and they were extending the factory. Everything pointed to their wanting new capital, but he felt that if they should want more money they could call the necessary meetings and raise all the capital they would require in the course of a few weeks. For that reason the directors had decided not to deal with the question then, for it might be that they would be able to do without any new capital. A resolution was agreed to authorising the directors to apply out of the funds of the company a further £5,000 for the benefit of the staff pension and deferred pay funds.

The Allmanna Svenska Elektriska A.B.

The report of the directors of the Allmanna Svenska Elektriska A.B. (General Swedish Electrical Co.), of Vasteras, has just been issued for 1919, which is the 37th year of the company's existence. The report states that activity during the year was characterised by the transition from war to peace conditions, but the effects of the war were still far from being overcome, and some years would probably elapse before the industry was again brought into a state of equilibrium. The prices of materials fluctuated rapidly, and the cost of labour showed a constant tendency to increase, this being contributed towards by the reduction in the working shift and the unrest in the labour market. The result of last year's working was influenced to a not inconsiderable degree by the falling prices of materials and the growth in working expenses, although the prices of the company's manufactures were increasing. As a result of the absorption of Surahammars Works A.B. and the Nya Forenade Elektriska A.B., the central management had been reorganised so as to secure increased efficiency for the different departments and clearly definite responsibility. During the year the company's liquidity was considerably improved, partly on account of the release of the capital tied up in goods which was rendered possible by the resumption of free communication after the cessation of the world war, and partly through the funds derived from the new issue which was carried out in 1919. The amount of the disposition fund which was not required for covering the taxes for the years 1916 and 1917 had been transferred to the reserve fund.

The activity of the department for electrical installations proceeded on normal lines; the high cost of coal hastened the use of water powers, and rendered possible the utilisation also of waterfalls which were formerly considered to be uneconomical for the purpose. In the case of agriculture electrification was being continued, whilst the long-pending question of the conversion of the railways to electrical working was rapidly approaching a solution, and considerable orders in this branch were received from Scandinavian countries during the year. The export of electrical machinery was resumed in July. New markets had been obtained in the West of Europe, but trade with the East of Europe continued at a standstill. The exports, however, were rendered difficult by the prevailing conditions of exchange and the need of a stabilised currency system was all the more perceptible. After referring to the iron and steel and other departments, the report mentions that the total staff and workmen numbered 7,220 at the end of the year, and that the profit sharing system approved a year ago for leading members of the staff was now in operation. The expenses for the welfare arrangements had declined and were expected to be further reduced in the near future.

After writing off 1,338,000 kr. for depreciation, as compared with 1,280,000 kr. in 1918, the accounts show net profits and balance forward amounting to 8,313,000 kr., as against 7,790,000 kr. in 1918 and 16,610,000 kr. in 1917. It is proposed to pay a dividend of 10 per cent. on share capital of 75,000,000 kr., this contrasting with 15 per cent. on 50,000,000 kr. in 1918, leaving 818,000 kr. to be carried forward. The turnover last year experienced a decrease of 5,000,000 kr., but the company's debts were reduced by 26,000,000 kr.

German Companies.

The directors of the *Lloyd Dynamo Werke A.G., of Bremen*, recommend the payment of a dividend of 7 per cent. for 1919, being the same rate as in the previous year.

The *Elektrizitats Lieferungs Gesellschaft, of Berlin*, proposes to pay 12 per cent. out of net profits of 3,950,000 marks in 1919, as contrasted with 10 per cent. and 3,274,000 marks respectively in 1918.

The *Welter, Elektrizitats und Hebezeug Werke, A.G., of Cologne-Zollstock*, reports net profits of 135,000 marks for 1919, as against 84,000 marks in the preceding year. It is intended to distribute 10 per cent., as compared with 8 per cent. in 1918.

The directors of the *Hochfrequenz Maschinen, A.G., fur Drahtlose Telegraphie, of Berlin*, recommend for 1919 a dividend and bonus of 35 per cent. on the "A" shares, as compared with 20½ per cent. in 1918, and 92.8 per cent. on the "B" shares, as against 49.1 per cent. in the preceding year. The net profits are returned at 1,897,000 marks, as contrasted with 588,000 marks in 1918.

The net profits of the *Sachsenwerk Licht und Kraft, A.G., of Dresden-Niedersedlitz*, increased from 1,930,000 marks in 1918 to 2,240,000 marks last year. It is proposed to pay a dividend of 20 per cent. for 1919, being the same rate as in 1918, when less share capital participated in the distribution. An abundance of orders at adequate prices is reported for the present year, but expenses have increased and raw materials are difficult to obtain.

The *Ges. fur Elektrische Hoch und Untergrundbah, of Berlin*, reports net profits of 1,542,000 marks for 1919, as compared with 4,050,000 marks in the previous year, and a dividend at the rate of 5½ per cent. is recommended, being the same rate as in 1918. It is stated that the price of coal, which cost the company 16 marks per ton before the war and 81 marks in 1919, is now over 250 marks per ton.

The directors of *Siemens Elektrische Betriebe, A.G., of Berlin*, report gross profits of 4,230,000 marks from electricity supply works and investments in 1919, as compared with 3,730,000 marks in the previous year. After making provision for depreciation it is necessary to place 2,360,000 to reserve in order to equalise differences in exchange, so that there only remain net profits of 67,000 marks, as against 1,970,000 marks in 1918, when a dividend at the rate of 5 per cent. was paid. The balance for 1919 has been carried forward.

Vickers, Ltd.—The directors announce that, owing to the immense volume of work executed for the Government during the war years—much of which, due to extreme urgency, had to be undertaken by the company without prices being fixed—there are Government contracts yet remaining unsettled, some reaching back as far as 1916. It is still, therefore, not possible to present the accounts for 1916, or any of the subsequent years. The final accounts up to the end of 1919 may be presented before the end of the current year. Considering the necessity for preserving and increasing the financial strength of the company while changing over from war to peace products, the directors have decided to declare a final dividend for 1919 of 1s. 3d. per share, or 6¼ per cent. (free of income tax up to 5s.). This, together with the interim dividend declared in August, 1919, will make a total dividend for the year of 2s. 3d. per share, or 11¼ per cent. (free of tax up to 5s.). The main works of the company, and of the companies associated with it, are well filled with orders.

Madras Electric Tramways (1904), Ltd.—Mr. A. M. Quill presided on April 7th at the annual meeting. He said that the Mount Road extension was commenced immediately after the Government Order was issued last July. Good progress had been made with the permanent way, but in consequence of labour troubles at home considerable delay had taken place in the shipment of poles and other materials, and some time would elapse before the extension could be opened for traffic. When the line was completed important extensions of the system would become practicable, but progress with these would depend upon a substantial reduction in the prices of tramway materials, of which there was no indication at present. After referring to the improvement in the traffic receipts (9 per cent.), and to the demands of the employés for higher wages to meet the cost of living, the chairman said that they were considering the advisability of applying to Government for authority to increase the fares authorised by their Government Orders.

Stock Exchange Notices.—The committee has ordered the undermentioned to be officially quoted:—

Brompton & Kensington Electricity Supply Co., Ltd.—166 ordinary shares of £5 each, fully paid, Nos. 34,085 to 34,250.

Pennsylvania Water & Power Co.—$2,154,000 first mortgage sinking fund 5 per cent. gold bonds, 1940, of $1,000 each, within Nos. 8,506 to 10,940.

British Electric Transformer Co., Ltd.—The accounts for 1919 show that after paying all manufacturing costs and expenses of administration the net profit is £48,038, plus £3,964 brought forward. There is put to reserve £10,000, to depreciation reserve £3,000; 6 per cent. preference dividend £8,407; 10 per cent. on the ordinary shares, and bonus of 2½ per cent. £17,550; extra remuneration to directors £2,522; carried forward £10,523.

Monte Video Telephone Co., Ltd.—Interim dividend on the ordinary shares for the half-year at the rate of 6 per cent. per annum, free of tax.

Indo-European Telegraph Co., Ltd.—Final dividend of 22s. 6d. per share, making 7 per cent., free of tax, for 1919; also distribution out of the equalisation of dividends fund of 15s. per share, free of tax, making 10 per cent. for the year.

Northern Electric Co. (Montreal).—Dividend 3½ per cent. for 1919. Foreign exchange situation a very serious factor, costing the company $252,172 for the year.

Consolidated Electrical Co., Ltd.—Dividend on the ordinary shares for the year ended March, 1920, 3½ per cent., against 2½ per cent. for the previous year. Carried forward £1,685.

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Electrical Utilities Corporation, Ltd.—Quarterly dividend of 1¼ per cent. on the preferred stock.

Shawinigan Water & Power Co.—Net revenue for 1919 $1,473,743, as compared with $1,410,093. To depreciation reserve $300,000. Dividends 7 per cent.

Bell Telephone Co. of Canada.—Quarterly dividend of 2 per cent., less tax.

STOCKS AND SHARES.

Tuesday Evening.

There is nothing very much to be said this week for the consolation of the investor. It would be indeed amazing were Stock Exchange markets to exhibit any particular degree of strength, having regard to the forces arrayed against confidence and hopefulness. The Budget and the French exchange, the trouble on the Continent, and the renewed labour restlessness at home, the stream of new issues and the possibility of a rise in the Bank Rate—it would be hard to imagine any fresh element that might make things worse than this combination of adverse conditions. To put money on deposit at some modest rate and leave it there until the air clears—this is the course advocated by many people nowadays, and one which they are apparently following, if the quietude of business in Stock Exchange markets may be taken as a trustworthy guide. The flatness of Monday was compensated by partial recoveries on Tuesday, when the Anglo-French rift looked less threatening, and perhaps prices may pick up after the Budget provisions are officially announced.

The demand of another £1 per week by the railwaymen is the more serious from the inference it holds of agreements between employers and employed being held of no value by the latter when they want to vary the terms. Sanctity of contract is deemed to lie at the base of all business, in this country at any rate, and if that goes, what can be substituted in its place? A rise in railwaymen's wages of £1 a week would introduce further advances in the cost of living and fresh demands for more pay on every hand. It is inevitable that money should shun shares in companies where profit-earning capacity is liable to be interfered with a month after a threatened strike is settled by agreements signed for a year or more.

Underground income bonds are 2 lower at 72, and Metropolitans ½ down at 21, but Districts rose to 19. Other traction issues are easier. Bombay Electric preference have come down 25s. to 17½. The ordinary shares, after their meteoric spurt, are quoted lower at 130 middle, with business done the other day at 125. Mexicans are flat. The Light and Power Common and preferred have both shed 5 points, and the bonds lost 2½. Mexico Tramways Sixes are marked down to 24, and changed hands at 23¼. Other Mexican utilities have moved similarly. British Columbia Electric Railway preferred, after a drop to 46¼, rallied to 49¼, which makes the yield work out to over 10 per cent. on the payment of 5 per cent. dividend. Brazilian Tractions remain at 50. A timid inquiry for London and Suburbans—on the fare-raising proposals—failed to advance prices of the shares.

In view of the changed circumstances of the times, a few companies have already raised the dividends on their preference shares. Obviously it presses harshly upon investors in senior issues, that they should be obliged to take a modest 5 per cent., or thereabouts, on money they have furnished to a company in bygone days, when to-day's appeals, even from that same undertaking, may offer 7½ or more per cent. on security practically identical. There is so much to be said, on both sides of the subject, that it cannot be more than mentioned in a paragraphic manner, but the question is closely occupying the attention of many directorial boards at present.

Electricity Supply shares show a few mixed movements. County ordinary, Charing Cross ordinary, and South Metropolitan preference are firmer. City Lights and Westminsters are both ½ down. Business is meagre, as usual at this season of the year. Nor do manufacturing shares display any particular activity. British Aluminium at 25s. 7½d. are ex rights, and so are India-Rubber shares at 13½. On the latter, the premium varied between sixpence and a florin. Metropolitan-Vickers preference went back to 2⅝, and Vickers fell to 31s. 3d. on disappointment with the dividend, though subsequently the price rallied to 32s. 6d. General Electrics and Siemens are easier. Cromptons at 22s. have gained sixpence. Edisons remain about 22½.

Thursday in this week was the last day for sending in applications for the new issue of shares by the four big cable companies in the Eastern group. The prices kept up strongly to the finish. This served to harden the existing securities. Eastern ordinary is up 3. Globes and Westerns are both 5s. higher, joining Westerns at the common level of 15s. 4d. At this price the yield comes to a little over 6½ per cent. on the money, equivalent to 9¼ per cent., less tax, at 6s. in the pound. Marconis rose to 4, reacted to 3¾, and recovered to 3⅞. It is said that the idea has been revived, and is likely to be put into execution, of proceeding with the wireless-chain project that was interrupted by the outbreak of war. Indo-Europeans are at present unchanged on a reduction of 3 per cent.—to 10 per cent.—in the dividend.

It may perhaps—diffidence urges a little dubiety—be of some slight interest to remark that this particular article on stocks and shares has just attained its majority. In twenty-one years there have appeared 1,092 articles, and without any special count having been kept of the number, it is fair to say that well over a thousand of these have been penned by the same hand. The scope of financial interest in stocks and shares connected with the electrical industry has widened enormously during the period. If there be one thing more than another that stands out as a special feature, it is the way in which individual finance is gradually being replaced by a condition of affairs in which internationalism is the prime factor. The Paris exchange is rocky and Brazilian Tractions feel its effect. A strike in America is reflected in shares of manufacturing companies over here, and so on. It would be more beguiling to the writer than to his indulgent reader to dwell at length upon other striking aspects of financial affairs connected with the electrical world during the past twenty-one years. But the temptation shall be avoided. Nor is it altogether certain that Editorial censorship will allow to be printed a little expression of gratitude to those who have followed these Stock Exchange letters week by week.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1918.	Dividend 1919.	Price April 18, 1920.	Rise or fall.	Yield p.c.
Home Electricity Companies.					
Brompton Ordinary	8	12	6½	—	£9 4 8
Charing Cross Ordinary	4	7	8⅝	+ ⅛	9 0 8
do. do. do 4½ Pref.	4½	4½	2⅝	—	8 8 8
Chelsea	8	4	8	—	6 8 4
City of London	8	10	13	— ⅛	7 13 10
do. do. 6 per cent. Pref.	6	6	9½	—	6 9 8
County of London	7	8	9½	+ ⅛	8 13 10
do do. 6 per cent. Pref.	6	6	8½	—	6 17 2
Kensington Ordinary	6	7	5	—	7 0 0
London Electric	Nil	2½	1⅜	—	5 2 6
do. do. 6 per cent. Pref.	6	6	8½	—	9 4 8
Metropolitan	5	6	38	—	8 5 6
do. 4½ per cent. Pref.	4½	4½	21⅜	—	8 0 0
St. James' and Pall Mall	10	12	6½	—	8 16 10
South London	5	6	9⅜	—	7 12 8
South Metropolitan Pref.	7	7	11/-	+6d.	7 0 0
Westminster Ordinary	8	10	5⅜	— ⅛	8 17 10
Telegraphs and Telephones.					
Anglo-Am. Tel. Pref.	6	6	83½	— 8	7 8 9
do. Def.	33/6	1½	18½	— ½	8 0 0
Chile Telephone	8	6	6⅜	—	*1 13 2
Cuba Sub. Ord.	7	7	10	—	*7 0 0
Eastern Extension	8	10	15½	—	*6 10 1
Eastern Tel. Ord.	8	10	157½	+8	*6 7 0
Globe Tel. and T. Ord.	8	10	15½	+ ½	*6 11 2
do. do. Pref.	6	6	9½	— ½	6 9 9
Great Northern Tel.	22	—	22½	—	9 15 6
Indo-European	18	10	48⅜	—	5 8 1
Marconi	25	—	3¾	+ ⅛	6 8 10
Oriental Telephone Ord.	10	—	2⅛	+ 1/16	8 14 4
United R. Plate Tel.	8	—	7⅜	—	*5 8 3
West India and Panama	1/8	—	1 1/16	—	5 19 0
Western Telegraph	8	10	15½	+ ½	*6 11 2
Home Rails.					
Central London Ord. Assented	4	4	47½	—	8 8 6
Metropolitan	1	1½	21	— ⅛	5 19 1
do. District	Nil	Nil	19	+ ⅛	Nil
Underground Electric Ordinary	Nil	Nil	2½	— ⅛	Nil
do. do. "A"	Nil	Nil	7/-	—	Nil
do. do. Income	5	4	72	— 2	5 11 1
Foreign Trams.					
Anglo-Arg. Trams. First Pref.	Nil	Nil	8⅜	—	—
do. do. 2nd Pref.	—	—	5⅜	—	—
do. do. 5 Deb.	5	5	62½	—	7 15 0
Brazil Tractions	—	—	50	—	—
Bombay Electric Pref.	6	6	17½	—1½	8 8 7
British Columbia Elec. Rly. Pfce.	5	5	59⅛	—	8 5 4
do. do. Preferrred	2½	5	49⅜	—1	10 10 6
do. do. Deferred	Nil	3	42½	—	7 1 2
do. do. Deb.	4½	4½	56⅜	—1	7 10 5
Mexico Trams 5 per cent. Bonds	Nil	Nil	85⅜	—	Nil
do. 6 per cent. Bonds	Nil	Nil	24	—2	Nil
Mexican Light Common	Nil	Nil	12½	—5	Nil
do. Pref.	Nil	Nil	22½	—5	Nil
do. 1st Bonds	Nil	Nil	44	—2½	—
Manufacturing Companies.					
Babcock & Wilcox	15	—	8¾	—	*4 16 2
British Aluminium Ord.	10	10	1 3/32xd	—	7 16 0
British Insulated Ord.	12½	15	11⅞	—	7 14 8
Callenders	25	—	8¼	—	7 5 10
,, 6½ Pref.	6½	6½	4⅜	—	6 16 10
Castner Kellner	20	—	4	—	—
Crompton Ord.	10	—	23/-	+6d.	9 1 10
Edison-Swan, "A"	10	—	1⅛	—	8 17 10
do. do. 5 per cent. Deb.	5	5	79½	—	6 5 9
Electric Construction	10	—	23/-	—	8 13 10
Gen. Elec. Pref.	6½	6½	18/6	—	7 0 6
do. Ord.	10	—	1⅜	— 1/16	*5 14 4
Henley	25	15	2⅜	—	6 6 4
do. 4½ Pref.	4½	4½	8⅜	—	6 4 3
India-Rubber	10	—	13½xd	—	*7 8 2
Met.-Vickers Pref.	—	8	2⅜	— ⅛	6 2 0
Siemens Ord.	10	10	24/-	—6d.	*7 2 10
Telegraph Con.	20	20	24½	—1	*4 16 0

* Dividends paid free of Income Tax.

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NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

The "Kingsway" Telephone Bracket.

Desk telephones are easily knocked over and broken, and are seldom found in a convenient position when required in the rush of business. The General Electric Co., Ltd., of 67, Queen Victoria Street, E.C. 4, has recently put on the market a new form of bracket for dealing with this inconvenience, the "Kingsway," fig. 1. This device has an extension of 30 in., the instrument is firmly gripped by one end of the bracket, while several types of base can be supplied to enable the bracket to be fixed to a wall or to the side or top of a desk. It is self-balancing and free to move in any direction, having a special motion giving height adjustment and being swivelled at the base. The "Kingsway" telephone bracket is well finished in oxidised copper.

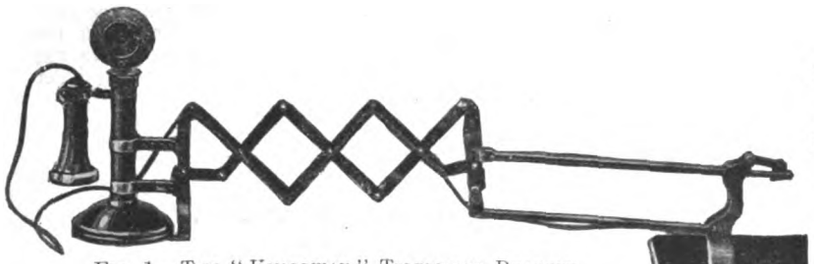

Fig. 1.—The "Kingsway" Telephone Bracket.

A Portable Wireless Receiver.

The following is a brief description of the portable receiver used in a demonstration by Mr. R. C. Clinker, of the British Thomson-Houston Co., Ltd., 83, Cannon Street, E.C.4, at a meeting of the Wireless Society of London on January 29th last. This set, which measures 13 in. by 14 in. by 5 in., is completely self-contained, and comprises within its case a receiving coil, tuning condenser, two B.T.H. valves, accumulator, dry battery, transformers, and a reaction coil. The receiving coil is wound upon a frame which fits inside the outer case with a small air space between coil and case. Inside the receiving coil is placed all the apparatus enumerated above. The cover is fitted with "lift-off" hinges, and has fixed on its inside face a projecting pin surrounding which is a large circular scale marked with the points of the compass, fig. 2. The case has a co-operating socket led into its base which allows of the whole set being placed on the pivot and turned easily on a vertical axis, fig. 3, so that the line of direction in which the received signals are travelling can be found. A small compass card fixed to the cover enables the latter to be placed approximately correctly relatively to the points of the compass. These details are seen in the illustrations, figs. 2 and 3. The connections of the set are such that the first valve is used as a detector, and the second as a low-frequency amplifier. A hinged reaction coil is provided which is connected in the "plate" circuit of the first valve and the coupling of which to the receiving coil may be varied by adjustment of its angular position. At a certain closeness of coupling the detecting valve commences to oscillate at a frequency depending upon the inductance of the receiving coil and the capacity of the condenser connected across it. When signals are to be received, whether from spark or continuous-wave stations, the condenser is set to give the correct wave-length, and the reaction coil is closed in until oscillation commences, when the signals are heard. Spark stations also are thus "heterodyned," and their true notes are modified, but can be read clearly. The set can be provided with sufficient capacity to tune between the limits of 2,000 and 15,000 metres wave-length, so that Paris time signals can be taken, and long wave stations such as Carnarvon and Lyons read. In all, about a dozen of the largest stations in England, France, and Germany may be read, and several more heard, without any additional wire. The signals obtained thus, while not, of course, loud, are clearly readable in a reasonably quiet room. To obtain the direction from which signals are coming, the case is rotated on its pivot, fig. 3, until the signals sink to a minimum or become inaudible. A pointer then indicates on the scale the direction, or one 180 deg. removed from it. The accumulator is of an "unspillable" type, and can be sent out with the set, ready charged for immediate use. A plug switch is provided for lighting the valve filaments, the handle of the plug being of such length as to prevent the case from closing if the filaments have been left alight. The weight of the complete set is 20 lb., and it requires no aerials; it should, therefore, be of interest to technical colleges, large works, watchmakers, &c., desiring to secure the correct Greenwich mean time daily.

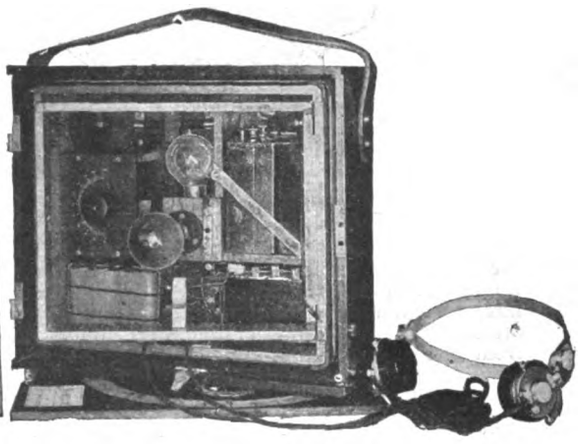

Fig. 3.—Wireless Receiver Mounted on a Pivot, with Telephone Connected Ready for Use.

Wiring Connector Box.

Messrs. Ward & Goldstone, Ltd., Sampson Works, Salford, Manchester, manufacture the connector box shown in fig. 4, which can be employed for practically any wiring system. It can be used as a 2 or 3-way joint box and a number of wires can be taken off each of the contacts. The box is of porcelain, the cover being fixed by means of penetrating studs and external nuts. The terminals are of substantial construction, and able to carry a current up to 25 amps. Wires can be introduced through either the base or top of the box.

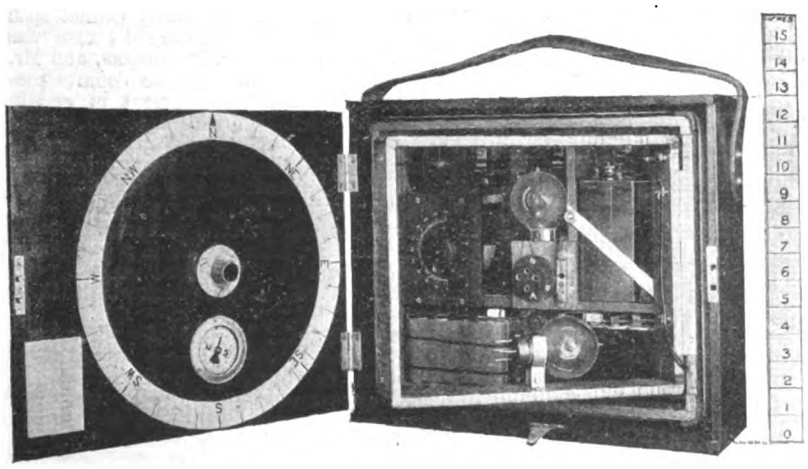

Fig. 2.—B.T.H. Portable Wireless Receiver with Cover Open.

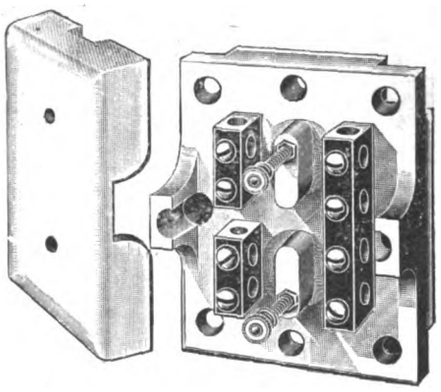

Fig. 4.—Connector Box

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Reyrolle Telephone Terminal Box.

A new type of telephone dividing and sealing box has recently been designed and produced by Messrs. A. Reyrolle and Co., of Hebburn-on-Tyne. This box (fig. 5) has been specially designed for use in power stations, and the arrangement of terminals with ample space between them simplifies

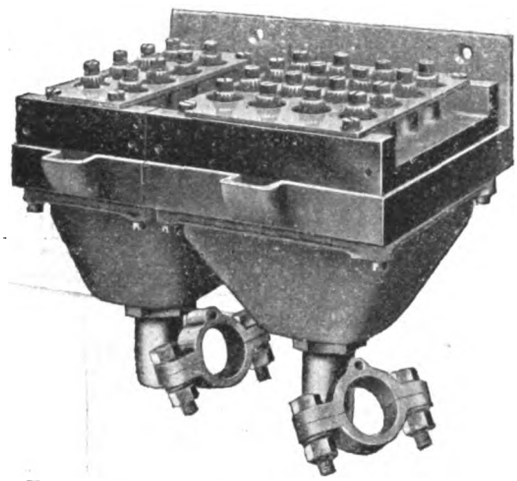

Fig. 5.—Reyrolle Telephone Terminal Box.

the making of connections and at the same time eliminates the danger of short circuits. The cables are brought into the box through screwed wiping glands, and armouring clamps are supplied. A plain sheet-iron cover protects the terminals from dirt and dust.

The Lodge Igniter.

At the recent Motor Boat Exhibition, at Olympia, Messrs. Lodge Bros. & Co., of Rugby, exhibited several types of igniter for use on both motor car engines and large gas engines. The Lodge igniter is used in precisely the same way as an ordinary single-trembler coil, with the usual battery and spark plugs. A H.T. distributing device on the camshaft is required for use with the igniter on all 4- and 6-cylinder engines. The coil is the special feature of the Lodge system of ignition. The essential difference between this and ordinary H.T. coil ignition is the presence within the former of special glass condensers or Leyden jars. These jars store up H.T. current induced by the secondary winding of the coil, and at the required moment release the whole of their contents across the sparking plug points with an impulsive rush of stored-up energy in the form of a high-frequency electric discharge, oscillatory in character, and of high velocity and heat. The Lodge spark is entirely different in character to the ordinary H.T. spark as produced either by coil or magneto; it is an explosive white-hot spark of great brightness and intensity. Instead of passing quietly through any deposits on the spark gap, the spark, it is claimed, blows all accumulations away, and actually keeps

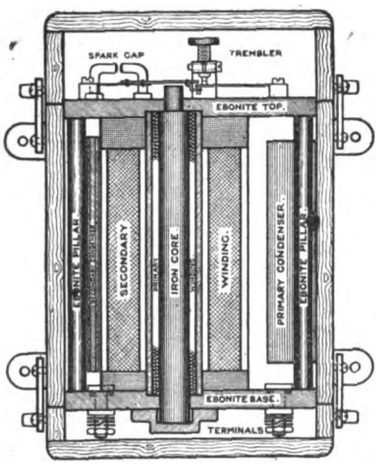

Fig. 6.

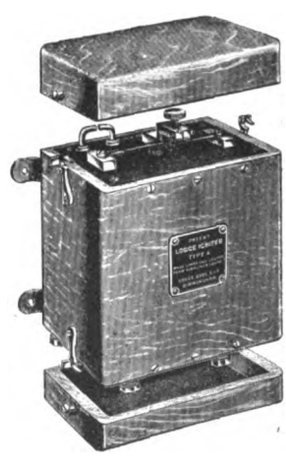

Fig. 7.

The Lodge Igniter.

the gap clear for itself. The spark from an ordinary coil or magneto is a steady flow of current in one direction, which passes quietly and easily. The Lodge spark is an oscillatory high frequency current, momentarily of large capacity. It is, in fact, a Leyden jar discharge, which surges backwards and forwards across the plug points.

In the Lodge igniter the terminals of the coil are not connected to the sparking plug directly as usual, but are led to it through the intervention of a pair of coated insulators, or Leyden jars, with their outer coatings short-circuited by a leak or imperfect conductor, the object of which is to keep them always at the same potential except at the instant of a sudden electric rush. Accordingly there is no strain thrown upon the leads or the sparking plug, whose terminals remain at the same potential up to the last moment when the two jars are full and overflow, at which instant everything is liberated, and with a rush the jars empty themselves across the spark gap and round the complete circuit through the sparking plug.

The chief pattern at present in use for motor-car purposes is the type A, illustrated in fig. 7 and in section in fig. 6.

The trembler will give very accurate timing even at the highest speeds; at the same time it is an easy one to adjust, and not very sensitive to a small change of setting. The contact points are made from pure platinum-iridium and are substantial in size. The trembler and the spark-gap are placed under the upper lid, and the four terminals, which are completely enclosed, under the lower lid.

The igniter is mounted in a strong wood, weather-proof case, and its insulation is of high quality. The secondary winding is wound in sections, not in layers, thus the electrical strain is evenly distributed. All connections inside the igniter are sweated together. On a 4-cylinder engine the average current taken is 0.75 amp., and on a 6-cylinder engine about 1.25 amp.

THE FARADAY SOCIETY.

At the March meeting of the Faraday Society, Dr. E. J. Russell, F.R.S., Director of the Rothamstead Experimental Station, opened a general discussion on "Basic Slags: their production and utilisation in agriculture." Prof. F. G. Donnan, C.B.E., F.R.S., presided over what proved to be a very fruitful discussion.

The idea underlying the arrangement of the meeting was to bring together the metallurgical and agricultural chemists interested in the subject to enable them to state their requirements and difficulties to one another, so as to facilitate solution of the many complex problems involved. Before the meeting broke up it was keenly felt that the most should be made of so useful—and unusual—a rapprochement between such diverse interests, and a very practical outcome was a decision to form a Standing Committee of agriculturists and metallurgists, and a resolution inviting the Ministry of Agriculture to act as the honest broker in this union, an invitation cordially accepted by Mr. Lawrence Weaver, C.B.E., speaking informally on behalf of the Minister.

The agricultural side of the question: The value of basic slag as an artificial fertiliser, the importance of increasing supplies of it, and the possible demands on the part of the farmer, were comprehensively and lucidly formulated by Sir Thomas Middleton, K.B.E., Sir Daniel Hall, K.C.B., F.R.S., and Mr. G. Scott Robertson. This aspect of the subject must not detain us here, of general interest though it be.

The problem for the steel maker was tersely stated by Dr. Russell: Is it possible to define chemically the constitution of the basic slag of highest agricultural value under various conditions of soil; if so, is it possible either to improve the product yielded by the furnace or else enrich it so as generally to increase its effectiveness? The problem is complicated by the all-important fact that basic slag is, after all, only a by-product for the steel maker, who naturally cannot spoil his steel to improve his slag. The metallurgist's case was stated most ably by Dr. J. E. Stead, Mr. D. Sillars, and Mr. F. Bainbridge, among others, and although no definite conclusions could be determined, broad agreement in certain directions seemed to be reached. For example, it seemed fairly clear that suggestions to improve low-grade slag by additions of phosphate rock to the furnace must be ruled out as impracticable. Less impossible, but still of dubious practicability, is selective tapping of slag, by which the high grade variety (in the open-hearth process) is removed at an early stage in the process. Enrichment during subsequent grinding is quite feasible, and is, of course, practised. A stimulating paper by Mr. W. S. Jones dealt with these phases of the subject.

On the whole, the most hopeful line of advance seemed to be to find out the most advantageous conditions under which the various grades as naturally produced can be utilised, and apply them always where their effectiveness will be greatest. This may seem a very empirical, not to say an unscientific, method; but the whole subject is at present in an empirical state of knowledge. Prof. C. H. Desch discussed the physico-chemical aspects of basic slags, but he was not able to throw very much light on their constitution, and the fundamental question as to what are the valuable constituents is not yet answered. Dr. Desch inclines to the view that they are the calcium silico phosphates, but Mr. C. H. Ridsdale was not satisfied that even phosphorus itself was the magic element, and he adduced reasons worthy of all consideration for supposing that the iron in some unknown form may be a fertilising element—a truly far-reaching suggestion, if it has any stable foundation.

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THE COSMOS FLASH LAMP.

The Cosmos Lamp Works, Ltd. (owned by the Metropolitan-Vickers Electrical Co., Ltd.) possesses within its organisation a factory developed expressly for the production of electric lamps of the flash light type. Up to the present time, most of the flash light type lamps used in this country have been imported, but the company decided to make this a home industry, and already tens of thousands of these small lamps are turned out from the factory each week.

The standard flash lamp produced at the works is sold to the public at the recognised price of 6d. per lamp, despite the fact that the rate of wages to workers employed on this work here is some ten times as great as in Japan, whence many of the imported lamps emanate. Furthermore, there is no doubt that the British article is superior to the imported one.

The Cosmos flash lamp factory is situated at Brimsdown, Middlesex, and is equipped upon a modern and efficient basis, the whole process of manufacture being carried on in the works, from the blowing of the glass bulbs onwards.

As in the larger lamps, the drawn-wire filament is mounted on leading-in wires sealed in a flanged foot, as illustrated in fig. 1, the glass being melted around the wires. The bulbs are blown on very ingenious machines from glass tubing in series of eight or ten, as shown in fig. 3 (A).

The bulbs are separated by heat at the point z, and the mounted foot is inserted as shown in fig. 3 (B) and sealed to the bulb. The piecing or exhausting tube is now joined to the flange as shown in fig. 2. The lamp is next cut from the adjoining bulb at the point z and the opening sealed over so as to make the bulb complete.

The lamp with a score or so of its kind is now connected to a high vacuum pump and exhausted to a very high degree, the filament being lighted towards the end of the process. The vacuum is determined by means of the well-known McLeod gauge, so as to avoid "bad vac" lamps. When the desired vacuum is attained, the piecing tube is sealed off at the point x, shown in fig. 2. The resulting pip on the lamp becomes hidden within the cap, which at this stage of manufacture is cemented on.

Examination, marking, cleaning, and further tests follow, and then the lamps are packed in boxes ready for dispatch. The finished standard Cosmos flash-light lamps are shown in fig. 4.

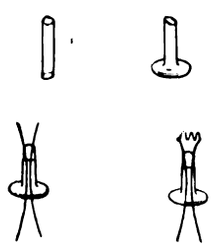

Fig. 1.

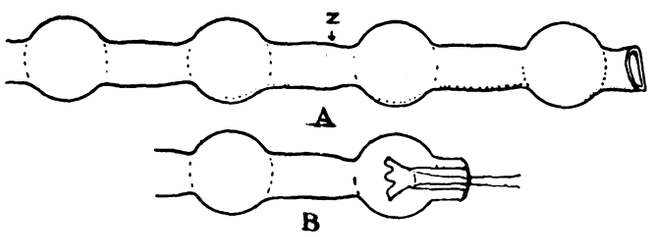

Fig. 3.

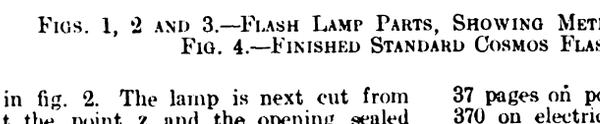

Fig. 2.

Fig. 4.

Figs. 1, 2 and 3.—Flash Lamp Parts, Showing Method of Manufacture.
Fig. 4.—Finished Standard Cosmos Flash Lamp.

REVIEWS.

Hydro-electric Power Stations. By David B. Rushmore and Eric A. Lof. Pp. x+822, 404 figs. London: Chapman and Hall, Ltd., 1917. Price 28s. net.

Although both the actual and possible development of hydro-electric power in this country are relatively insignificant, the possibilities in other parts of the Empire are so vast that British engineers are well advised to keep themselves conversant with modern practice. The principal literature upon the subject naturally proceeds from countries where the development is greatest and the present volume gives an excellent survey of current American practice with regard to hydroelectric developments. It is descriptive, rather than academic, yet scientific principles are explained and mathematical formulæ presented whenever they are needful to an understanding of the subject. It is in fact a well-balanced treatise which one has no hesitation in commending to anyone interested in hydro-electric plants.

After a very brief, but interesting review of the historical aspect of power development, with a chronological summary of all important land-marks of progress, terminating with the 150,000 volt system of the Pacific Light & Power Co. of Los Angeles, inaugurated in 1913, the available water power of the world is discussed. This is estimated in the aggregate as about 700,000,000 horse-power, of which the United States are credited with an amount of not less than 31,000,000 horse-power, and a maximum of 56,000,000. Of this amount about 6,500,000 horse-power have, so far, been developed, mostly in the States of California, New York, and Washington. In connection with the use of water power for electrochemical processes, the authors give a table showing the KW.H. required per ton (2,000 lb.) in various industries. The fixation of nitrogen is said to require from 15,000 to 60,000 KW.H., the reduction of aluminium, abrasives, and calcium carbide are put at 30,000 KW.H., 7,500 KW.H., and 4,000 KW.H. per ton respectively. The manufacture of pig iron takes from 2,000 to 3,000 KW.H. per ton, and the refining of copper only 300 KW.H. per ton. Unfortunately the source of these figures is not stated, and there is some ambiguity as to their meaning.

A chapter on hydrology includes the methods of gauging streams, and various types of dams and headworks, pipe lines, &c., are then dealt with. The treatment is brief and anything but exhaustive, yet a considerable amount of useful data and information is given. In fact, this last sentence can be fairly applied to the whole work. We have some 37 pages on power-house design, 68 on hydraulic equipment, 370 on electrical equipment, 100 on the economical aspect of hydro-electric undertakings, and a dozen pages or so dealing with organisation and management. It will be seen that the electrical portion of the work is considerably the largest. Starting with a brief discussion of transmission voltages, the authors give a curve which indicates that up to one hundred miles, the most economical voltage may be taken as one thousand volts per mile. The curve then bends over and for 250 miles it indicates 150,000 volts, a voltage which would seem to be nearly the limit from the appearance of the curve. Sixty cycles is the frequency recommended when a lighting load predominates, and 25 cycles where there are to be many synchronous converters on the lines. These two frequencies, of course, are the standards on the other side of the Atlantic.

A good deal of information and numerous formulæ relating to the design of motors, synchronous generators, transformers, reactances, &c., are given, and although no doubt these subjects are dealt with more logically and exhaustively in special treatises on the design of electrical machinery, yet the facts are presented in so clear and readable a form in the present work that one would certainly regret their omission. The authors have a good sense of proportion, and consequently indulge in no more theory than is sufficient to bring out the fundamental principles underlying design. The illustrations, too, are well chosen, representing typical apparatus and standard practice, while the selection of apparatus for description is entirely commendable. As might be expected, quite a large amount of space is devoted to switching equipment and the problems arising out of the protection and safe control of extra-high-tension circuits. The treatment is entirely free from the defect of appearing to exalt the practice of any particular manufacturer, indeed, except when one can recognise the electrical apparatus depicted, there is no clue to the maker's name.

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In the chapter on the general economic aspect of possible developments, the authors quote in full the excellent "Guide for the compilation of Water-Power Reports and the securing of Field Data," prepared by Mr. J. T. Johnstone, and printed in the 1914 annual report of the Dominion Water Power Branch of the Department of Interior, Canada. This guide was originally drafted to secure complete and standardised reports from the Canadian field engineers, and it should serve as a model for every engineer who is called on to submit a report on a possible water power development. Detailed costs of construction of various plants are next tabulated, and the items are so particularised that except for the uncertainty as to prices both relative and absolute, at the present time, the figures would be most valuable to any American estimator. The authors are not to blame because prices may have changed enough to detract from the value of their figures, which are presented in admirable form. For example, to take one instance only, the cost of excavating a tunnel, the nature of which is described, is made up of twelve separate items, the cost per cubic yard of each being given. The cost of the concrete lining is subdivided into thirteen separate items, and so on.

The book closes with several appendices. One gives references to descriptions to be found in other publications of apparently every hydro-electric system in the States or Canada. Another furnishes the principal data on over forty transmission systems of 70,000 volts and over, and the last gives the American standard code for testing hydraulic turbines. There is a good index, and the work as a whole is one that can be cordially recommended to those interested in hydro-electric plant.

Modern Electrical Engineering. By Magnus Maclean, M.A., D.Sc. Glasgow: Gresham Publishing Co., Ltd., 1918. Six vols., price 12s. 6d. per vol. net.

This work, in which Prof. Maclean has enlisted the services of twenty-four experts in their respective subjects, affords a striking commentary on the growth of the electrical industry. Owing to this expansion, it frequently happens that information is required on some subject which is indirectly connected with the work in hand, and in such cases these books should prove particularly valuable as a reference library.

They will also appeal to teachers and students who require a good general knowledge of electrical engineering, and to the many engineers who, although obliged to devote their main attention to their own particular work, take a keen interest in everything that relates to the applications of electricity. In view of the fact that the work consists of six large volumes, it will be impossible to do more than give a general idea of the scope and nature of the subjects dealt with.

The first volume opens with the fundamental theory of magnetism, continuous and alternating currents, and their measurement. The treatment of alternating current theory is largely analytical, and assumes a fair knowledge of integral calculus. The descriptions of the different types of measuring instruments are very clear and a useful summary is given for each type, setting forth briefly its advantages and disadvantages for various classes of work.

The design of continuous-current and alternating-current generators is dealt with mainly on the lines of general principles. Some examples from actual practice are given, and the text is illustrated by excellent photographs of modern machines.

A particularly valuable section deals with single-phase and three-phase commutator motors. The principles underlying the design and the advantages and disadvantages of these machines as compared with other alternating-current motors are clearly stated. This section will prove most useful to engineers who are concerned with the use of electricity for motive power, and who are sometimes confronted with the difficult task of deciding on the best type of machine to use for a particular purpose. There is much practical illustrated information on the design of transformers.

The author of this section shows a fine disregard for the conventions by the use of expressions such as "effective $\sqrt{\text{mean}^2}$" for R.M.S., but we must confess to a preference for the more usual form.

The various types of accumulators are described, and the use of boosters is discussed. Much valuable information on the proper care of secondary cells is given, and there are few battery users who would not save themselves trouble and expense by a careful study of the author's remarks.

The section on switchgear has been completely rewritten; it contains descriptions of a large number of modern switches, motor controllers, and alternating-current relays, and is illustrated by excellent photographs. Some line drawings showing details of construction are included, and the number of these might have been increased with advantage.

The chapters on high-pressure transmission of energy contain much information on the latest developments of this subject, and the author has given extensive references to papers and publications.

The design of transmission systems probably lends itself to as much diversity of opinion as any branch of electrical engineering. The author states the rival claims fairly, whilst indicating the conclusions to which his experience has conducted him.

It is rather unfortunate that the section dealing with electric lighting and wiring should have been illustrated by views of obsolete apparatus, such as concentric wall plugs with brass covers, which have been banned for many years.

There is some interesting information on the methods of manufacture of incandescent lamps, and useful curves showing the best efficiencies at which tungsten lamps should be run for various costs of lamps and energy. We should have liked to find fuller information on gas-filled lamps, but possibly this is still within the category of trade secrets.

The major portion of a volume is devoted to electric tramways, and contains chapters on the dynamics of electric traction, general lay-out of systems, the permanent way, rail bonding and welding, overhead and underground systems. The text is well illustrated by line drawings and photographs.

Electric traction on railways is dealt with from the point of view of the fundamental principles underlying this application of electricity. Long-distance lines as well as suburban traffic are considered. An interesting description is given of the methods of signalling employed on the District and other electric railways.

Boilers and prime movers are treated from the point of view of their suitability for use in the generation of electricity, and there are chapters on condensers, air-pumps, water-cooling, economisers, and feed heaters, feed pumps, and the treatment of feed-water.

A section on electrochemistry and electrometallurgy contains an account of the general principles underlying modern practice. The space allotted is somewhat limited, but the more important processes are well described and illustrated.

The chapters on telegraphy open with a description of the line plant in use by the British Post Office. Instruments are next dealt with, and a very clear description is given of the Wheatstone automatic and the Hughes and Baudot printing telegraphs. Radio-telegraphy is hardly treated in accordance with the importance of the subject at the present time.

The section on telephony describes the standard practice in manual exchanges, and also contains a chapter on automatic exchanges. The latter, though excellent in itself, can hardly be taken as a guide to modern practice. The most recent development of automatic telephony, in which all connections are made by relays, is merely mentioned.

Descriptions of apparatus employed in the coal mining industry, and of electric cranes and hoists, complete the series.

The editor and publishers are to be congratulated on the excellent style of the volumes. The print is clear and the illustrations are exceptionally good. Each volume has a separate index, and there is also a good general index.

The names of the contributors are, in themselves, a guarantee of the excellence of the work, which should find a place on the shelves of all engineers who desire to have information on the standard practice in all branches of the electrical industry in a handy and accessible form.

PROTECTION OF A.C. SYSTEMS WITHOUT THE USE OF SPECIAL CONDUCTORS.

At Newcastle-upon-Tyne, on March 8th, the paper by Major Kenelm Edgcumbe, R.E. (T.), an abstract of which appeared in our issue of February 20th, 1920, was read and discussed before the North-Eastern Centre of the Institution of Electrical Engineers.

Mr. Porter, who greatly appreciated the paper, said that Major Edgcumbe apparently had in mind rather smaller undertakings than those which were to be found in the Newcastle district. While he might criticise some of the things that the author had said, he, nevertheless, thought that the writer had given them something that was badly needed in a great many cases. Regarding small schemes, however, he thought the only way to tackle the subject was to approach it in the light of a scheme that might perhaps become a large one. In introducing protective gear there were generally two problems to be considered, the first being to make it impossible to damage apparatus, and the second to ensure the maintenance of the continuity of supply. If they were putting in gear for the second reason, then the "risk" was a double one, so they ought to be prepared to pay more for such an insurance policy than for one which provided for the protection of a single factor. Indeed, on a large system it would pay to put in more protective gear; it generally paid better to give attention to continuity of supply than merely to have regard to prevention of damage. With regard to the latter consideration, there was the time factor to be considered—there was a period at the end of which, whatever that time was, damage would accrue—but if they had more extensive protection it might remove the fault and save damage to the plant, although the gear had been installed with a view to ensuring continuity of supply. Speaking of the time limit, the speaker said that if they had instantaneous action it would clear the fault before it became a "short." They did not get any advantage from time-lag unless the fault started with a "short," which usually it did not. In small schemes where there was one power station and a few sub-stations, discrimination might answer, but in such cases as that district where there were 400 sub-stations, the position was vastly different. He thought that discrimina-

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tion by time-lag or by direction of current was only of limited applicability. These were all questions that each one should face for himself. For instance, where they had continuous processes going on it was a serious matter to have an interruption of the supply, and it might be worth while to have adequate protection. He pointed out that some protective methods hampered extensions.

Mr. H. W. Clothier was glad to hear that the author did not put forward his proposals as a solution of the problem for large systems, and he hoped that that would be emphasised, as otherwise the paper might seem to belie his intention. He thought it was Major Walters who set himself the difficult problem of solving the question of parallel feeder protection. In those cases it was necessary to make sure that the feeder they tripped out was the faulty one, for it was not always the faulty feeder that carried the greatest current. The author made a very good point when he suggested that in the case of sub-stations fed by a large number of parallel feeders, or from two sources by independent pairs of such feeders, it might sometimes be possible to treat the pair as a single unit, and to isolate both on the occurrence of a fault on either. The author's proposals for the protection of inter-connectors and ring mains were open to criticism, and the speaker referred to the diagrams showing protection by what the author called reverse relays; he did not think these should be called reverse relays, they were operated by potential in one direction, and he thought they should be called, perhaps, unidirectional relays. A question suggested by several parts of the paper was: How long was it permissible to allow a fault to stop on a system? One objection was that if faults were allowed to run on, synchronous plant would get out of step. He had heard that 0.5 of a second was possible for the duration of a "short" on a system without any danger of the synchronous plant getting out of step, but the figures given varied so much that it would be well to know the point definitely.

Mr. J. R. Beard said there were some mis-statements in the paper that he thought should be modified. In the first sentence the author spoke of the subject as "one of the most pressing of the moment." The speaker did not think it was pressing in a general sense; they knew from actual every-day experience that the problem had been solved, not perhaps in the most economical or perfect way, but it had been solved, and protection afforded in an efficient manner. He pointed out that the methods named were not the only ones; Glasgow, he believed, was without any protective gear until last year, and they rearranged their network for protection, and were fairly satisfied, he understood, with the change. He thought they did not want to omit any of the requirements mentioned by the author, but there were other points also to be noted. The speaker referred to the author's criticism of the Merz-Price system which acted in "watertight compartments," and claimed that this feature was a great advantage—it was complete protection.

Mr. Collins said that at various points throughout the paper attention was drawn to the effect of faults that might arise instantly, and he thought it was suggested that these faults should be removed as quickly as possible, while not going in for the principle of instant isolation.

Dr. Bowden drew attention to the question of earthing through reactances, a method adopted largely by Petersen in Germany. It was worthy of consideration.

Major Edgcumbe replied, and with regard to the last suggestion, said it could not be applied to the cases with which they were dealing.

At Edinburgh, on March 9th, Major K. Edgcumbe's paper was read and discussed before the Scottish Centre of the Institution of Electrical Engineers.

Prof. Bailey agreed with the author's view that protection devices worked from the cable itself had distinct advantages over those with separate cables. The little cables were more liable to break down than the big cables they were intended to protect, though not subject to the high voltages of the latter. In overhead lines particularly, he thought there was much more likelihood of the protective device breaking down.

Mr. Charles W. Marshall said that while the author pointed out the advisability of not breaking circuits at the time of maximum current, he (Mr. Marshall) thought it advisable to stake everything on an attempt to clear faults before they developed between phases. The most obvious way of doing this was by increasing the speed and sensitiveness of the relays and switches. This was especially desirable in systems which included synchronous converting machinery. He did not share the author's regard for the induction relay, as he had found it to be subject to the troubles of all instruments using jewels and pivots, and in addition the time calibration was liable to alter, due to the magnetising action of the alternating field produced under short-circuit conditions. The example chosen to illustrate the author's view that biasing was valueless did not represent practical conditions. Unbalancing of 5 per cent. could never be tolerated, and it was generally quite easy to balance within 0.5 per cent. Biasing to that extent was quite satisfactory. The biasing problem was closely analogous to that of compensating induction watt-hour meters. In these instruments, if the design was sound a fair degree of accuracy could be obtained without the use of compensating devices, and using these the accuracy could be very high indeed. On the other hand, if the meter was bad to begin with no amount of compensation could do it much good. In general, the methods of protection proposed by the author might be interesting to existing undertakings where special provisions could not readily be made, but he thought that much more general methods should be adopted in new systems. The schemes proposed by Whitaker and M'Coll seemed to him to be worthy of the closest investigation in this respect.

Mr. A. E. M'Coll did not see how any reasonable degree of protection combined with continuity of supply was possible on complicated systems without the use of special conductors. He did not mean to say that the author's methods would not find application on large systems, but he did not think they represented a general solution of the problem. In dealing with the protection of independent feeders, leakage relays were advocated in conjunction with overload relays. The author had omitted all mention of combined leakage and unsymmetrical loading devices, which gave instantaneous protection against faults between any two phases in addition to earth faults. A number of devices had been developed for this purpose, and these should find a ready field of application to the cases of individual feeders and isolated rotary plant. The author advocated delaying the action of overload relays so that on a short circuit between phases the energy of the system might be partially dissipated before the switch was called upon to interrupt the circuit. This was given as a good feature of the overload relay. The speaker thought it a distinct failing. He had always held that there was a field for an overload relay having a double characteristic, *i.e.*, a definite or partially inverse time function up to a point, and beyond that the relay to be instantaneous in action. One such relay had been put on the market by a certain manufacturer, but he was not at all convinced that the mechanical features of the device were satisfactory. It was a simple matter to install devices which would operate with faults irrespective of their location; it was a different matter, however, to make them discriminate correctly on a large and complicated distribution system, and this was where the systems of protection which employed pilot wires and specially constructed cables scored. He agreed that separate current transformers should be employed for operating the protective gear and measuring instruments. On the score of economy some manufacturers were putting two secondary windings on one magnetic core, one winding for the protective-gear circuits, and the other for instruments. It might be well to sound a note of warning with regard to such an arrangement. It was not safe to interrupt the protective gear circuits especially where the balanced current system was employed, and, moreover, it was equally disastrous to break the instrument circuits where transformers with double secondaries were employed. In this case it simply meant that if one winding was broken the other winding carried double current. For parallel-feeder protection the author advocated the employment of overload and leakage relays for the end adjacent to the source of supply. It seemed to the speaker that this parallel feeder arrangement might be fully protected by employing interlocked discriminating relays, which gave instantaneous protection, either with faults to earth or between phases. The only difference was that lower values of resistance were required for the neutral earth. Time lags for leakage relays on parallel feeders should not be necessary. He admired the ingenious arrangement of the author to obtain a flat characteristic for the relay down to fairly low potentials across the pressure coil. The speaker had obtained somewhat similar results with reactive type relays without the compensating winding. Transformers protected by Merz-Price gear should not be disconnected by the charging current when switched into circuit. This could be taken care of by simple means without resorting to fuse-shunted relays. He agreed with regard to the good features inherent in devices operating on the biased principle. When the biasing action was performed by a coil of the open plunger type whose pull would increase roughly as the square of the current, the operating torque for the relay was given by two quantities which might move in diverse directions under severe emergency conditions. It seemed, therefore, that the bias might increase under these conditions to a value which was actually unsafe. He was in agreement with the author on the best connection to be adopted for reverse relays, and should say that any other than that advocated was distinctly unsafe. He did not agree that the reverse relay in its usual form was the best means of protecting generators and transformers. The reverse relay to be operated demanded a plurality of plant on the bus-bars to give the necessary reverse flow. It was equally necessary that the protective device should operate in the case of a fault even should there be no reverse flow possible. Systems of generator protection had recently been developed which employed directional relays and which combined the functions of the differential system with the usual characteristics of the reverse current relays. This system was on the market now, and particulars should soon be available. He was in agreement with regard to earthing the neutral through resistance. If pure reactance was employed the phase shift with faults to ground might be sufficient to render the reverse relays on the faulty feeder of a pair of parallel feeders inoperative. With the author's schedule of minimum current in the earthing resistances he did not agree, particularly so in the case referring to parallel

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feeder protection. If they wished to have any discrimination between the relays at the power supply end sufficient to bring out the switch of the faulty feeder first, they must pass through the earthing resistance something more than twice the full load of the feeders.

Mr. E. Seddon, considering the short-circuit currents possible with the very large circuit currents used to-day, asked if it would not be better first to limit the flow of current by quickly opening a circuit breaker across which would be connected a reactance, and afterwards disconnect the faulty circuit by a second switch placed next to the bus-bars. This switch would also operate direct on single-phase leakage. This entailed two oil switches in series, but with such an arrangement they might be able to get something like standard switchgear. For independent feeders, he agreed with the author that leakage protection was the best arrangement of present-day practice, except that he preferred the fuse-shunted solenoid to mechanical movement of dashpots. As to the protection of closed feeders, the best arrangement was to protect all closed feeders independently of any other feeder, which could be done either by Merz-Price or split-conductor protection. The latter was preferable in all but very short feeders. The author referred to the high voltage being induced in exciter windings. He had experienced this on one or two occasions, and considered the practice of adjusting exciter brushes when a turbo set was on load was to be condemned unless an insulated stool was provided.

Mr. A. P. Robertson agreed with bringing about the opening of the circuit as early as possible if there was any fault, and he thought they should concentrate upon getting a maximum speed of opening with a system where there was a lot of synchronous machinery.

Mr. Henriker described the fuse time limit as the most satisfactory of all. He suggested 5 per cent. of normal F.L. current as a reasonable earth fault which could be left on a system. He considered that the two most important factors were maintenance of continuity of supply and the reasonable assurance that a faulty section would be cut out.

STANDARDISATION RULES FOR ELECTRICAL MACHINERY.

At Birmingham, on February 11th, an informal discussion took place on the British Electrical Standard Specification No. 72 before the South-Midland Centre of the Institution of Electrical Engineers. Mr. A. R. Everest, M.I.E.E., opened the discussion, of which an abstract follows:—

Mr. A. R. Everest said that following a long period of enforced inactivity due to war conditions, the International Electrotechnical Commission had resumed its activities, and as a result, many of the essential points which were still unsettled in the I.E.C. rules had been settled, and the first volume was in the printer's hands. The general plan was that the I.E.C. rules should establish the essential principles as internationally agreed, the various countries participating then each preparing its own set of national rules embodying the principles laid down by the I.E.C., and a new edition of the British Standardisation Rules, E.S.C. 72, would be undertaken in the immediate future. It was now well known that a machine when given the "British Standard" continuous rating, was rated for the highest load which it could carry for an unlimited period without exceeding the limits of temperature-rise allowed by the rules. There had been much misconception regarding the feasibility of allowing a machine so rated to take overloads in excess of its rating. The I.E.C. rules were now so worded as to show clearly that the rating was a test rating, for comparison purposes, and with regard to service conditions, the only limitation found in the rules was that the machine should not be subjected to any loads which caused it to acquire a temperature-rise higher than that allowed under the test condition. Clearly a machine when starting cold could take a very considerable overload while still keeping within this limit, but undoubtedly there were dangers associated with very excessive overloads. Against these dangers there appeared to be at present no safeguard in the British rules, which imposed no restriction on overload except in terms of temperature-rise. It appeared desirable, therefore, that there should be an agreed limit to the magnitude of the sustained overload to which a standard machine might be subjected. With regard to momentary overloads, the I.E.C. rules now recognised that when the overload peaks in service exceeded the values agreed as suitable limits for a standard machine, such service would demand a special machine with a special kind of rating. In the case of a standard machine, therefore, it would appear desirable to establish recognised limits to the magnitude of both the sustained and momentary overloads. For this purpose it had been suggested that a sustained overload of 25 per cent. for half an hour should be recognised for all motors not smaller than 5 H.P. This was subject to the rule that the standard temperature-rise must not be exceeded, but it was considered that the need for such overload margin occurred chiefly when a cold motor was starting cold machinery. With regard to short-time ratings, the method of rating provided in the rules corresponded with that which had been the general practice for some time past. The "British Standard" rating (with its associated limit of temperature-rise) was, by the rules, suitable for use in connection with cooling air of a temperature not exceeding 40 deg. C. (104 deg. F.) as a maximum. The need for additional ratings suitable for use under tropical conditions on the other hand, had been discussed. It was proposed to establish a tropical rating with an appropriate higher limit to the maximum temperature of cooling air. With regard to machines intended for cool countries, it was pointed out that these when used indoors were generally working under conditions not very different from those in temperate countries, and it was recommended that no special modifications should be made for such cases. Those unusual cases in which a machine would certainly be required to operate always under abnormally-low cooling conditions should be regarded as quite special, and designs made accordingly. The general rule for all such special designs would be that when tested under rated load the temperature-rise should be such that when added to the temperature of the cooling conditions contemplated, the highest temperature obtained must not exceed the limits of total temperature indicated in the rules. Another feature of considerable interest was the method recognised for measuring temperatures. The requirements of the earlier editions of the rules, that temperature-rise measurements of field coils and similar windings should always be by the resistance method, had been regarded as impracticable, particularly regarding small machines produced in large numbers. This objection had been met in later editions of the rules by permitting these measurements to be made by thermometer alone, provided that readings so obtained were consistent with the limits assigned to the resistance method, as shown by complete tests taken on a few typical machines. There was a strong feeling that for turbo-alternators, and for other large and important machines, the temperature-rise should be determined from measurements made by embedded temperature detectors built into the machine at points so selected as to give indication of the internal temperature. The last (1917) edition of the British Standardisation Rules, No. 72, recognised the advantage of these devices, but the I.E.C. had not as yet formulated definite rules. It had submitted for the consideration of the British and other national committees a proposal on the following lines:—

"That for the acceptance tests of large rotating machines the temperature should be measured by the embedded temperature detector method for parts where this method would be applicable."

It was not considered that the method would be applicable to any moving parts, but that it would be applied to windings in slots on the stationary part of a machine, the embedded temperature detectors being placed between coil and adjacent slot wall, and between coil and coil in the slot, in each case being outside the coil insulation. (The insertion of embedded temperature detectors within the insulation of the coil, adjacent to the copper, was not considered feasible for commercial tests on account of the risks involved, such measurements belonging essentially to research tests.) The proposal was that this method of temperature measurement should be employed for the stationary windings of machines meeting the foregoing conditions when such machines were wound for more than 5,000 volts, or were rated for an output exceeding 750 K.V.A., or if the stator cores exceeded 20 in. axial length. The proposal contemplated that the method also might be applied to the windings of large transformers, provided this was specified in the contract. The recognition of this method of temperature measurement for the acceptance tests involved also the establishment of limits proper for the temperatures when so measured, and the British Committee was arranging to collect evidence with a view to forming conclusions upon this important point. There was little that was essentially new in connection with high-pressure tests; while the one minute test still remained as the standard, suggestions had been made regarding the desirability of substituting one or more briefer tests of higher value, allowing time between such tests for the insulating material to return to its normal condition.

Dr. M. Kahn said that Mr. Everest's notes cleared up a number of controversial points and foreshadowed a revised edition, which contained several important improvements. It would be of considerable help if, together with the new rules, a complete series of explanatory notes of the various regulations and recommendations could be issued. The present rules did not contain any standard tests which were necessary to ascertain whether electrical machinery complied with the guarantees and specifications given in connection with it. This referred more particularly to efficiency and power factor, which could be determined in various ways. Standard margins which could be allowed in connection with these guarantees could also be embodied in the rules on the lines of the recommendations of the B.E.A.M.A. The proposed extension of the rules for temperature measurements on large generators by thermo couples or resistance coils was a step in the right direction. In large modern turbo-alternators, where the eddy current loss in the stator conductors was reduced by suitable means, the temperature gradient between conductors of a two layer winding was small, and if a temperature detector was inserted between the top and bottom coil of such windings, it would indicate the temperature rise of the conductors pretty closely, although

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it was not in direct contact with the copper. Alternatively such detectors might be placed between the coil and the wood or fibre wedge closing the top of the slot. As the heat conductivity of the wedge was low the temperature gradient between the copper and outside of the insulating tube was not appreciable at that point. If the neutral of the alternator was earthed a few detectors could be inserted inside the mica tube close to the copper conductors in the coils which were direct connected to the neutral point, where the voltage to earth was in consequence low. The readings obtained on these detectors could be compared with the readings of detectors placed outside the insulating tubes for comparison and the leads of these detectors could then be cut off where they came out of the stator coil if that appeared desirable. The questions arising in connection with self-starting synchronous motors deserved greater attention. In clause 6 of the rules the starting torque required and the starting current which could be allowed were omitted from the lists of information required with inquiries for such machinery. Clause 93 did not mention that the pressure induced in the rotor windings entirely depended on the pressure applied to the stator terminals when starting. If a certain ratio of this pressure to the full stator voltage had been assumed this ratio should be given with directions how the test pressures were to be altered in case a different ratio was employed. In clause 93 (*b*) a rough division was made in two classes of motors of exciter pressures above and below 250 volts. A further grading of test pressures depending on the exciter voltage seemed appropriate.

Mr. H. W. Taylor thought that British engineers might find it difficult at first to appreciate the new method of rating, but he thought it should be borne in mind that inasmuch as the conditions under which motors were used varied widely, and as the number of cases in which a machine was required to exert a continuous effort were few, any method of rating might be considered as a nominal one, on which the machine might be tested. It was proposed to standardise the inlet temperature as 40 deg. C. for British work, but it would seem that this figure was rather conservative. With regard to the rating of large machinery (more particularly of large turbo generators), he believed it would be the custom in the future for purchasers of such machines to specify, first, the actual inlet temperature with which the machines were expected to operate, and secondly, that under these conditions the maximum internal temperatures should not exceed those specified by the International Standardisation Rules. In this way the purchaser would not be expending an unnecessary amount of money on a large machine rated on a standardised inlet temperature which was higher than his own normal conditions. Temperature detectors, however, would be installed in such machines, so that the maximum load on them could be graduated to temperature variations from the normal. In tropical climates, the use of a wet air filter helped considerably in reducing the initial temperature at which the air entered the machine. Advantage might be taken of this fact by operating engineers in determining the inlet temperatures at which such machines would normally operate.

Mr. R. Orsettich thought that one of the advantages of the new rating would be in connection with machines which were not likely to require an overload margin, such as fans, compressors, &c. In all such cases it would be possible to select a machine which would work at the maximum load required, and it would, therefore, work with a considerably higher efficiency than was usual at present. Apart from this, in the case of A.C. motors, the power factor would be considerably increased, as the motor would be less likely to work under-loaded than at present. The standard frequency was 50 cycles; in view of the fact that two very large industrial districts in this country were supplied with power at 25 cycles, and that similar large supplies were established in Canada and Australia, it seemed desirable to consider the adoption of 25 cycles as a second standard frequency. The standard pressures for D.C. motors did not include 550 volts; as a large number of motors were continually required for traction systems, it seemed desirable that this additional pressure should be included. The short-time rating had given rise to several misunderstandings, as there was no explanation how this rating could be used in practice. The wording of clause 59, concerning the duration of temperature tests for machines with continuous rating, appeared somewhat doubtful, and it was suggested that, in order to reduce the duration of the test, a temperature gradient should be stated of, say, 1 deg. C. per hour, and that when this was reached, the test could be finished by making an allowance for the additional temperature. It appeared desirable that besides the frequency the output of the generator used for the pressure test should be given. The items specified to be given on every nameplate were so numerous that it would be difficult to accommodate them on a nameplate of reasonable size.

Mr. A. T. Bartlett said that the specification was remarkably complete; he was glad to see that there was no mention of the pernicious "flashing" test. He understood that it had been very deliberately decided to allow no tolerance in the matter of temperature rise, but he did not agree with this. There were errors of observation in measuring temperatures which were always present even when such tests were made under laboratory conditions. He agreed with Mr. Everest concerning the importance of an international specification as helping international trade. Another reason for such a specification was that it would become the only specification and thus free designers from having to deal with fancy specifications. The specification was not intended to limit in any way the actual duty a machine had to perform.

Mr. E. J. Kipps said that according to the rules, motors for intermittent work had a short time rating of either one hour or 30 minutes for temperature, and were to be capable of withstanding on test for 30 seconds a torque 100 per cent. in excess of that corresponding to their short-time rating. The difficulty of fixing a time for a continuous run at full load, which should give the same temperature rise as the same load on intermittent runs, was evident. Thirty minutes was too long for a continuous run for small motors on loads which they could carry satisfactorily on intermittent work with running time of two or three minutes. A short time rating of 15 minutes appeared to cover all cases of crane motors used in practice. For the increased load, which a certain motor could carry on a 15-minute rating, as compared with its load on a 30-minute rating, there would be a large increase in the temperature gradient between the copper wires and adjacent parts of the motor, but if the temperature of the armature and field windings was determined from the increase of resistance, there seemed no objection to a short-time rating of 15 minutes or even less. Presumably a test under short-rating conditions would not be repeated before the motor had time to cool down to atmospheric temperature.

Mr. N. Joseph endorsed the remark of Dr. Kahn that it would be of considerable utility if the specification in its final form included some standard of efficiency for motors. He suggested a table of efficiencies for varying sizes of D.C. and A.C. machines. He thought it essential that stress should be laid on the necessity for the name plate showing the rotor current of slip-ring motors, and he would add, the field current of all D.C. machines.

Mr. R. G. Jakeman said it was not clear why commutators and slip rings were only allowed a maximum temperature of 90 deg. C., while the maximum permissible temperature for mica was 125 deg. C. With regard to field coils, the maximum actual temperature was 105 deg. C., and the maximum temperature by resistance 95 deg. C. The difference took into account the fact that the mean temperature rise was measured by resistance, and he would like to know if it allowed for the deepest coils met with in practice; 10 deg. C. difference seemed rather high for the ordinary thin coils on large machines. In the list of particulars to be given when ordering machines, rotary converters were omitted.

Mr. A. R. Everest, in reply, said he would see that Dr. Kahn's suggestion regarding the free use of explanatory notes in the new edition of the rules should reach the proper quarters. With reference to the suggested introduction of embedded temperature detectors within the inculating tube and adjacent to the copper conductors, it was doubtful whether such methods ought ever to be admitted for the commercial tests to which the Standardisation Rules essentially applied. With regard to the suggestion that the subject of test pressures for the field windings of synchronous motors needed further consideration and sub-division, the clause in question was the result of much careful consideration both by the B.E.A.M.A. and the Rating Committee, but any further considered recommendations from the B.E.A.M.A. would receive every attention. Several considerations seemed to be involved in the suggestion that by utilising embedded temperature detectors in service, the output of a large turbo-generator might be controlled with reference to the maximum permissible limit of temperature. In tropical countries the air when at the highest temperature was frequently at the same time highly saturated with moisture, so that little reduction in the temperature of the cooling air would result at such times from the use of the wet filter. With regard to increased output to be obtained in winter time, it must be remembered that the output available from the prime mover was, at most, only a few per cent. greater in winter than in summer, therefore it was not easy to see how any larger increase in output of the generator made possible by abnormally low temperature could be utilised. Better attention given to the selection of motors with respect to duty required was certainly desirable. Regarding the short-time rating, that was a rating established for test purposes in which a specified load was applied to a machine for a specified time, starting cold. Machines rated in that way were employed particularly on intermittent service, and it was necessary that for any particular service a short-time rating should be selected which was thermally equivalent, *i.e.*, gave the same temperature rise as the intermittent load of service conditions. When a customer did not know from past experience which rating was suited to his particular service, the engineer-salesman should be able to advise. Possibly some explanatory note which would be of assistance might be added to the rules. Regarding the duration of temperature tests for machines with continuous rating, the present rule assumed that the shape of the temperature curve would be plotted and its ultimate value thereby predicted. A note explanatory to the rule might be of assistance in this matter. He was glad to hear the remarks regarding the assistance which might be expected in international trade by the adoption of an internationally agreed basis of test rating. The temperature limits given in the International Rules were expressly defined

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as being themselves the "maximum values"; hence, if a tolerance was to be employed it must be based on such lower value that with the tolerance added the "maximum" was not exceeded. Referring again to the short-time ratings and the suggested addition of a 15-minute rating to the standards recognised, if the makers agreed to its desirability there should be little difficulty with regard to its recognition. A table of standard efficiencies for various sizes of A.C. and D.C. machines was a matter which was largely in the hands of the makers themselves. If they were to agree upon the values of the efficiency suitable for the purpose, such lists might be usefully included in the rules. It was expected that the revised British Rules would embody a clause recently introduced into the International Rules, which permitted commutator temperatures higher than the usual limits, subject to special guarantees which were to be given regarding the performance.

NEW PATENTS APPLIED FOR, 1920.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. Sefton-Jones, O'Dell and Stephens, Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

9,080. "Device for suspension of glass illuminating bowls from electric-lamp holders." C. H. Barker. March 29th.

9,083. "Electrically-heated incubator." W. J. Anderson. March 29th.

9,089. "Circuit-conducting means for electrically-operated apparatus within gimbal-supported casing, &c." R. L. Davies and R. D. Metcalfe. March 29th.

9,099. "Receiving circuits." Western Electric Co. March 29th. (United States, January 5th, 1916.)

9,103. "Device for tilting shades of electric lamps." W. J. Markham. March 29th.

9,107. "Electric ovens." C. H. Lauth. March 29th.

9,127. "Automatic signaller for wireless telegraphy and telephony." R. E. Gray. March 29th.

9,141. "Electric switches." P. Rubert. March 29th.

9,165. "Antiseptic telephone mouthpiece attachment." A. T. Hutchinson. March 30th.

9,180. "Means for obtaining electricity from the atmosphere and uses for the same." H. Gough-Turner. March 30th.

9,221. "Electric heating and cooking apparatus." J. J. J. M. Kluyskens. March 30th.

9,222. "Oscillation generators." Western Electric Co. March 30th. (United States, June 1st, 1915.)

9,223. "Electrical transmission systems." Western Electric Co. March 30th. (United, States, May 18th, 1914.)

9,225. "Telephone systems." Automatic Telephone Manufacturing Co. March 30th. (United States, May 28th, 1919.)

9,236. "Manufacture of incandescent lamps." Westinghouse Lamp Co. March 30th. (United States, April 3rd, 1919.)

9,238. "Protective apparatus for multi-phase alternating-current circuits." Metropolitan-Vickers Electrical Co. March 30th. (United States, April 4th, 1919.)

9,251. "Electrolytic deposition of iron and treatment of deposits." H. Lovelock and T. Try & Son. March 30th.

9,264. "Morse-tapping instruments." J. H. Hansen. March 31st.

9,273. "Electric switches to prevent starting of internal-combustion engines." R. E. A. Akers and W. H. Briscoe & Co. March 31st.

9,279. "Means for electrically detecting or estimating dissolved matter or impurities in water, &c." A. W. Empson. March 31st.

9,326. "Electric transmission systems." Western Electric Co. March 31st. (United States, February 1st, 1918.)

9,337. "Electrical fuse-holders." A. H. Maxwell and F. Shergold. March 31st.

9,341. "Processes and cells for electrolytic decomposition of alkaline salts." M. Wilderman. March 31st.

9,345. "Varying field strength of electric machines." Siemens Schuckertwerke. March 31st. (Germany, April 26th, 1917.)

9,346. "Control of field strength of electric machines." Siemens Schuckertwerke. March 31st. (Germany, June 7th, 1917.)

9,347. "Terminal and sparking-plug tester." J. Davies and E. Lyons. March 31st.

9,352. "Protective devices for electric circuits and apparatus." British Thomson-Houston Co. (General Electric Co.). March 31st.

9,373. "Fittings for electric, gas, &c., lighting." A. G. Beaver and The Sun Electrical Co. March 31st.

9,389. "Electro-magnetic induction micrometers." J. M. Ford. March 31st.

9,433. "Thermionic relays or amplifiers." G. A. Mathieu. April 1st.

9,437. "Electrolytic rectifiers." H. Leitner. April 1st.

9,438. "Propulsion of electrically-propelled vehicles or trains." A. Raworth. April 1st.

9,445. "Electrolytic treatment of ores containing zinc, &c." Electrolytic Zinc Co. April 1st. (Australia, April 4th, 1919.)

9,446. "Electrical indicators." British L.M. Ericsson Manufacturing Co. and W. M. Crowe. April 1st.

9,452. "Cooling electrical apparatus." G. Schroeder. April 1st.

9,453. "Means for carrying off heat generated in electrical apparatus." G. Schroeder. April 1st.

9,460. "Dynamo-electric machines." G. A. Juhlin and The Metropolitan-Vickers Electrical Co. April 1st.

9,483. "Compound anode for electro-plating and method of making same." C. R. Dean. April 1st. (United States, December 12th, 1917.)

9,487. "Magneto-electric machines." British Thomson-Houston Co. and A. P. Young. April 1st.

9,492. "Sparking plugs for aero-motors, &c." A. Custoza. April 1st. (Italy, April 1st, 1919.)

9,496. "Self-supporting induction coils." De Forest Radio Telephone and Telegraph Co. April 1st. (United States, April 4th, 1919.)

9,519. "Lighting-magnetos for cycles, &c." Soc. Anon. La Magneto Belge. April 1st. (Belgium, October 2nd, 1919.)

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1918.

10,455. Electro-osmotic process for removing water from materials. Elektro Osmose Akt. Ges. (Graf Schwerin Ges.). October 20th, 1917. (135,817).

18,321. Automatic regulating systems for dynamo-electric machines. British Thomson-Houston Co. (General Electric Co.) November 8th, 1918. (139,836.)

20,759. Magneto ignition systems. Compagnie Generale de Magnetos. August 31st, 1918. (132,222.)

21,831. Electric furnaces. E. Fenton. June 21st, 1919. (139,843.)

1919.

1,464. Electric terminals. G. J. Parker and G. A. Parker. January 20th, 1919. (139,849.)

2,361. Electric lamp sockets. G. Frankel. January 30th, 1919. (139,855.)

3,158. Telephone instruments. Western Electric Co. and V. Amberg. February 8th, 1919. (139,861.)

3,855. Methods of using three-electrode ionic tubes, applicable for wireless telegraphy and other purposes. L. B. Turner. February 17th, 1919. (139,867.)

4,709. Alternating current limiting apparatus. S. Salto. February 28th, 1918. (123,766.)

4,791. Circuits of incandescent lamps. A. H. Railing and C. C. Garrard. February 26th, 1919. (139,876.)

5,119. Heating by electrical means and to any desired temperature metal rings or bands of any shape or size. H. S. Binns. March 1st, 1919. (139,881.)

6,024. Step-by-step mechanism for electric motor-starters. A. H. Railing, C. C. Garrard and W. Wilson. March 11th, 1919. (139,889.)

6,025. Trolley heads of electric tramcars and the like. R. J. Clarke. March 11th, 1919. (139,890.)

7,032. Connecting-devices for electric circuits. Remy Electric Co. April 22nd, 1918. (125,943.)

7,181. Electrical switches. J. W. Haran and H. C. Tofield. March 22nd, 1919. (139,897.)

7,501. Automatic switching apparatus for telephone exchange systems. Western Electric Co. (Western Electric Co.). March 25th, 1919. (139,900.)

8,286. Holders for wireless detecting crystals. W. P. Thompson (V. J. Brochard). April 2nd, 1919. (139,904.)

8,609. Cable conduits for electric travelling cranes. C. L. Browne and S. H. Heywood & Co. April 5th, 1919. (139,913.)

8,863. Rheostats. F. C. Curtis. April 8th, 1919. (139,915.)

9,284. Automatic welding devices. British Thomson-Houston Co. (General Electric Co.). April 11th, 1919. (139,919.)

10,065. Sparking plug. W. G. Clayton. April 22nd, 1919. (139,933.)

11,427. Cables for electrical machines adapted to be coiled and uncoiled. Electro-Agricultur, Aktiebolaget. June 7th, 1918. (127,812.)

14,111. Preparing aluminium or its alloys for electro plating. H. D. Cunningham. June 4th, 1919. (139,967.)

14,680. Electric switches. R. L. Murray and Telephone Manufacturing Co. June 10th, 1919. (139,972.)

14,776. Electrically-heated laundry irons. F. Angell and H. Angell. June 11th, 1919. (139,973.)

15,342. Methods of indirectly coupling a radio-telegraphic antenna to a high-frequency alternator. March 15th, 1918. (128,575.)

17,422. Electrical signaling apparatus. M. J. Railing and J. J. V. Connoughton. July 11th, 1919. (139,994.)

18,005. Sparking plug for internal-combustion engines. E. Piquerez. December 18th, 1918. (136,798.)

The A.C. Commutator Motor. — The A.C. commutator motor in its various forms has been developed principally for the purpose of obtaining adjustable or variable speeds. In general, control of speed with the A.C. induction motor implies variable or adjustable frequency in some form, and this, in turn, involves a commutator of some type. In consequence, the problem of commutating A.C. usually goes hand-in-hand with that of speed control. The simplest method, according to the author of a paper on this subject in the *Journal* of the American I.E.E. for March, 1920, for viewing both the A.C. and D.C. commutating problems, is to consider primarily the actual E.M.F.'s short-circuited by the brushes, and the resistance in the short-circuited paths, *i.e.*, the problem is largely one of the permissible amount of short-circuit current. In the D.C. machine the E.M.F. short circuited by the brushes is that generated by rotation of the short-circuited armature coils in the armature and external field fluxes. In the same way, in the A.C. commutator motor, there is an E.M.F. due to the armature flux or field, as in the D.C. machine, and in addition there are other E.M.F.'s due to the primary or field fluxes. The latter may be classified as primary rotational and transformer E.M.F.'s. One limitation in the design of A.C. commutator motors, in general, is that these rotational and transformer E.M.F.'s are often larger in degree than the E.M.F. due to the armature flux. However, the author contends that the commutation problem in A.C. motors is the same as for D.C. when all E.M.F.'s are taken into account. The major part of the paper covers the consideration of the different E.M.F.'s which should be taken into account in the various types of A.C. commutator motors, and it is shown in a general way that the E.M.F.'s involved in speed control also appear in the commutation problem. In the latter part of the paper certain general conditions of commutation and brush operation are treated, and some figures are given for comparison of A.C. and D.C. commutating limits.

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THE

ELECTRICAL REVIEW.

VOL. LXXXVI. APRIL 23, 1920. No. 2,213.

ELECTRICAL REVIEW.

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PROFIT-SHARING AND LABOUR CO-PARTNERSHIP.

THE Intelligence and Statistics Department of the Ministry of Labour has just published a report of 244 pages, bringing the available information on this subject down to 1919, the last previous report having been issued by the Labour Department of the Board of Trade in 1912.

At October 31st, 1919, the number of schemes in existence was 182, representing some quarter of a million employed persons. The total number of schemes known to have been started was 380, one of which dated from 1829, while all the rest had begun since 1865. More than half have been brought to an end, and the average life of the abandoned schemes was about 8½ years. Of the existing schemes, only 36 were inaugurated before 1901, and 95 have commenced since the beginning of 1911. The average life of the schemes now in existence, excluding 29 started during 1919, is about 14 years.

Considered in detail, the report shows that there are very great variations in the numbers of schemes started from year to year; and it is stated that it is difficult to correlate these variations with the fluctuations which occur with greater or less regularity in other industrial statistics. From time to time profit-sharing attracts considerable interest, and great energy is displayed in the devising and inauguration of schemes, then activity dies down, and very little is done for several years. The present time is one in which attention is focussed on profit-sharing as a means by which it is hoped that the identity of the interests of capital and of labour may be more fully recognised by all sides, and the legitimate claims of those concerned may be satisfied.

There can, we think, be little doubt in the minds of any that considerable progress has been made in the democratisation of the outlook of those whose chief concern is with capital. Employers realise that they cannot hope to retain all the profits of manufacture, trading, or commercial enterprise of any kind, while the manual worker remains a wage-slave. There has, in short, been much levelling down. Has the levelling up on the part of labour, of which there has been some, been commensurate?

This is a most difficult question to answer. There is undoubtedly a tendency on the part of many manual workers' Trade Unions to demand that by far the greater part of the profits shall be distributed in the form of wages. We have shown on previous occasions that this tendency is the inevitable result of centuries of inadequate remuneration and deplorable industrial conditions. The only hope of counteracting it is by the education of the mass of workers to that point when they become conscious that all those concerned in the industrial problem—capital, labour, and management—are mutually interdependent and necessary, the one to the other and each to each. When this fact is realised, we believe it will appear obvious that as all are interested in the results, all must do their utmost to attain them; and it seems to us to follow logically that a system of payment by results, or profit-sharing, is the best means of bringing this about.

We know that this has been realised by many of the leaders of thought in the labour world, but it is certain that among the main body it is regarded with suspicion. It is felt that payment by results is bound up with what has been called "scientific management." Process specifications, calling for the performance of a given task in a given way in a given time, hour after hour, day after day, are considered to be destructive of human initiative and enterprise. The man in the works says, in effect: "You may have, on the capitalist side, great responsibilities, enormous issues may depend upon your judgment, and the mental strain involved may occasionally be too great to be

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borne; but the life you lead is of an altogether different kind from ours, the reward you reap is greater, and not one of you would change with a typical representative of ourselves." The monotony of daily existence leads to the demand for such pay as will make it possible for the worker, if he wishes, to take a day or two off every week, which means that two days' wages and time produce one day's results.

It would appear, from the statements advanced on behalf of labour, that profit-sharing is opposed because of the close association between the firm and its workpeople, which a good scheme must produce. It is feared that those workpeople will lose interest in the welfare of their fellows in other concerns, and that the solidarity of the Union may, in consequence, be imperilled. Profit-sharing based upon particular firms, then, is not regarded with favour. The attitude of organised labour might possibly be different towards a system of profit-sharing based upon a whole industry, though recent events in the coal world seemed to indicate that a more selfish view existed. It would be very much more difficult to administer schemes having whole industries for their bases. The difficulty of drawing definite boundaries would be great, and a unification of interest among competing undertakings and their shareholders very much closer than anything existing at present, or likely to exist in the near future, would be required.

Profits depend on the organisation of the undertaking, and this is mainly planned and brought into being by the employer, though the trained brain worker plays an important part. They also depend on economical buying of the materials required in manufacture; and management, with clerical assistance which may or may not be organised, is entirely responsible for this part, even in the case of those large closed corporations which cover so much ground as to be practically self-contained. The sale of the finished product is carried out by the same class of workers, and upon efficient selling tactics the profits of any establishment lean very heavily. The concern of organised labour—not, as is sometimes stated, of the *worker*, for the salesmen and buyers, the designers, engineers, and shop superintendents are all workers—is with manufacture, and labour's chief contribution to profit lies in the avoidance of waste, both in time and material.

Organised labour claims that only in this last province can it assist profit-making, and to make the worker's remuneration depend on profits will be to subject him to the operation of forces which he cannot direct or control. Workers of all classes have experienced the undoubted tendency which is manifested in its full evil as completely in the electrical industry as in any other, to cut piece-rates, assign maximum limits to monetary reward, and generally to bring the employé up against a limit. This is strongly resented, and it certainly seems that an expanding system would be more effective in getting the last ounce out of all concerned. If a manager, let us say, received 1 per cent. on the first £10,000 of profit, and 2 per cent. on the second £10,000, would he not be far more interested in putting his whole heart into the advancement of his firm's business than if, as is more generally the case, he were to be paid ½ per cent. on the second £10,000? And this is a consideration which applies to all grades.

Profit-sharing, with its logical corollary, a share in direction and control, has prospered more in the gas supply industry than in any other, but the Report issued by the Ministry of Labour gives a vast amount of detailed information relating to every kind of commercial activity. On one page alone we find such various walks of life as oyster cultivation, printing, tea-blending, paint manufacture, farming, and shipbuilding, and these are schemes which are in existence at the present time. Equally full details, where they are available, are given of the schemes which have come to an end, so that information as to what defects to avoid may be extracted therefrom. The reasons for the abandonment of the schemes are stated, and we find that in some cases employers were dissatisfied, while in others employés were apathetic. We should not like to suppose that in every case where the employers were dissatisfied it was because the workers received too much, and *vice versâ*; but this was at least a probable cause in many instances. Any scheme will be regarded apathetically if it produces insignificant results, and any scheme will be regarded with suspicion if the means by which the results are arrived at are kept secret from those concerned.

The development of the ideal scheme in every case is a difficult business, but we are convinced that it should be boldly tackled, and that the present is the right time to begin.

The Building Trades.

An exhibition in connection with the building trades is now in progress at Olympia. It is strongly held in electrical circles that new buildings should be wired for electricity *ab initio*. Obviously the Building Trades Exhibition is the place for exhibits of electrical wiring systems, and all kinds of domestic electrical apparatus. Consequently the electrical industry, being wide awake and enterprising as behoves a comparatively youthful and energetic member of the building trades, is fully represented and very much in evidence at this exhibition, taking advantage of an excellent opportunity to catch the eye of the architect and engage the interest of the builder—what? *No?* Is it possible that the opportunity has been *missed*? That gas has it all its own way, and that electrical exhibits are almost conspicuously absent from such a show?

Alas!—it is but too true! While the gas interests occupy about a fifth of the floor space, there are not half-a-dozen electrical exhibits of wiring and fittings.

When will the electrical men wake up to the fact that they must seek and obtain publicity, in the right way, and at the right time? Fifteen electrical stands out of 285!—and many of these, though excellent in themselves, in no way connected with the electrical equipment of new buildings—not a single exhibit of installation materials or wiring methods!

The Budget.

On Monday last the Chancellor of the Exchequer (Mr. Austen Chamberlain) made his Budget statement in the House of Commons. For some time past there has been fairly general acknowledgment of the necessity for steps to be taken to put the national finances in a fair way for carrying without unsteadiness the terrible burden imposed by the war. On the whole, it may be said, the nation was in a mood to stand new taxation wherever really necessary for the present in order to secure stability, and to promote abroad confidence in British credit. Increases in various expenses and taxes have been inevitable, and were a foregone conclusion; for example, the higher wages bill of the Post Office has rendered changes in postal, telegraph and telephone rates necessary unless that department is to be conducted at a loss. The Budget is described as a tax on industry, and there is good ground for the criticism, though one cannot easily imagine a practicable alternative. Most of the changes seem likely to have a restrictive and restraining influence upon trade and industry, and we shall need to watch their effect; but the continuing of the Excess Profits Duty has come as a surprise to the industrial world—still more its increase from 40 per cent. to 60 per cent. For some reason or other the impression had got abroad that because it had been so recommended to the Chancellor, the Excess Profits Duty was to give place to another form of tax. Instead of that, the Duty is retained, and increased, while the suggested substitute is to be imposed simultaneously as well, in the form of a Corporation Tax—5 per cent. on undivided profits of limited companies, concerns with less than £500 having exemption. As some sort of solatium, more imaginary than real, it may ultimately prove to be, there is to be due allowance made for the difference of 20 per cent. if any scheme of Capital Levy on war fortunes is brought in later in the year. At the moment of going to press it seems probable that the addition to the Excess Profits Tax may not be approved, owing to the hostile reception accorded to the proposal at Westminster, in the City, and in industrial circles generally. Among the welcome features of the Budget is the promised relief from double Income-Tax within the Empire. It is obvious from the statement of the Chancellor that trade and industry will have to contribute largely to the return of national financial stability. Already the burdens due to industrial conditions

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are occasioning continual and serious anxiety, and the troubles of business men promise to become still heavier. Amid all the suggestions, criticisms, and forebodings which are in the air at the moment, we can at least hold it certain that whatever happens, industry and trade will have to make an immense effort if they are going to weather the storm and carry on with profit to themselves after they have met the claims of the State.

A Big German Amalgamation.

A noteworthy event in the German electrical engineering industry that has been under consideration for several months past, is now to take place by the practical amalgamation of two big firms. An official intimation to this effect was made last week, when it was announced that the directors of the Berlin A.E.G. had decided to issue new shares so as to be able to effect an interchange of shares with the Felten & Guilleaume Co., of Cologne, and that the directors of the latter company had resolved to recommend the shareholders to accept the offer. The quotations for the shares of the Cologne company have recently risen largely, partly on rumours of purchases for foreign account, and partly because of reports of a prospective amalgamation, and they stand higher than the shares of the A.E.G.

It may be recalled that close relations have existed between the two companies for a number of years. The first step was taken in 1910, when the prosperity of the Cologne company was threatened through the absorption of the Frankfort works of the Lahmeyer Co. The A.E.G. participated in the reconstruction, and took over the Frankfort works, which, however, was subsequently closed. Shares to the amount of 16,000,000 marks in the F. and G. Co. were acquired for the purpose of establishing a community of interests, and of these shares slightly over 8,000,000 marks are still in the possession of the A.E.G. A new period of development then began, and the efficiency of the Carlswerk considerably increased in intimate co-operation with the Berlin company.

A new factor in the situation has recently risen through a foreign group displaying interest in the Carlswerk. The group, the nationality of which is not disclosed, is said to have held out the prospect of guaranteeing the supply of raw and semi-finished materials to the Cologne company provided that the group were given an interest in the latter by the acquisition of shares. Negotiations on the question are only proceeding slowly, and the result cannot be foreseen. In the meantime, it has been ascertained that shares have passed into foreign ownership. Dealing with the question of pressure from outside, the official communication states that, on the one hand, negotiations would be facilitated if there were one big German shareholder capable of making binding agreements concerning participation in shares, and who, on the other, could form a counterpoise to the influence to be exercised. Having regard to this economic problem, which not only affects the considerable holding of the A.E.G. but also the whole position of the Carlswerk, it was considered natural that such close relations should be established between the two companies also in the matter of capital structure as to be equal to an amalgamation. As a consequence, the directors of both companies have decided to recommend the shareholders to accept an offer on the basis of an interchange of three A.E.G. shares for two shares in the F. and G. Co., which will require 75,000,000 marks of the former for the 50,000,000 marks of the latter. The directors of the A.E.G., therefore, propose to increase the company's share capital by 100,000,000 marks, the difference between this amount and that required to carry out the projected transaction being intended to strengthen the working capital.

As far as can be understood from the official information, the sole object of the scheme is to safeguard the interests of the F. and G. Co. from the invasion of foreign capital to such an extent as to be able to control the Carlswerk. Yet it would have been possible for the directors to have attained this object in another way and without surrendering the independence of the company, namely, by the issue of preference shares having manifold voting rights, as has been already carried out by many companies, and is still being proceeded with by others, in order to prevent foreign capitalists from taking advantage of the depreciated German currency and the state of distress existing in the country. In any case, the success of the scheme of absorption, which is not contingent upon the presentation for interchange of a specified minimum number of shares, appears to be assured, as large blocks of shares in the F. & G. company are held by the directors and their friends. It is, moreover, not improbable that the eyes of the A.E.G. are also pointing in the direction of further acquisitions in the near future, so as to render the company absolutely independent in the matter of all kinds of raw and semi-finished materials for manufacturing purposes.

The Southampton Strike.

The strike of employés of the Southampton Electricity Department, of which we give further particulars to-day, must be regarded as a very regrettable incident. It does not relate to wages or conditions of labour, questions in which public sympathy might be enlisted; the matter at issue is the right of a British citizen to resign from one Trade Union and join another Trade Union.

On the strength of that question—a dispute between Unions, in no way affecting the employers, who in this case are the municipality, a section of the State—the employés went on strike without warning, and did their best to paralyse the diverse activities of the townspeople by cutting off the public supply of electric light, heat, and power. For a short time they were successful, but the engineers, with the help of volunteers, succeeded in restoring the supply, and later new men were engaged, with a firm promise of permanency. Several Unions are involved in the strike, but the Electrical Trades Union, as usual, is the ringleader.

The dispute has now shifted to the question of reinstatement; the Corporation cannot discharge the new men without a gross breach of honour, and the certainty that on a future occasion its word will not be trusted.

To sum up the situation, the men struck without warning, against the community, on a matter with which the community had no concern whatever. Their action was inexcusable and entirely unwarranted, being based upon a dispute that might, and should, have been settled by a friendly conference between the Unions. The strike weapon should never be employed save in the last resort.

[As we go to press, we learn that the strike has been settled by the dismissal of the new men, with two months' pay, and the reinstatement of the strikers.]

Investments in a German Company.

As mentioned in a previous issue, it is proposed to transfer the undertaking of the German Transmarine Electricity Co. to a Spanish group, which is to issue interest bonds and shares in exchange for the ordinary shares in the Germany company, and to redeem the latter's preference shares at the price of 150 per cent., or a premium of 40 per cent. as they are nominally redeemable at 110 per cent. But the holders of the loan capital (bonds or obligations) appear to be receiving scanty consideration. Between 1903 and 1913 the company issued seven series of bonds of the nominal value of 120,000,000 marks, and according to the last balance-sheet, which refers to the end of 1916, bonds for 105,350,000 marks were still in circulation. The bonds which are already terminable, were issued partly outside Germany, and with the exception of the loan of 3,000,000 marks of 1903, which was also issued in English currency (£150,000), they are repayable in German marks at a premium of 3 per cent. Having regard to the enormous depreciation of the mark, considerable concern is being manifested by the holders of the bonds both in Germany and Switzerland, in consequence of the directors of the German company having given notice to redeem all the bonds without delay. If this intention is carried into effect, it will imply a heavy loss to the holders; in Switzerland alone the 1,000-mark bond is only worth about 80 fr., whereas at one time the capital value was 1,250 fr. It is, therefore, suggested that in the interest of German credit abroad, the bonds should also be taken over by the Spanish group, and be redeemed gradually by annual drawings, as is customary.

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THE NEW BAKERLOO ROLLING STOCK.

(*Concluded from page* 484.)

Fig. 7 is an interior view of one of the cars; the interior steel panels are painted a dark cream, while the ceiling of the arched roof, which is constructed of agasote, is enamelled flat white. All unnecessary ornamentation is dispensed with, and no roof advertisements are to be placed inside the cars. The seats are upholstered in red and black rep. It will be seen from figs. 7 and 10 that strap-hanging is abolished; in place of the leather straps, strong vertical wooden bars are conveniently placed to give some sort of stability to passengers who are compelled to stand, and metal "grab handles" at the seat ends serve the same purpose. Each

Fig. 7.—Interior of New Bakerloo Coach.

person seated is assured of ample room, and comfortable elbow rests are provided between the longitudinal seats. Hat or light-luggage racks are fitted for the first time in tube railway cars, and below the seats electric heaters are installed.

With regard to ventilation, in addition to the ordinary drop lights, an air duct with perforations runs the whole length of the car. The illumination is by diffused light from opal bowls placed in a row along the centre of the ceiling, and globe lamps at the shoulder provide for passengers who wish to read, as shown in figs. 7 and 10.

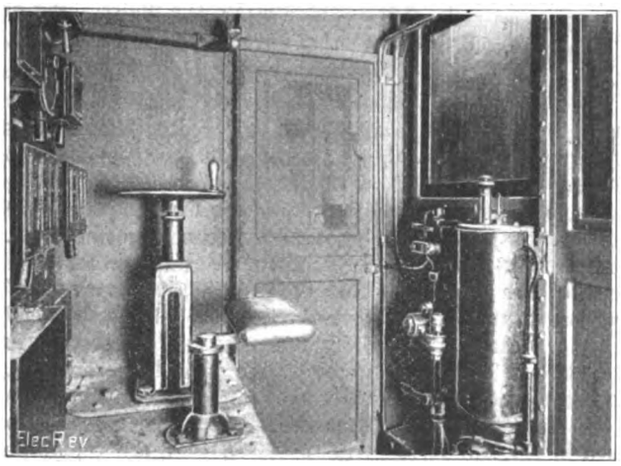

Fig. 8.—Interior of Driver's Cab.

All the cars are fitted with emergency electric lights, which are supplied from accumulators carried on the motor-cars, and arranged in such a manner as to be automatically switched into circuit in the event of the main supply failing at any time.

Fig. 8 is an interior view of the driver's cab, while fig. 9 shows the control contactor gear. Figs. 10 and 11 show elevations, plan, and sections of the motor and trailer cars respectively.

The train control equipment was supplied by the British Thomson-Houston Co., Ltd., and is of the relay-automatic type. The normal method of operation with this system is to place the controller at once to the full parallel position when starting a train. The contactors are then picked up in their correct sequence by the current-limiting relay, which operates as soon as the motor current has dropped to a predetermined value. The relay consists of two shunt coils and one main coil. The latter carries current equal to that of one motor only. The actuating coils of the contactors are energised through one or other of the two shunt coils in such a manner that, if one is energised through one shunt coil, the next one to close will be energised in series with the other shunt coil. The two relay shunt coils act on two plungers controlled by gravity. Each plunger, when in its lower position, closes a disk switch in series with the other shunt coil; but when raised, due to its coil being energised, opens this switch. Thus, when one of the plungers is raised, the shunt coil, acting on the other, cannot be energised because of the break in the circuit produced by the above-mentioned switch, but although it is the control current that raises the plunger, so as to produce this break, it is the current passing through the main coil which maintains the break, and the plunger is not released until this current has dropped to the predetermined value. Then the plunger falls and closes the

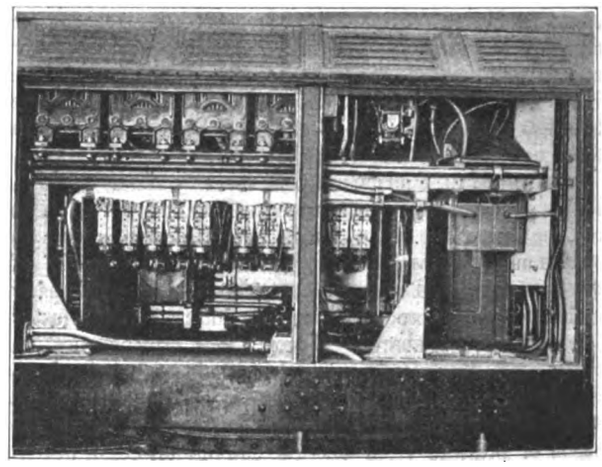

Fig. 9.—Train Control Contactors.

switch which completes the circuit for the next contactor coil to be energised.

The principle underlying the method of control adopted in connection with the current-limiting relay is that, after a contactor has been picked up, as described above, its coil is immediately transferred, by means of interlocks, to another wire. There are thus essentially two operating wires, the picking-up wire and the retaining wire, although other wires are introduced for forward and reverse running, circuit-breaker setting, &c. As there are no main bus lines down the train, a potential relay is fitted on each motor car, which drops all contactors on that car when the shoes lose current. This is necessary, because when no current passes through the main coil of the current-limiting relay, it ceases to exercise its control over the rate of picking-up of contactors.

The controller has four forward points and two reverse (series only), of which Nos. 2 and 4 are running points, where all resistance is cut out. A useful provision in the control is that, if, in the course of the automatic notching up, the controller handle is brought back to the first or third notch, as the case may be, the automatic closing of contactors is stopped, but those already closed are kept up.

The working of the safety button on the controller handle differs from the London Electric Railway standard in that the safety button cannot be released, except when

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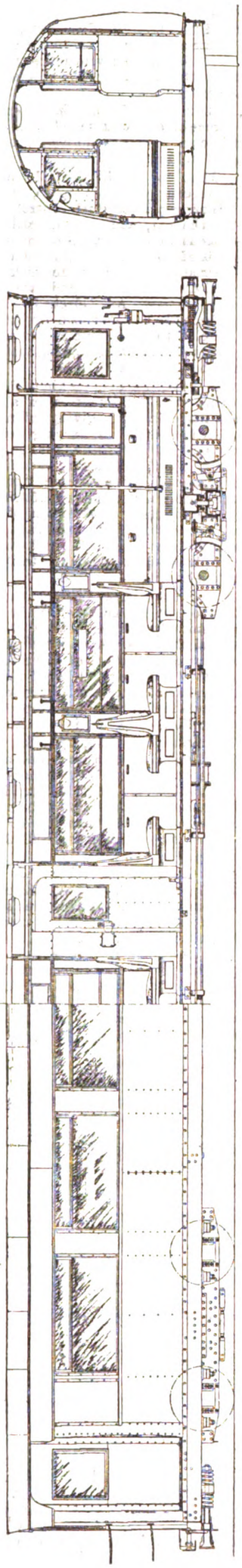

Fig. 10.—Elevation and Section of New Bakerloo Trailer Car.

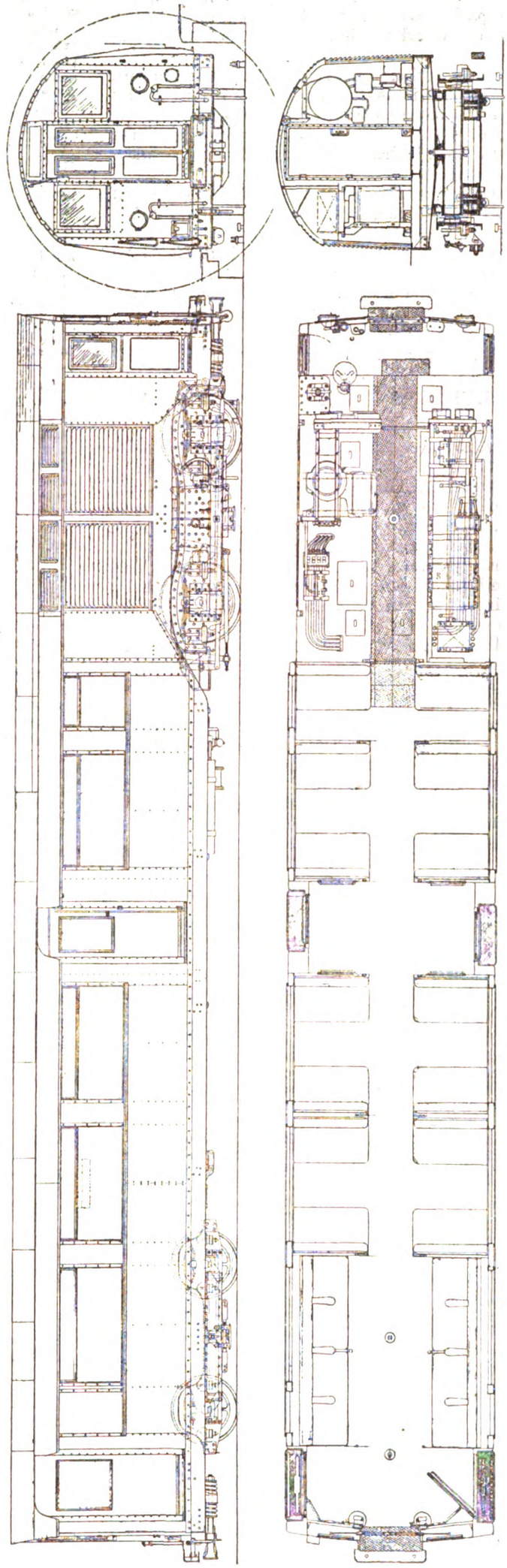

Fig. 11.—Elevation, Plan, and Sections of New Bakerloo Motor Car.

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the handle is at the off position. If, however, the handle itself be let go, it flies back to the off position, when current is instantly cut off, and the brakes are applied throughout the train.

Another safety device, which is now part of the standard L.E.R. equipment, is the control circuit governor. By interrupting the control circuits this device prevents the train being driven forward, unless the main pipe of the Westinghouse brake is charged with air and the trip-cock is cut in.

Each motor-car is fitted with two G.E. 212 motors of 240 H.P. each, which are geared for a free running speed of from 40 to 45 M.P.H.

In conclusion, our thanks are due to Mr. A. R. McCallum for providing us with an opportunity to inspect the new stock, and also for the loan of photographs and drawings from which the above illustrations were reproduced.

THE BUILDING TRADES EXHIBITION.

It is exactly 25 years ago since the first building exhibition was held at the Royal Agricultural Hall, London; in 1907 it was transferred to Olympia, where it has since been held biennially up to the year 1913. The present Exhibition, which was opened at Olympia on April 10th, and closes to-morrow, is the first purely technical one of its kind entirely devoted to the building trade, to be held since the outbreak of war, and the promoters have succeeded in assembling a fine collection of materials and plant. The Exhibition is, therefore, of more than usual interest. A party of French gentlemen interested in building, and particularly in refractory goods, was to come to London to attend the Exhibition, and afterwards a conference of French and British manufacturers on refractory goods was to be held. A number of visits and conferences of associations and societies interested in building were arranged to take place during the period the Exhibition remains open.

Although the exhibits are of much interest, there is very little of an electrical nature to be seen; only on some 15 out of a total of nearly 285 stands are electrical goods exhibited. In what follows, a brief description of these exhibits is given, but nothing new was noticed, most of the exhibits having been shown at other recent exhibitions.

The Titan Lift Co., Ltd., London, has on view a five-floor, push-button lift machine of the drum type suitable for carrying four passengers: a service lift suitable for loads of 1 cwt., also push-button controlled, and V-sheave type four and six-passenger machines arranged for push-button or car-switch control.

Messrs. Mann, Egerton & Co., Ltd., London, show self-contained sets for lighting, cooking, and heating, in country houses, both by electricity and by the "Willett" air-gas system.

Messrs. R. A. Lister & Co., Ltd., Dursley, also show an electric lighting and power plant suitable for farms, country houses, &c., of the automatic type, having a capacity of 1 KW. at a pressure of 55 volts. Various sizes of petrol and oil engines, as well as a single ram pump driven by a 2-H.P. petrol engine are also included in this exhibit.

The Rawlplug Co., Ltd., London, has on view patent fibre plugs which are used for fixing screws into any sort of material; the plugs require no skilled handling, nor do they damage the surrounding material, and they are invisible when in position. The exhibit, which attracted well-merited attention at other recent exhibitions, includes excellent specimens of work in all classes of materials. Frequent demonstrations of the uses of rawlplugs and the advantages over the usual method of obtaining a fixture are given.

The Metropolitan-Vickers Electrical Co, Ltd., Manchester, shows a selection of domestic electric heating and cooking devices, as well as electric fans, switches and metallic-filament lamps. A selection of porcelain insulators of various types and sizes is also shown.

Messrs. Petters, Ltd., and Vickers Petters, Ltd., Yeovil, exhibit an electric lighting set, consisting of an internal combustion engine coupled to a 2·5-KW. Metropolitan-Vickers dynamo, generating at a pressure of 50 volts. The set starts on a small quantity of petrol, changing over automatically to paraffin, on which it runs at low fuel costs.

Messrs. Building Products, Ltd, London.—This firm's specialities are interesting to the engineering, as well as to the architectural, profession. "Rigifix" bolt-hanger sockets and slotted inserts are used for embedding in reinforced concrete beams and columns for the purpose of attaching mechanical equipment without the necessity of cutting into the finished concrete. Specimens of various types and fittings and photographs, also miscellaneous specialities connected with reinforced concrete construction, are shown.

The Sturtevant Engineering Co., Ltd., London.—This exhibit consists of electrically-driven turbine vacuum cleaning plant for large and small buildings; ventilating plant and fans; and a 0·5-H.P. portable turbo-electric suction cleaner, with a small power consumption for work done.

Messrs. F. & C. Osler, Ltd., Birmingham, exhibit electric lighting fittings in wrought and cast metals, English alabaster, and cut crystal glass, in classic styles, suitable for use in domestic, ecclesiastical, and public buildings.

Messrs. Waygood-Otis, Ltd., London, have an electric passenger lift working to convey visitors up to, and down from, the gallery. The lift is arranged for dual control—by car switch with an attendant in the car, and automatically without an attendant, by push-buttons in the car. A change-over switch is fitted to the car, which is of up-to-date design and construction of steel and glass. The wrought-iron enclosure work illustrates one of the many designs that can be arranged, and two different forms of position-indicators are shown. An "electroil" lift, consisting of a direct-acting ram beneath the platform, operated by a patent oil pump which is coupled to an electric motor and electrically controlled, is also shown, together with working models of different types of lifts and a number of accessories.

Messrs. Holophane, Ltd., London, exhibit lighting fittings and glassware, including standard reflectors in all sizes; these prismatic reflectors are made in types giving extensive, intensive, and focusing light distribution to suit varying heights of buildings. Reflector bowls and prismatic glassware in four sizes, and giving a strong, soft downward light; semi-indirect units designed for decorative and diffusive effects; "concealed" prismatic shop window reflectors: a new design of reflector-refractor for interior lighting, employing a combination of reflective and refracting properties; and street lighting refractors, a two-piece enclosing bowl designed to give lateral light distribution, and having a smooth surface both inside and out to facilitate cleaning, are also to be seen on this stand.

Messrs. Marryat & Scott, Ltd., London, show a complete electric service lift in operation, the control being effected by momentary pressure on suitably marked buttons. Safety in operation is assured by several fitments. A standard passenger lift car is exhibited to demonstrate the action of the safety gear, which device, in the event of stretching or failure of the lifting ropes, automatically operates and sustains the load by gripping the guide runners. The car is shown fully loaded and supported by the gear. A line of standard controlling equipment is also shown.

Messrs. British Electric Vehicles, Ltd., Churchtown, Southport, show electric battery industrial trucks and an accumulator locomotive similar to those that have been described in our pages from time to time. The trucks are manufactured in five different standard patterns and capacities, in addition to being built to meet special requirements when so desired. The locomotives are manufactured to suit any rail gauge, and to haul 10, 20, and 50 to 75 tons each.

Carron Company, of Carron, Stirlingshire, has a fine show of heating stoves and cooking ranges, heated by both coal and gas as well as by electricity. A considerable space has been set apart for the exhibition of a selection of the firm's well-known electric heating and cooking apparatus, which comprises cookers, grills, fish fryers, hot-plates, electric kettles, irons, and glue pots. There are, in addition, several models of electric fires in various finishes, and the manner in which electric fires can be attractively fitted to existing chimney breasts is effectively shown in one typical example in the form of a complete electric fireplace.

Messrs. Underwood (Manchester), Ltd., of Manchester.—On this stand is exhibited the well-known "moonstone" illuminating glassware, which is of Canadian manufacture throughout, consisting of lighting units for indirect lighting. It is neither opaque nor transparent, but is between the two, and when lighted exhibits a uniform luminous appearance, diffusing the light in a manner very restful to the eyes. It is claimed that in passing through the glassware the light loses very little of its illuminating power, and is not coloured in the slightest degree. A large variety of table standards, &c., together with an instantaneous electric water-heater are also to be seen.

Messrs. Alloy Welding Processes, Ltd, London, exhibit samples of structural steel work, in which the joints are welded instead of being riveted, as is usual practice. Samples of tramway rail welding and other work carried out by the A.W.P. process, and different types of electrodes, are also on view.

Emigration of Workmen from U.S.A.—Recent reports show that workers are leaving the United States at the rate of 1,000 a day. Most of them that emigrate will not come back, and few will come to replace them. Wholesale emigration of this kind will harm industry, lessen production. The electrical industry will suffer in proportion to the others. But this very thing, in a way, may prove helpful to the industry, as it will result in renewed activity in search for, and invention of, labour-saving devices, and in new applications of the use of electrical energy. Developments during the war period proved that electricity, through its numerous applications, replaced in some measure the loss of man-power in the industrial world. It did it then, and it can do it now if a real shortage of man-power results from the heavy tide of emigration. *Electrical Review*, Chicago.

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THE CURRENT TRANSFORMER.

By C. W. MARSHALL, B.Sc.

The following is an outline of the principal characteristics of current transformers used for operating alternating-current instruments, such as relays, ammeters, and watt-meters. The subject is dealt with from the standpoint of the user.

Engineers responsible for the constructional side of switchboard work generally look on instrument transformers as a necessary evil, and their requirements are that the primary windings should have as few turns as possible, and that the sectional area of copper and the insulation used should be very liberal. In many cases it is specified that single-bar primaries only are allowable. The reason for this attitude is that transformers with multiple-turn primaries are liable to break down between turns in the case of potential surges, and to act as fuses during the enormous rushes of current which pass through them when faults occur. These points are specially important on systems of large K.V.A. capacity, and the only note that need be made on them is that, although the secondary winding is almost as important as the primary, it is very seldom mentioned in specifications. On low-tension systems, open-type transformers are used; but on high-tension systems they must be enclosed and insulated with oil or "compound." The latter type is much superior, as it requires less supervision and is far easier to keep clean.

The testing engineer for whom accuracy is the essential point wants a transformer in which the secondary current is an exact reproduction on a reduced scale of the primary current. It is a fairly easy matter to fulfil this requirement so far as numerical ratio is concerned, and at the same time to satisfy the constructional features mentioned above. To be a true reproduction, however, it is necessary that the reversed secondary current should be exactly in phase with the primary, and this can only be the case when there are many primary ampere-turns.

As the importance of this aspect of the subject is extremely great, an outline of the elementary features of the current transformer will not be out of place, although it has already been exhaustively dealt with.

In fig. 1 the notation is as below :—

I_1—Primary current, n = turn ratio. (Secondary turns ÷ primary turns).
I_2—Secondary current.
I_m—Magnetising current.
E_2—Secondary induced E.M.F.
I_2—Secondary terminal E.M.F.
ϕ—Phase angle of transformer.

The essential purpose of the diagram is to show what determines the transformation ratio I_1/I_2 and the phase angle ϕ (the angle between the primary and reversed secondary current vectors). The diagram is drawn in the following steps :—

1. Draw O E_2, to represent the secondary terminal voltage = secondary current (I_2) × secondary load impedance.

2. Draw O I_2 to represent the secondary current in magnitude and direction.

3. Draw E_2, E_2 parallel to I_2, representing the voltage drop in the secondary winding. This gives O E_2 the secondary induced E.M.F.

4. O F perpendicular to O E_2 through O represents the flux in the core of the transformer.

5. O I_m drawn slightly in advance of the flux vector represents the magnetising current.

6. $n I_2 + I_m$ gives O I_1 the primary current.

The load on the secondary is generally almost non-inductive, and the ratio and phase angle may be approximately determined from—

$$I_1/I_2 \doteq n + I'_m/I_2 \quad \left.\right\} I'_m = \text{power component of } I_m.$$
$$\text{and } \tan \phi \doteq I''_m/n I_2 \left.\right\} I''_m = \text{wattless} \quad \text{,,} \quad \text{,,} \quad \text{,,}$$

These equations can readily be verified by a perusal of fig. 2. The deduction to be made from them is that both ratio and phase angle are directly dependent on the magnetising current and accordingly on the ampere-turns of the windings. It is also clear from the diagrams that the reversed secondary current is in advance of the primary current by a small angle referred to above as the "phase angle of the transformer." The importance of this angle lies in its effect on the indications of power and energy meters used in conjunction with transformers. On lagging loads the effect of the phase angle error is to increase the instrument reading and on leading loads the converse holds. To give readers an idea of the numerical values of the ratio and phase angle variations with different types of transformers graphs have been drawn, showing the variations of these for two transformers, one being of very high quality, while the other is of the ordinary commercial grade. These are shown in fig. 4. Instead of plotting ratios directly, it was thought preferable to plot percentage errors in secondary current, so that a positive error should mean that the connected instrument would read high. It will be noted that the ratio of the standard transformer with a load of 5 volt-amperes was constant within 1/1000 from full load to tenth load current.

A simple experiment, which shows the great importance of "phase angle" in power measurement, consists in making a comparison between the readings of a good total current wattmeter and one whose current coil is supplied from a current transformer (preferably one with bad phase-angle characteristics). The scheme of connections is shown in fig. 3. The current and potential circuits are supplied from

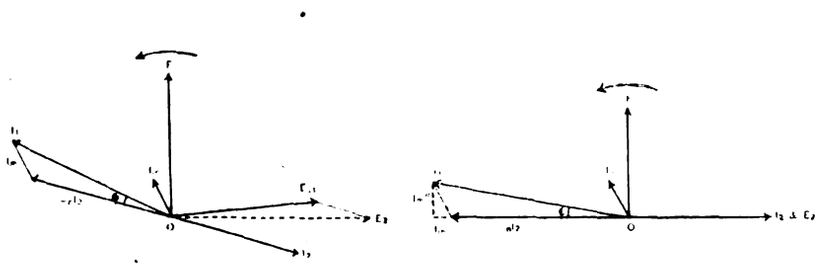
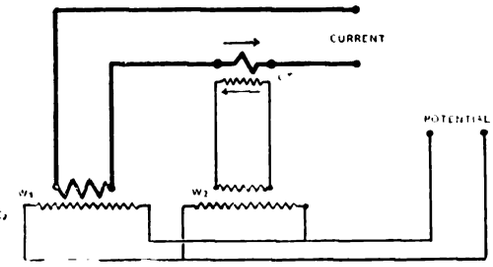
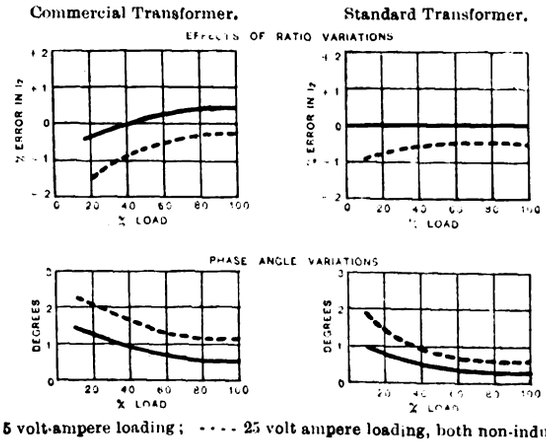


FIG. 1.—GENERAL DIAGRAM. FIG. 2.—DIAGRAM FOR NON-INDUCTIVE LOADS.
Vector Diagrams for Current Transformer.



C T, Current transformer under test; W_1 and W_2, Wattmeters.

FIG. 3.—TEST TO ILLUSTRATE EFFECTS OF PHASE ANGLE.



—— 5 volt-ampere loading; - - - - 25 volt ampere loading, both non-inductive.

FIG. 4.—COMPARISON BETWEEN CURRENT TRANSFORMERS.

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separate sources which can be varied in phase with respect to each other. If the volt-ampere load on the two wattmeters is kept constant, and if their readings are varied by changing the phase relationship between the current and potential, the effect of the current transformer phase angle will be shown very clearly. Fig. 5 shows the results of such a test on a 500/5 current transformer, with a bar type primary. It will be seen that on low power factors, the errors are very large, and that under ordinary conditions (lagging loads) they will be positive, *i.e.*, the wattmeter connected to the transformer will read high. The ratio of the transformer tested was almost exactly correct at 5 V.A. load, and was approximately 2 per cent. wrong (secondary

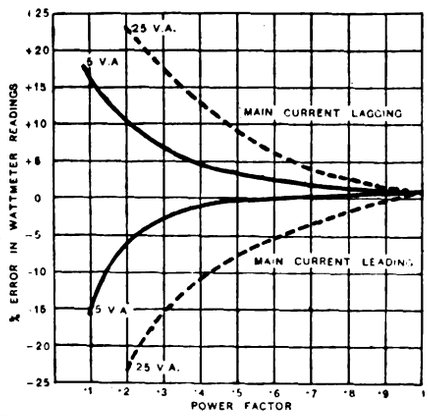

Fig. 5.—Effect of Power Factor on Phase-angle Errors.

current low) at 25 V.A., hence it may be said that ratio tests by ammeters are almost valueless.

The final message of these notes is to emphasise the fact that phase-angle is of vital importance in power and energy measurements, and that ratio tests should be made by means of wattmeters rather than ammeters. This, of course, is well known to all engineers engaged in instrument testing on a large scale, but it is hoped that the information given may be useful to others less fortunately placed as regards testing equipment. It may also help to persuade the few reactionary managers who remain, that it is in their own interests to provide sound testing apparatus for their assistants. Those who wish to pursue the subject further will find the following articles of interest:—

1. Instrument Transformers. Chapter XII of "Electrical Measurements," by F. A. Laws.

2. A Study of the Current Transformer. P. G. Agnew. Reprint No. 164. *Bulletin* of the Bureau of Standards.

3. The Selection of Current Transformers. N. W. Lofvengren. *British Westinghouse Gazette*. Vol. III, p. 584.

Nos. 1 and 2 treat the subject in detail, and give extensive bibliographies.

No. 3 is extremely readable, and is strongly recommended.

THE INTERNATIONAL ELECTROTECHNICAL COMMISSION.

As mentioned in our last issue, meetings of the Advisory Committees of the I.E.C. were held in Brussels from March 27th to 31st inclusive.

In addition to the secretaries, about 35 delegates were present from eight different countries, the British representatives being: Major K. Edgcumbe, Messrs. A. R. Everest, A. J. Stubbs, C. Rodgers, W. B. Woodhouse, C. H. Wordingham, C.B.E., and C. C. Wharton.

Rating.—The first volume of the I.E.C. Rating Rules for electrical machinery for machines not exceeding 5,000 volts, 750 K.V.A. rated output, and 50 cm. in length axially, had been previously approved for issue; this meeting therefore devoted most of its time to the consideration of questions which would apply to larger machines. It was agreed to recommend that the dielectric tests given for small machines should apply also to large machines, with the exception of turbo-alternators. With regard to the latter, the French Committee's proposals that the high-voltage tests should be increased were referred to the National Committees for consideration. The use of embedded temperature detectors for the acceptance tests of electrical machinery was again discussed; and whilst it was generally agreed that these should be used in the case of large machines, there was still a very considerable difference of opinion as to the limit above which the use of this method of measurement should be compulsory, and the question will need further consideration. The American Committee recommended the use of embedded temperature detectors for all rotating machines larger than those dealt with in Vol. 1 of the I.E.C. rules, whereas the British Committee proposed their compulsory use for acceptance tests only for turbo-generators and similar machines over 5,000 K.V.A., whatever the voltage and core length, and for other rotating machines over 90 cm. core length, whatever the K.V.A. and voltage, or over 65 cm. core length, if over 6,000 volts, whatever the K.V.A. With regard to the terminal markings given in appendix 1 of the I.E.C. rules, it was not agreed to recommend these for adoption, as the American Committee pointed out that it was undesirable to fix terminal markings for transformers until terminal markings for motor and control apparatus had been settled; the American Committee was invited to forward a specific recommendation on this point.

Graphical Symbols.—The British delegates submitted the British list of graphical symbols which had been prepared, but not yet issued. This list had been based on the proposals received from the Italian National Committee, the B.E.A.M.A., and many other sources, and many of them were adopted for recommendation to the National Committees for acceptance internationally.

Nomenclature.—The work on nomenclature which had been suspended during the war was commenced. The general principles upon which the work should be developed were discussed, and it was decided to prepare an international electrotechnical vocabulary taking into consideration all the existing national vocabularies, each National Committee to add a translation of the definitions in its own language in a national edition. The vocabulary should be compiled so as to include a definition of the word in English and French, and in such a way that there would be no difficulty in finding, either in the vocabulary or in an appendix, the equivalent words in the various other languages. It was felt that it would not be possible in the official publications to extend beyond the official languages of the I.E.C., namely, English and French. In order to hasten the work, a sub-committee was appointed consisting of one delegate from each of eight countries, and a meeting of this sub-committee is to be held at Zurich in June.

A recommendation proposed by M. Paul Janet was accepted for reference to the National Committees, to the effect that it was very desirable that the National Committees should exercise in their respective countries a moral influence to prevent or to stop the formulation of electrotechnical terms, definitions, and symbols which would ultimately present a serious obstacle to international agreement.

Standard Pressures.—The Advisory Committee on Standard Pressures for Insulators considered various proposals which had been submitted by the National Committees, and finally formulated a series of standard high pressures together with the proposals for the high-pressure test in each case. These proposals will be submitted to the various National Committees for their consideration.

It is proposed to hold the next meeting of these committees in Paris in November.

A report of each of the meetings, giving the proposals in detail, will be available very shortly.

CORRESPONDENCE.

Letters received by us after 5 P.M. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Chelmsford Street Lighting Contract.

As the Press has drawn attention to the fact that Chelmsford has decided to revert to the use of gas for street lighting of the borough, I would ask you to publish this letter explaining our view of the case.

The streets of Chelmsford have been lighted by electricity for over 30 years. It has been stated that Chelmsford was the first town in the United Kingdom to use electricity exclusively for street lighting. My recollection of the matter is that Fareham was lighted in this way a few months before Chelmsford. There is no doubt, however, that Chelmsford was one of the pioneers, and it has always maintained its position in the electrical world. The old-established firm of Crompton & Co. is still pre-eminent in the manufacture of electrical machinery, and in more recent years Marconi's wireless telegraph works have, by their establishment at Chelmsford, associated the town with another branch of the electrical industry.

The contract under which we carried out the street lighting at Chelmsford came to an end on March 31st last, and it was not renewed, as our tender for a new contract was not accepted.

In 1914 the main street of the town was lighted by flame arc lamps, the other streets by means of 100-C.P. incandescent lamps except for a few which were lighted by gas.

Our tender which was refused provided that we should light the main street by means of ¼-watt lamps taking the same amount of energy as the pre-war arc lamps, and for this

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we tendered the pre-war price. For the other streets we tendered at an increase of 59 per cent., *i.e.*, £5 instead of 3 guineas per lamp per annum. These prices are, surely, a moderate increase in view of the changed circumstances with regard to the cost of material and labour.

We have not been told why our tender was refused, but we understand that the gas lighting scheme shows a saving on the rates we put forward.

The Chelmsford Gas Co. was some years ago taken over by the Chelmsford Corporation, and the rate of 3s. 5d. per 1,000 cu. ft. charged by the Gas Co. in 1914 has now been increased to 5s. 7d., an increase of 64 per cent.

In the past we secured the street lighting in competition with gas; it would appear, therefore, that it is proposed to provide gas for street lighting purposes much below the present price to the general public; moreover, it will, of course, be necessary to provide gas lighting equipment for all the streets, and at present prices.

We can quite understand that having acquired the gas works the Corporation of Chelmsford is desirous of providing its own street lighting, but would like to take this opportunity of pointing out that its decision cannot have been influenced by any unreasonable demand on our part.

K. Moncrieff,
Managing Director,
The Electric Supply Corporation, Ltd.

London, E.C.
April 17th, 1920.

Electrical Appliances in Bathrooms.

With reference to your article in the Electrical Review of the 16th inst., is it not a fact that *switches* in bathrooms are the most frequent cause of electric shocks? If contractors would only use a high-grade rotary switch, all-china switch with china dolly, or, as an alternative, place all switches at about ceiling level controlled by strings, this would avoid trouble and would not unduly increase the cost of installation. For wiring I favour lead-covered cable and sealing-in boxes.

Electrician.

April 14th, 1920.

Capitalists All.

Your interesting article boiled down means what has often been suggested before, viz., that workmen shall share in the profits as they increase, as the shareholders do. Good. But what about when the profits decrease?

F. Perceval.

Manchester, *April 13th*, 1920.

[It is not our article. The author deals with the point in the concluding instalment to-day.—Eds. Elec. Rev.]

Electric Japanning Ovens.

I was much interested in reading your notes re electric japanning ovens. Perhaps you would consider the following experience with electric stoving of equal importance to your readers, and worthy of space in your next issue.

It is over eight years since my employers installed a battery of nine varnish stoves for stoving varnished printed tin sheets. These stoves were heated by gas, and the temperature of each stove was from 180 deg. C. to 290 deg. C., according to the class of work being stoved. The size of each stove is 18 ft. deep, 6 ft. wide, and 6 ft. high.

In 1913 I converted four of these gas stoves for electric stoving, and I am more than satisfied with the results. Since these four stoves were converted I have been able completely to shut down the remaining five gas stoves, and we are able to get through more work, in the same time, with four electric stoves than was possible with the whole nine gas stoves.

Comparing the actual cost of electricity against gas, we find that the cost of gas per 1,000 sheets stoved is 10 per cent. less than that of electricity. The advantages of electric stoving are chiefly:—

Greatly increased output.
No fear of explosion.
Easy to control.
Purer atmosphere, and
Much better work turned out.

There may be other users of electricity in this country for the same class of work, but I have not up to the present heard of any.

Alfred Rider, A.M.I.E.E.

Hull,
April 15th, 1920.

The Commercial Efficiency of Fuel.

I am somewhat surprised that you repeat your statement that in the discussion in Birmingham the case of electricity was not adequately presented, in view of my pointing out that the report on which you admittedly based your conclusions is an imperfect one.

It was not possible, I think, for an adequate report to be put in the Press unless very much more space had been given. For example, I myself spoke, I believe, for as long as any of the other speakers, and yet the report of my remarks was suppressed altogether. This is probably my own fault, as owing to pressure of work I did not prepare a typewritten copy of my speech, and I do not make any complaint about it not being reported, but I certainly feel that the other speakers and I have a just cause for complaint of your action in making the statements you have without being fully informed of what took place on the occasion of the debate in question.

C. C. Garrard.
Chairman of the South Midland Territorial Centre of the Institution of Electrical Engineers.

Witton, Birmingham.
April 10th, 1920.

[So far as opinion is concerned, we are entitled, and are able, to form our own opinion without assistance. But Dr. Garrard assures us that we are not in possession of the facts, and that the report, though provided by the authorised reporter, and said to have been revised by the speakers, was far from representing the discussion. Very well, then; it is obviously common ground, that *the report of the discussion does not adequately present the case for electricity.* We accept that position, and the speakers leave the court without a stain on their character.—Eds. Elec. Rev.]

Illicit Commission.

It is an unfortunate fact that the electrical trade is none too free of underhand methods, but it is not often that one has experience of so gross a misdemeanour as the following letter, which is dated from Walsall, and addressed to this firm:—

Walsall,
April 15th, 1920.

Dear Sirs,

I beg to ask you if you will let me know what commission you will let me have on all orders for switch gear.

The orders would be for single, double, and triple pole switches ranging from 30 to 150 amperes. Now, if you like I will have the orders sent to you by a firm in this town. I can assure you they will open an account with you if I ask them, for I am in charge of their large electric plant. We are always in want of switches, and I had six of your single-pole switches two years ago, but through another firm, and I may say they have been exceedingly good ones.

My firm need not know that you would give me commission. I should also be glad if you would send lists of your switches and other electrical goods you supply.

Trusting I shall hear from you and your agreement.

Faithfully yours,

X. X. Xxxxxxx.

(We refrain from giving the name.)

The Cantie Switch Co., Ltd.

Nottingham.
April 16th, 1920.

[There is a brazen candour about this proposal which compels admiration—but in no way lessens the iniquity of the intention, while it aggravates the insolence of the suggestion that the firm would stoop to such practices. Walsall firms would do well to search out the writer and prosecute him.—Eds. Elec. Rev.]

The Conjoint Board of Scientific Societies.—The annual report for 1919 states that four societies were admitted to membership, the Royal Statistical Society, the Röntgen Society, the Illuminating Engineering Society, and the Surveyors' Institution, bringing the total number of constituent bodies up to 57. Three ordinary meetings were held, and also a special meeting to consider the reports of the Committees on the Metric System and the Patent Laws. The Committee on Water Power, under the chairmanship of Sir Dugald Clerk, K.B.E., F.R.S., claim to have stimulated considerable interest in the subject, and that steps are being taken in many parts of the Empire to survey water resources for the development of electricity. The report states that "During the year a number of applications for advice or assistance have reached the committee from various Colonial Governments interested in the development of their hydraulic resources. These have served to strengthen the opinion of the committee, expressed in their first report, that some permanent central body is urgently required to co-ordinate, advise, collect, and distribute data relating to water powers throughout the Empire. In view of this opinion, the committee welcome the suggestion to hold an Imperial Conference on Water Powers in London during the present summer." An elaborate report on the advisability or otherwise of the compulsory adoption of the metric system, dealing boldly with the actual practical difficulties confronting the scheme, will be published shortly, together with the criticisms of the various scientific and technical societies to which it has been submitted.

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LEGAL.

Factory Act Prosecution.

At Spennymoor (County Durham) Petty Sessions, on April 13th, Messrs. Coulson & Co., Merrington Lane Ironworks, Spennymoor, were charged under the Factory and Workshop Act with having neglected to sufficiently earth electric wires used in connection with a portable drilling machine.

Mr. W. Lauder, factory inspector, who prosecuted, stated that Joseph Richardson, an employé of the defendant firm, received a severe electric shock whilst attending to the machine in question, and as a result had been unable for a month to follow his employment. The regulations specified that the machine should have been sufficiently earthed so as to make it impossible for any workman to incur risk from the electric current. Richardson sustained a shock at 230 volts.

In the witness-box, Richardson said he was knocked over and injured while attempting to get hold of the machine handle.

Mr. Proud, for the defence, contended that there had been no wilful neglect, the firm invariably complying with the recommendations of inspectors.

After a long consultation in private the Bench decided to dismiss the case on payment of costs.

It was stated there would be an appeal against the decision.

Can Special Specifications be Charged For?

In the City of London Court, on April 13th, before Assistant Judge Jackson, Mr. Reginald Williams, trading as "Y" Electrical Installation Co., 4, Creechurch Lane, E.C., sued the Paddington Radical Working Men's Club, Ltd., for 10 guineas for services rendered with reference to the electrical installation at their premises. Mr. Scott Duckers appeared for the defendants.

Plaintiff said that the club had got out a specification for lighting the place with ordinary drop lights. He thought a special ceiling bowl fitting, if utilised, would cast a reflected light from the ceiling and give much more light. That would naturally save current. The secretary suggested that he (plaintiff) should give the club a special estimate based on his idea of the reflected light. The secretary took him round to the club, and witness pointed out to the secretary where, in his view, the particular lights should be placed. At the same time he pointed out the points that had been specified in the specification. The secretary was convinced that the lights proposed by witness would be more effective and that fewer points would be required. Consequently, less current would be consumed. The secretary asked him to give the club a special specification, and at the same time to specify the cost in accordance with the club's own specification. Accordingly he sent the club two specifications, and the special specification took a long time to get out, and involved expense in production. The club decided to adopt their original specification, notwithstanding the fact that they had asked him for his suggestions in writing. He went to no end of trouble in the matter, and went over the club premises three times. At last he sent a telegram quoting for their own specification. They did not even acknowledge his estimates, and they ultimately turned him down altogether. He now claimed the very moderate fee of 10 guineas for loss of time and professional services in the matter.

Frederick Samuel Morris, secretary of the club, was called. He said that on October 28th the committee decided to have some fresh lighting arrangements, and a rough specification was drawn up with a view to the club being electrically lighted. They posted up a notice on the club's notice board to the effect that tenders would be invited, and as a result of that they received tenders from five firms. The plaintiff was one who tendered in common with others. He was not asked to effect any improvement in the club's specification, nor was he asked to do anything more than each of the other firms who tendered for the work was willing to do. He did not employ plaintiff professionally to evolve any new scheme of lighting. Witness had no power to pledge the club's credit, nor did he in fact do so. The tenders were examined by the club's committee, and the tender of Mr. McLelland, who did the work, was accepted. Then he received a telegram from the plaintiff making a further quotation, but the matter having been settled there was no reply.

The Assistant Judge was fully satisfied that the plaintiff tendered in the same way as the others, and that he had made some suggestions which, if they had been adopted, might have improved the light or not, but that was done on plaintiff's own account. The plaintiff's tender was not accepted, and he was clearly of opinion that the plaintiff had no legal claim. Judgment for defendants with costs.

Rist v. Vulco Magneto Co.

A partnership purchase of Government magnetos gave rise to an action heard by Sir F. Newbold, the newly-appointed High Court Official Referee, on the 13th, 14th and 15th April, in which Mr. D. V. A. Rist, trading as the Vulco Manufacturing Co., claimed from the Vulco Magneto Co. and Mr. H. Rothwell the delivery of 90 magnetos or their value, and damages. The original claim was for the delivery of 140 magnetos, but by order of Mr. Justice McCardie 50 of that number had been delivered.

Mr. Arthur Lawton appeared for the plaintiff, and Mr Cartwright Sharp represented the defendants.

It appeared that in 1917 the Government desired to sell a number of magnetos stored at the White City which had belonged to the R.A.F. Mr. Rist tendered for them, and his tender was accepted. For the purpose of carrying out the purchase he entered into partnership with Mr. H. Rothwell under the title of the Vulco Magneto Co., and that partnership continued from December 17th, 1917, until November 20th, 1918, at which latter date it was dissolved, and the business of the defendant firm was afterwards carried on by Rothwell in partnership with one S. J. Watson. In October, 1918, the defendant firm assigned to the plaintiff £220, the whole of their stock of the B.T.H. (British Thomson-Houston), T.B. (Thomson Bennett), and D.U.5 (Bosch) magnetos, being 190 in number, comprising 100 D.U.5, 23 T.B., and 17 B.T.H., with a further 23 T.B. and 17 B.T.H. The consideration for the sale was met by a reduction *pro tanto* of a debt then owing by the defendant firm to the plaintiff. On the same date the plaintiff assigned to the defendant Rothwell for the sum of £110 90 of the magnetos. It was alleged that the defendant had not completed the transaction, and that he had wrongfully detained certain of the magnetos. It was a term of the sales that Rothwell should deliver to the plaintiff within reasonable time, but it was alleged that he had failed to do so, and a claim of some £600 was made for non-delivery, with damages for detention.

The defendant denied liability, alleging that it was a matter of account and counter-claiming against the plaintiff for breach of contract. There was also a minor claim by the defendant Rothwell for small sums relating to the partnership prior to the dissolution amounting in the aggregate to £56.

After several witnesses had been heard, the Official Referee offered a suggestion as to the nature of the matters in dispute, and the desirability of the parties considering whether under the circumstances a settlement could not be arrived at.

With this end in view the parties agreed to an adjournment of the action for three months.

Harvey v. London Electric Railway Co.

In the King's Bench Division, on April 19th, Mr. Justice Roche heard an action brought by Mrs. Kate Harvey, a widow, against defendants to recover damages for personal injuries sustained by her whilst attempting to board a train at Baron's Court Station on the Piccadilly Railway, on January 8th, 1919.

Evidence was given for the defence that the plaintiff attempted to board the train when the gates had been closed and the train had begun to move.

His Lordship said he accepted the evidence of the plaintiff that the gates were not closed when she attempted to board the train, and that the train was started when the gates were sufficiently open to constitute an invitation to the plaintiff to follow her daughter into the train. He therefore found there was negligence on the part of the company's servant. Judgment was given for the plaintiff, the damages being assessed at £275, with costs.

Bennett v. A.A. Electrical Co., Ltd.

In the King's Bench Division, on April 15th, Mr. Justice Rowlatt sitting without a jury had before him an action which raised certain complicated issues as to electrical goods seized by the sheriff, and as to money garnisheed. The action was brought by a Mr. Bennett against defendant company, of Farringdon Road, E.C.

In giving judgment, his Lordship said the two interpleaders included goods taken in execution, and the other affected a sum of money garnisheed, and the question was whether the execution debtor had not assigned both goods and money to the plaintiff in the interpleader issue. Documents had now been produced by which the assignment was clearly made on March 27th, 1919, and what the defendants' execution creditors had to make out was that those documents were not intended between the parties to have any operation at all, so that not only did nothing pass at the time, but that the business had ever since been carried on as the business of the execution debtor, or at any rate the business of somebody not the plaintiff under the interpleader assignee, because the goods which had been seized and the money garnisheed were not the original subjects of the assignment, and were the assets and money of the business as it existed some six months later at the date of the execution and the garnishee proceedings. It was an issue which required a good deal of proof on the part of the defendant. It required a good deal of evidence to make one come to the conclusion that the whole thing was a sham and that the business had not become the property of the plaintiff. He could not say the position of this business and these assignments was at all clear. In fact, he was not certain he had been told all about it, or that he knew exactly what the position was. The

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business was carried on in a very odd and informal and elementary way in several respects. In the first place, the business of Williams, the assignor, was very largely in the hands of a manager. He seemed to be a man who knew rather more about the business than Mr. Williams himself. He guaranteed the purchase, and even guaranteed the banking account, and when the assignment was executed he remained on as manager under the assignee. He had some business interest as a creditor in it, and he was to receive a considerable portion of the moneys from the assigned. It might be that he continued on in the service of the assignee in order that he might see that the business earned what he was going to get out of the assignment. With regard to the transfer of the assets, it was clear that there were a number of lighting accessories, largely including batteries, but the assignee never seemed to have had any proper valuation made, but judged what he thought they were worth in a rough-and-ready sort of way. There was no evidence that the assignor had ever had any beneficial interest in what was to be made out of it in a business sense. He had to be paid certain sums, but they were fixed sums provided for, and there was no hint that he had received any sum which corresponded with that which was actually made out of the business. He could not maintain the defendants' position in this interpleader, as he (his Lordship) felt he had not got to the bottom of the transaction. Under the circumstances he must hold that the plaintiff succeeded in both the interpleaders, and must give judgment for him with costs.

LINDSELL *v.* PAIGNTON ELECTRIC LIGHT CO., LTD.

MR. JUSTICE BAILHACHE, on April 13th, delivered the judgment of the Divisional Court of the King's Bench in the case of Lindsell *v.* Paignton Electric Light Co., Ltd., heard on January 23rd, which was an appeal from the judgment of the County Court Judge of Paignton, raising the question whether electricity supplied to a kinema could be charged for as for power or as for lighting purposes.

Mr. Justice Bailhache, in giving judgment, said the question to be decided is whether certain electrical energy supplied to the respondent is to be charged at the lower rate, as he contends, or at the higher rate, as the appellants contend. The learned judge has decided in favour of the respondent.

The electrical energy in question is used except as to a small part of it for making light in the arc lantern, and the dispute as between the parties has arisen because the electrical energy so used passes through a transformer or rotary converter. The transformer receives the energy at a pressure of 440 volts, and passes it out to the arc lamp at a pressure of 60 volts. No new energy is created. The same energy that is supplied by the appellants from their generating station reaches the arc lamp, but at a reduced pressure. The appellants, therefore, supply electricity for the defendant's arc lamp. Is the electricity used for light or for power? I think for light. The learned judge has found otherwise. The contract is, I think, plain enough, although there may be room for doubt in a given case whether in point of fact energy supplied is used for light or for power. He further seems to restrict the word lighting to such light as would enable the respondent to pursue the ordinary habits and purposes of life. I must respectfully differ. The light used in showing films can only, I think, be described as light, and is not the less light than the light of a reading lamp. The chief reason for the decision of the judge below was, I think, to be found in the sentence "one must look at the primary use of the introduction of the energy to the machine, and not to the ultimate result, to see to which of the two objects the energy was supplied within the meaning of the contract." It seems to me that the fact that the energy passes through the transformer, and in so doing causes part of its mechanism to rotate, does not affect the question. The energy is not supplied for the purpose. It is supplied for light, and is used for light. As I have said, the energy which leaves the generating station is intended to reach and does reach the illuminating apparatus, although at a lower pressure. A small portion of the electricity supplied is used for operating the film-driving motors. This is clearly used for power, and is only chargeable at the power rate. The rest and by far the largest amount must be paid for at the lighting rate. The parties can no doubt agree the relative proportions. In my opinion the appeal must be allowed with costs.

Mr. Justice Bray concurred, and the appeal was accordingly allowed.

BUSINESS NOTES.

Exports and Imports of Electrical Goods for March, 1920.—The returns of electrical exports for the month of March show an all-round improvement as compared with the previous month, the export values reaching £1,102,781, as compared with £761,973 in February, 1920, with £420,452 in March, 1919, and £992,681 in March, 1913; the 1913 total including a large telegraphic export to Ceylon, valued at £450,000, the 1920 export total also including telegraphic and telephone cables and materials to the value of £464,000. The total weight of electrical machinery exported amounted to 695 tons, as against 569 in March, 1919, and 2,007 for March, 1913.

The electrical import totals for the past month were £136,310, as against £188,026 for the previous month of February, the principal falling off occurring in electrical machinery, £30,000, and telegraph and telephone cables and apparatus, £10,000. The re-exports of foreign and Colonial electrical material vary very slightly, the March total being £10,114, as against £9,798 for February.

VALUES OF ELECTRICAL EXPORTS AND IMPORTS FOR MARCH, 1920.

	Exports.	Imports.	Re-exports.
Electrical goods and apparatus (unenumerated)	£131,084	£37,720	£2,308
Insulated wire	254,077	5,178	—
Glow lamps	18,174	3,643	2,576
Arc lamps and parts	4,352	1,353	—
Batteries...	37,775	8,753	—
Meters	29,998	4,781	197
Carbons	5,438	9,841	—
Electrical machinery :—			
Railway and tramway motors...	1,686	—	—
Motors and generators	84,398	—	—
Elec. machinery (unenumerated)	61,307	57,482	3,846
Switchboards (not telegraph or telephone)	7,460	—	183
Telegraph and telephone cables and apparatus :—			
Telegraph and telephone wires and cables (not submarine)...	45,821	184	—
Submarine telegraph and telephone cables	303,406	50	—
Telegraph and telephone instruments and apparatus ...	114,805	7,325	1,004
	£1,102,781	£136,310	£10,114

New Belgian Company.—La Société Indépendante Belge de Télégraphie Sans Fil is the name of a new company which has just been formed in Brussels, with a capital of 1,000,000 fr., in connection with wireless telegraphy and telephony, and to enter into a contract with the Société Indépendante de Télégraphie Sans Fil, of Paris.

Winnipeg.—The Winnipeg Board of Trade has issued some interesting publicity literature respecting the vast electric power resources of the City, and the importance and merits of the place as an industrial centre.

Electric Vehicles in Milan.—A company has just been formed in Milan, with the title of La Società Italiana dei Veicole Elettrica, to inaugurate a service of electrical motor vehicles in that city. The cars to be employed are to be imported from America.

Whitley Council.—DISTRICT COUNCIL (No. 1) NORTH-EAST COAST AREA ELECTRICITY SUPPLY INDUSTRY.—This Council has been constituted as follows :—

Employers' Representatives.—Mr. E. B. Barlow, A.M.I.E.E, engineer and manager, Berwick Electric Lighting Co.; Mr. J. Cusworth, operation engineer, Cleveland and Durham Electric Power, Ltd.; Mr. E. Hatton, general manager, Newcastle Corporation Tramways; Mr. J. R. P. Lunn, M.I.E.E., electrical engineer, Darlington Corporation; Mr. E. Moxon, A.M.I.E.E, electrical engineer, South Shields Corporation; Mr. R. H. Scotson, electrical engineer, Middlesbrough Corporation; Mr. R. P. Sloan, C.B.E., M.I.E.E., manager and director, Newcastle-upon-Tyne Electric Supply Co.; Mr. J. W. Spark, electrical engineer, West Hartlepool Corporation; Mr. N. S. Tennant, M.Sc., general manager and engineer, Newcastle and District Electric Lighting Co.; Mr. C. Vernier, M.I.E.E., mains engineer, Cleveland and Durham Electric Power, Ltd. (auditor); Mr. J. S. Watson, technical manager, Newcastle-upon-Tyne Electric Supply Co. (chairman); Mr. A. Wood, director, Newcastle and District Electric Lighting Co.

Trade Unions' Representatives.—Mr. T. Bowmaker, Amalgamated Society of Engineers; Mr. J. Cassidy, National Amalgamated Union of Labour; Mr. J. Egerton, Amalgamated Society Toolmakers, Engineers and Machinists; Mr. A. Ford, United Machine Workers Association; Mr. J. Gibson, Amalgamated Society of Engineers; Mr. H. Lynas, National Union of General Workers (auditor); Mr. G. A. Olley, Electrical Trades Union (vice-chairman); Mr. W. C. Percival, Steam Engine-Makers' Society (secretary); Mr. T. Reed, National Amalgamated Union of Labour; Mr. G. C. Richardson, Steam Engine-Makers' Society; Mr. E. Robinson, Electrical Trades Union; Mr. W. Sherwood, National Union of General Workers.

Employers' Secretary.—Mr. A. A. Dunn.

A Hungarian Company.—The Hungarian Felten and Guilleaume A.G., of Pesth, proposes to pay a dividend of 15 per cent. for 1919, as in the previous years. The directors state that a very considerable stock of orders has been brought over into the new financial year, although the difficulties experienced in obtaining raw materials, which have to be procured from abroad and paid for in foreign currency, are greater. It has been decided to increase the share capital from 3,000,000 kr. to 5,000,000 kr., so as to be able to take up new branches of manufacture,

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Applications for British Trade-marks.—Appended is a summary of the recent applications for British trademarks in respect of goods connected with the electrical trades and industries :—

Nife (letters combined with design). No. 393,429. Class 8. Electric lamps and lanterns. Batteries, Ltd., 19, Coleman Street, London, E.C. July 18th, 1919.

Nife Accumulator (letters combined with design). No. 393,430. Class 8. Electrical accumulators. Batteries, Ltd., 19, Coleman Street, London, E C.

Lewcos. No. 395,075. Class 40. Wire, insulated, coated with india-rubber. London Electric Wire Co., and Smiths, Ltd., 7, Playhouse Yard, Golden Lane, London, E. September 9th, 1919.

Siddor. No. 398,519. Class 13. Electrically-heated ignition plugs, soldering-irons and metal utensils. Charles H. Reddis, 66, Elstow Road, Bedford.

Graham (lettering combined with design). No. 398,084. Class 13. Electric bells, diaphragm horns for motors, &c. Edward A. Graham, trading as Alfred Graham & Co., St. Andrews Works, Crofton Park, London, S.E. December 5th, 1919.

Dielex. No. 399,711. Class 50. Electrical insulators. J. J. Eastwick & Sons, 3, Belfast Road, Stoke Newington, N. 16. January 19th, 1920.

Areco. No. 400,169. Class 18. Electric fires, heaters and stoves. Anglo-Russian Engineering Co., Ltd., 374-378, Old Street, London, E.C. January 29th, 1920.

Homo. No. 399,679. Class 18. Electric lighting plants. Tattersalls, Ltd., 4, Great Marlborough Street, London, W. January 7th, 1920.

Spitfire. No. 400,517. Sparking plugs and metal goods in Class 13. Frederick A. Greensmith, trading as the Vital Motor Units Co., Tyler Street, Trafalgar Road, Greenwich, S.E. February 7th, 1920.

Simfix. No. 399,788. Electrical goods included in Class 13. Witchell's Electrical Accessories, Ltd., Endwell Works, Endwell Road, Brockley, S.E. January 21st, 1920.

Simplete. No. 399,789. Electrical goods included in Class 13. Witchell's Electrical Accessories, Ltd., Endwell Works, Endwell Road, Brockley, S.E. January 21st, 1920.

Simpact. No. 399,790. Electrical goods included in Class 13. Witchell's Electrical Accessories, Ltd., Endwell Works, Endwell Road, Brockley, S.E. January 21st, 1920.

Hercules (lettering combined with design). No. 389,974. Class 13. Sparking plugs. Eclipse Manufacturing Co., 424, North Meridian Street, Indianapolis, Ind., U.S.A. April 8th, 1919.

Nichro. No. 396,543. Class 13. Electric cooking and heating appliances. Harry Cheshire, trading as Cranmer & Cheshire, 9, Stewart Street, Spring Hill, Birmingham. October 28th, 1919.

Planet. No. 398,389. Class 13. Sparking plugs for internal combustion engines. Arthur T. Ellis and Harry A. Hands, 129, Castelnau, Barnes, S.W. December 13th, 1919.

Elfa (lettering combined with design). No. 399,863. Class 8. Electrical batteries (not medical), heating elements (being electrical resistances), and electric lamps (philosophical). Arthur Kupper, 62, Noordestraat, Amsterdam, Holland. January 22nd, 1920.

Perna. No. 398,696. All goods in Class 6. The Perna Engineering Works (Blackpool), Ltd., Castlegate, South Shore, Blackpool. December 22nd, 1919.

EElex. No. 399,710. Class 8. Electrical goods and apparatus. J. J. Eastick & Sons, 3, Belfast Road, Stoke Newington, N. January 19th, 1920.

Ediswan. No. 400,157. Machinery and parts of all kinds, included in Class 6. No. 400,159. Class 11. Instruments, apparatus, and contrivances, not medicated, for surgical or curative purposes. No. 400,160. Metal goods in Class 13. No. 400,161. Class 15. Goods of precious metals and imitations thereof. No. 400,162. Class 16. Porcelain or earthenware goods. No. 400,163. Class 18. Engineering, architectural and building contrivances. No. 400,164. Class 32. Silk-covered electrical wire. No. 400,165. Class 40. Goods manufactured from india-rubber and gutta-percha. The Edison-Swan Electric Co., Ltd., 123-125, Queen Victoria Street, London, E.C. January 20th, 1920.

Sollyte. No. 398,050. Class 1. Electrolytes, being chemical substances. Haslam & Stretton, Ltd., 11, Windsor Place, Cardiff. December 4th, 1919.

Foreign Trade.—March Figures.—The following are the values given of electrical goods and machinery in the official returns of imports and exports for March :—

	March, 1920.	*Inc. or dec.*	3 *months*, 1920. *Inc. or dec.*
Imports.	£	£	£
Electrical goods, &c. ...	78,828	— 41,081	— 77,694
Machinery	1,199,539	— 538,978	— 205,964
Exports.			
Electrical goods, &c. ...	952,390	+ 652,514	+1,418,537
Machinery ...	3,417,192	+1,554,972	+4,887,548

What's in a Name?—The Rio de Janeiro Municipality has decided to impose a tax of 1 conto (about £65) per annum on every plate or sign bearing the designation in a foreign language of any firm or company. It is understood that most of the foreign firms in the city may in consequence change their designations into Portuguese.—*Board of Trade Journal.*

Runcorn Strike Settled.—The Runcorn dockers and watermen who were on strike have returned to work, and the Mersey Power Co. have been again enabled to produce full electrical supplies to the various factories, workshops, and places of amusement in the Widnes and Runcorn district.

French Company Notes.—The Société des Accumulateurs Electriques (A. Denin) is about to increase its capital, which now stands at 3,000,000 fr.

It has been decided to embody the Société Anonyme Westinghouse with the Compagnie Electro-Mecanique, the former company receiving for its assets 20,000 500 fr. fully paid-up shares, and a sum of 1,216,000 fr., payable on June 30th, divided among the shareholders of the Westinghouse Co. *pro rata* with their holding of shares. The Compagnie Electro-Mecanique will also issue 10,000 shares, the subscription to which will be reserved to the shareholders of the liquidating company.

L'Heure Electrique has been established at Paris (92, Rue St. Lazare) for the working of various patents for electric clocks (Mees, Campiche & Verain). The capital is 2,500,000 fr.

Under the name of L'Enterprise Electrique a company has been formed at Paris (13, Rue Dupont-des-Loges), with a capital of 2,000,000 fr.

According to the *Intérêts Economiques*, the Etablissements Maljournal et Baurron are taking a large money share in the Société des Isolants du Rhône, now being formed with a capital of 2,000,000 fr.

Under the style of Le Transformateur has been formed a company at Paris (39, Rue des Acacias), for the manufacture and sale of electrical material, and especially static transformers. Capital, 2,000,000 fr.

Société de Transport d'Energie des Alpes is the name of a company formed at Lyons (49, Rue de la Bourse). Capital, 2,000,000 fr., for the objects indicated in its title. The board of management is made up of leading officials of 10 great Southern companies.

Wages in the Electrical Supply Industry.—At a meeting of District Council (No. 1) North-East Coast Area, held on April 9th, 1920, an application from the Trade Unions to put into operation Industrial Court Award No. 180 was considered, and it was resolved as follows :—

In view of the fact that no standard basic rates had yet been established for the No. 1 North-East Coast Area, the District Council recommends to the National Council that the following increases be paid by the undertakings in the area :—

3s. per week from the beginning of the pay period immediately following March 31st, 1920.

3s. per week from the beginning of the pay period immediately following May 31st, 1920, providing that standard basic rates are not established previous to the latter date.

Italian Company Notes.—There has been formed at Turin the Società anonima Imprese Elettriche Sarde, with a capital of 100,000 lire, for the utilisation of the water resources of Sardinia.

The following companies have augmented their capital :—The Officine Elettromeccaniche Bolognesi, from 500,000 to 1,000,000 lire ; the Società Elettrica Mesagnese di Mesagne : and the Benigno Crespi (Forze idrauliche di Trezzo d'Adda), Milan, from 9,000,000 to 12,000,000 lire, and also issued bonds to 6,000,000 lire.

L. L. Pinard e Ca is the name of a company launched at Milan (Via Duvini 31) for trade in electrical material and machinery and raw materials. Capital, 25,000 lire.

The Società Italiana Laminazione Alluminio has been established at Alessandria with a capital of 650,000 lire for the rolling of aluminium.

Foccaccia de Castaldo, Fittipaldi e Ca have formed themselves into a company at Naples with a capital of 40,000 lire, for the prosecution of the electro-mechanical industry.

For the construction, taking over, and working of electric plants, the Società Sabina di Elettricità has been established at Rome with a capital of 40,000 lire.

Vaschetta e Labella have been formed into a company at Naples (Via Taraia 58) with a capital of 50,000 lire, for electro-mechanical trading.

A.B.G.D. is the style of a company formed at Milan (Via Bigli 22) with a capital of 600,000 lire, for the working of electro-mechanical patents.

To work the "Fax" accumulator patents in Italy, Scaini, Tronrie e Ca, have been formed into a company at Milan with a capital of 105,000 lire.

The Imprese Elettriche dell'America Latina is a company formed at Milan (Via Borgonuova 3) for the foundation and development of electrical undertakings in Latin America. Its capital is 5,000,000 lire.

Under the style of Società Anonima Monti e Martrini, two firms have joined forces for the manufacture of electrical material, with a capital of 2,000,000 lire. The company's works are at Milan.

The trust, or Consorzio per l'Alienazione degli Impiante e Materiali Elettrici, telegrafici e telefonici residuati della guerra, has been formed at Milan, with a capital of 100,000 lire (to be raised to 5,000,000 lire), to take over war-time electrical plants, &c.

An Indian Ropeway Inquiry.—H.M. Trade Commissioner in India states that the electrical engineer of an Indian municipality is desirous of entering into communication with firms who would be prepared to undertake the construction of a ropeway capable of conveying both goods and passengers over a distance of 10 miles to an altitude of 6,700 ft. (actual rise 4,500 ft.) with a capacity of 10 tons per hour at a rate of 10 miles an hour. For power, it is understood that three-phase, 380 volts, 50 cycles supply is available. The engineer also seeks information relative to electrically-driven rock drills. The address of the engineer referred to may be obtained by interested United Kingdom firms upon application to the D.O.T. Department.

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Lead.—In their report dated April 17th, Messrs. James Forster & Co. state :—

On Thursday all markets were more or less affected by the rise in the Bank Rate, and lead did not escape the general depression. July shipment selling down to £41 5s. On yesterday's market further liquidation set in, and prices declined to £37 15s. April, £38 15s. May, £39 5s. June, and £40 5s. July, these being the closing quotations. The Board of Trade returns for March show a balance for home consumption during that month of 6,073 tons, and the figures for the last five months are: Imports, 43,261 tons; exports, 30,084 tons, leaving for home consumption 13,177 tons.

Messrs. G. Cawson & Co., writing under the same date, say :—

The market has fluctuated considerably since our report of 10th inst., apparently without any justification since there is really nothing new in the position to warrant any change. . . . There is no doubt that the financial position and the heavy cost of carrying lead is having its influence on operations, and some realisations have taken place as some of them are evidently not disposed to carry lead with the present uncertain outlook. Fresh supplies are not coming in very freely. It is fortunate, perhaps, that this is so, as they are not wanted. There is at present rather more lead about than is required by consumers, and it is very fortunate that the Government are arranging to warehouse some parcels, and are now more ready to meet the wishes of buyers as to deliveries. By doing this they have probably prevented a real débâcle in the market. . . . The supply of lead coming forward is at present ample for all requirements, in addition to the parcels which are being warehoused here privately, and also for account of the Government. The outlook has again become uncertain. The speculative spirit is to some extent broken, and the dubious financial prospects do not encourage fresh operations for an advance in price. We are, therefore, now again inclined to look for quiet markets, and, perhaps, even some further decline.

An Austrian Company.—The report of Felten and Guilleaume A.G., of Vienna, states that it was possible to keep the Vienna works supplied with raw and other materials in 1919, but the Styrian ironworks was at a standstill for some months. As net profits the accounts show the sum of 4,454,000 kr., as compared with 3,993,000 kr. in 1918, and the directors recommend a dividend at the rate of 17 per cent., as in the preceding year. The prospects are regarded favourably in view of the extension of hydro-electric works and the projected conversion of the railways to electric traction.

Catalogues and Lists.—The India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd., Silvertown, E. 16. Booklet No. 17 (36 pp.).—This is an attractively produced account of the works and products of the company, dealing with various departments, and well illustrated by photographs of the buildings and machinery. The extremely wide field covered by "Silvertown" products is brought to notice effectively. The booklet touches upon dynamos and golf-balls, submarine cables and hot-water bottles.

The Sun Electrical Co., Ltd., 118-120, Charing Cross Road, W.C. 2. List No. 302 (12 pp.).—An illustrated and priced catalogue of tungsten lamps, vacuum and gas filled, carbon filament lamps, automobile lights and flash light bulbs, and the "Ediswan" "Pointolite" lamps.

Welco Patents, 150, Alma Street, Birmingham.—A folder, giving particulars of fixing panels, an electric iron, and the "Welco" combined electric fire and cooking stove, with forms of application for these.

Metrodes, Ltd., 87, Fargate, Sheffield.—We regret that the address of this firm was erroneously given in our columns last week as "Leeds."

The British Electric Transformer Co., Ltd., "Tricity" Showrooms, 50, Oxford Street, W.1.—Catalogue No. 36 (36 pp.), with current price list. The former is an illustrated list of "Tricity" products, including electric fires, ovens, kettles, &c., profusely illustrated by means of photographs.

Messrs. Landis & Gyr, Ltd., Windmill Road, Hampton Hill, Middlesex.—Leaflet dealing with friction-compensated ampere-hour meters for D.C. two-wire circuits. Illustrated and dimensioned.

Credenda Conduits Co., Ltd., Chester Street, Aston, Birmingham.—Illustrated leaflet giving price and details of the new "Creda" kettle.

Messrs. Sterns Ltd., of Royal London House, Finsbury Square, London, E.C., have issued a wall sheet with calendar for 1920, and a chart showing what lubricants they recommend for use for specified types of cars in summer and winter respectively.

Works Extensions.—The extensions are proceeding at the works of the General Electric Co., Ltd., at Witton. Land at the side of the London and North-Western Railway, between Aston and Gravelly Hill (with the canal running through the site), is rapidly being developed, and within the last three months the steel frame-work of several large factories has been erected. The shell of one large building on the ferro-concrete principle is rapidly approaching completion. A portion of the estate on the opposite side of the canal is being laid out for recreative purposes for the employés.

Canadian National Exhibition. — The forty-second annual Canadian National Exhibition will be held at Toronto from August 28th to September 11th next. Approximately 1,000,000 visitors attended last year's Exhibition. French manufacturers have applied for considerable space for the display of French products. United Kingdom firms should apply without delay to Mr. Waters, Canadian National Exhibition, King Street East, Toronto. Information regarding past exhibitions may be obtained at the Department of Overseas Trade, 35, Old Queen Street, S.W. 1.

Plant for Sale.—Rotherham Corporation invites offers for seven Lancashire boilers, two Green's economisers, also complete lay-out of steam and feed piping and valves. See our advertisement pages to-day.

Calendar. — Messrs. Metropolitan-Vickers Electrical Co., Ltd., of Trafford Park, Manchester, have prepared a wall calendar (April, 1920—March, 1921). The study emphasises the chilliness of the April morn on which we write.

Points from the Budget.—The postage rates on inland letters are to be 2d. for 3 oz. and ½d. for every additional oz. Dominion letters will be 2d. for 1 oz. and 1d. for every additional oz. Newspaper postage rates (inland) are to be advanced to 1d. for not exceeding 6 oz. and ½d. for each additional 6 oz. Parcel-post rates are increased, as are also rates affecting postcards, printed matter, &c. Inland telegrams will be 12 words for 1s. (instead of 9d.) and 1d. for each additional word. Telephone charges are to be dealt with after a Select Committee has reported on the matter. Taxes on motor cars and vehicles are revised as from January next, a H.P.-basis being adopted in place of the petrol tax. The duty on share capital is increased from 5s. per £100 to £1 per £100. The Excess Profits Duty, which in many quarters it was expected would give place to another form of tax, is to be raised from 40 per cent. to 60 per cent., and a new tax, to be known as "Corporation Tax," at the rate of 1s. in the £, or 5 per cent., on undivided profits of limited liability companies engaged in trade, is also added. In the event of a Bill being introduced later in the year making a levy on war-wealth increase, the 20 per cent. increase in Excess Profits Tax will be taken into account. Surprise is being expressed that the Corporation Tax has been imposed in addition to, instead of in place of, the Excess Profits Duty, as had been expected would be the case. There is to be relief from double income-tax within the Empire.

Book Notices.—"Report of the Fuel Research Board for the years 1918, 1919. (Department of Scientific and Industrial Research)." 57 pp. London: H.M. Stationary Office.—The report of the board, which consists of Sir George Beilby, F.R.S. (Director), the Hon. Sir C. A. Parsons, K.C.B., F.R.S., Sir Richard Redmayne, K.C.B., and Sir Richard Threlfall, K.B.E., F.R.S., covers an extremely wide field, the main points dealt with being "Oil Fuel for the Navy and the Mercantile Marine," "Survey of the National Coal Resources from the Physical and Chemical Points of View," "Peat Inquiries," "Alcohol as Fuel," and "Pulverised Coal."

"Tungsten Ores." By R. H. Rastall, M.A., F.G.S, and W. H. Wilcockson, M.A., F.G.S. 81 pp. London: John Murray. Price 3s. 6d. net.—This monograph, prepared under the direction of the Imperial Institute, presents, in Chapter I, a brief survey of the character, occurrence and uses of tungsten ores. Chapters II and III are devoted to sources of supply. The enormous demand for tungsten created by the war is graphically shown in a curve on page 2. The world's production from being about 7,400 metric tons in 1914, jumped to over 22,000 metric tons in 1917, the production of the British Empire rising from 3,900 tons in 1914 to 7,200 in 1917. Throughout the work, references to literature on the subject are given in parentheses, and an index is provided at the end.

L'Electro Journal, a commercial review of electricity which was established in 1915, but ceased publication about a year ago, has resumed regular appearance; it is edited by M. G. Arbaud, at 1, Villa Ornano, 1—Paris (18e). Price 1 fr.

"The Chloride Chronicle." Pp. 32, No. 10. April, 1920.—The current issue of the Chloride Electrical Storage Co.'s magazine is full of bright interesting notes and articles, including "Recollections of Indian Life and Customs," and a descriptive contribution, "The Devil as Architect," illustrated by some very good photographs.

"The Coolidge Tube." By H. Pilon. Pp. viii + 96; 54 figs. London: Baillière, Tindall & Cox. Price 7s. 6d. net.

The Federation of British Industries has issued a useful pamphlet of 28 pages giving a financial review of 1919, by Messrs. J. S. M. Ward and N. E. Crump. It includes tables and charts showing the fluctuations in the rates of foreign exchange, and the prices of raw materials of industry.

"Electric Wiring: Theory and Practice." (Second edition.) By W. S. Ibbetson. Pp. vi + 463; figs. 218. London: E. & F. N. Spon, Ltd. Price 18s. net.

"Science Abstracts" (A. and B.). Vol. XXIII, Part 2. No. 266. February 28th, 1920. Price 2s. 3d. each net. Index (A. and B.) to Vol. XXII. Price 2s. 3d. each. London: E. & F. N. Spon, Ltd.

"America's Merchant Marine: Its History and Development to Date." New York: Bankers Trust Co.

Electrolytic Iron.—It is announced from Stockholm that the Conrad Werner Lindman, of the Avesta Ironworks, Sweden, has succeeded in developing a method for the electrolytic refining of iron. The experiments have been proceeding for six months, and specially good sheets are said to have been produced which are almost chemically pure, even, and homogeneous. The iron is made in thin sheets, having a higher magnetising capacity than ordinary rolled sheets, and can be turned out in the thinnest dimensions, and without requiring further treatment. The details of the process are kept secret.

Lundberg's Switching Competitions.—We understand that these well-known electric lighting switching examinations, which were conducted with such success by Messrs. Lundberg during the years previous to the war, have again been resumed, and that the papers for the next examination will appear in the columns of our contemporary *Electricity*, commencing with the issue of April 23rd.

American G.E. in Brazil.—The New York correspondent of a Birmingham newspaper says that on 17th inst. American General Electric securities were in demand on the Stock Exchange, on reports that the company had received a large order from Brazil.

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The Southampton Strike.—The trade union members of the electricity works staff came out on strike, as stated last week, on account of the refusal of the power house superintendent, Mr. E. J. Hooper, to remain a member of the E.T.U. instead of transferring his allegiance to the E.P.E.A. Alderman S. G. Kimber, the Mayor of Southampton, was interviewed by a deputation upon the subject, and was asked if he could not persuade Mr. Hooper to at least remain an honorary member of the E.T.U. He replied that this was not a matter in which he could properly take action, and said that the decision lay with Mr. Hooper himself. Upon interviewing the latter, the members of the deputation were informed that the question had been referred to the headquarters of the E.P.E.A., and the association would endeavour to arrive at an agreement with the E.T.U. by which settlement Mr. Hooper would consider himself bound. In the meantime, while these negotiations were being proceeded with, the borough Electricity Committee had taken action. After carrying on with volunteer aid during the first part of the strike, by means of which the greater part of the service was maintained, the committee engaged new men to the extent of 80 per cent. of the vacancies created by the dispute. These men went to the works upon the express understanding that their positions would be permanent. The conditions under which the breach was filled by outside labour precluded the reinstatement of all but a small part of the strikers, and the trade unions were informed accordingly. This gave rise to threats of a general strike. On April 17th a mass meeting of members of several local branches of trade unions resolved that unless a satisfactory settlement of the problem had been reached by noon on April 20th the whole of the workers in Southampton would be ordered to cease work. The Corporation appointed a deputation to meet the men's representatives in the hope of averting this action, but the Mayor stated that if a general strike was ordered, the town would have to do its best to "carve its way through." As we go to press we learn that the strike has been settled. (See our leading columns.)

The Electrical Power Engineers' Association informs us that this dispute hinges on the fact that Mr. Hooper, a member of the staff of the electricity undertaking, recently resigned his membership of the Electrical Trades Union, and joined the Electrical Power Engineers' Association. Mr. Hooper was formerly a charge engineer in the generating station, but in November, 1919, he was promoted to the position of station superintendent. In this capacity he was in charge of the maintenance of the plant, and controlled a number of men who were members of various Unions, such as the A.S.E., &c. On his assuming this position he decided that he could not properly remain a member of the E.T.U., and consequently tendered his resignation, at the same time indicating his reasons for the step he was taking. Although Mr. Hooper was accepted as a member of the E.P.E.A. in February, the first intimation that the Association received of their grievance was that the E.T.U. members had come out on strike, and the Association contends that it would have been more reasonable on their part to discuss the matter with the E.P.E.A. before adopting such drastic measures.

The E.P.E.A. doubts whether the present strike is an official one, and has received the sanction of the E.T.U. executive, and it is for this reason that it is determined to support Mr. Hooper. It holds that this is a direct attack by one Union against another, and the E.P.E.A. is bound to defend itself and its members. Seeing that Mr. Hooper is a member of a recognised Trade Union, nothing but strong exception can be taken to any form of coercion which would compel him to abdicate his right to act as a free agent in the choice of a Union best fitted to serve his interests.

Mr. H. S. Ellis, Borough electrical engineer, asks us to thank the applicants for positions as shift engineers, junior charge engineers and general assistants, and to inform them that testimonials, &c., will be returned in due course. No further applications need be sent in, as the whole of the old staff has been reinstated.

Our Trade with India.—Commissioner's Visit to England.—In accordance with the practice that has been established for His Majesty's Overseas Officers when in this country to visit various industrial areas in order that manufacturers and merchants may have an opportunity of consulting them on any matters connected with their business or of obtaining information as to the possibilities of extending their overseas trade, it has been arranged for Mr. T. M. Ainscough, O.B.E., H.M. Senior Trade Commissioner in India, to undertake a tour of certain areas. Mr. Ainscough will commence his tour in London on Monday, May 3rd. Visits to other centres in the United Kingdom will follow in due course. He will be pleased to meet manufacturers and merchants who wish to consult him in regard to steps to be taken for opening up trade with India, and who are desirous of obtaining advice and information as to the state of trade in that country. Among the matters in regard to which he will be prepared to give information and advice are the general state of trade in India, appointment of agents, methods of marketing and distribution of goods, terms of payment, statistics of imports, rates of Customs duties and general information as to the openings existing for British goods. The Trade Commissioner is primarily interested in the imports from the United Kingdom into the Territory in which he is stationed, and not in the exports from that Dominion to this country. Firms desirous of meeting Mr. Ainscough should communicate without delay, with the Department of Overseas Trade, 35, Old Queen Street, London, S.W. 1.

Electric Meters in France.—The French Ministerial decree of July 29th, 1915, relating to the approval of various types of electric meters has been withdrawn.

Canada.—Motor Agency Wanted.—A Canadian firm have asked H.M. Trade Commissioner in Toronto to place them in touch with United Kingdom manufacturers of single-phase motors with a view to their representing such a manufacturer in the Dominion market. Firms interested may obtain the name and address of the firm on application to the D.O.T. Department in London.

Conveying Machinery for Norway.—Official reports received by the D.O.T. show that in Norway there is a general demand for conveying machinery of all kinds (*a*) for mines; (*b*) for factories, &c.; and (*c*) for docks and quays; owing to shortage of labour and high wages. Plans are under consideration for some large warehouses at the docks in Christiania, and these, it is believed, will be started in the near future.

Sequestration.—Messrs. Marshalls, electrical, mining and mechanical engineers, Townhead Works, Strathaven.—Estate sequestrated by the Sheriff of Lanarkshire, April 16th. Meeting to elect Trustee and Commissioners, April 27th, at the County Buildings, Hamilton. A composition may be offered. Claims must be lodged by August 27th.

Bankruptcy Proceedings. — H. H. Shave (H. H. Roberts), electrician, 228, Sultan Road, Portsmouth.—Receiving order made April 16th on debtor's own petition.

Liquidations and Dissolutions.—Spanish and General Wireless Trust, Ltd.—Winding up voluntarily for reconstruction purposes. Liquidator, Mr. S. Pears, 14, George Street, Mansion House, E.C. Meeting of creditors Arpil 29th.

E.I.C. Magnetos, Ltd.—Winding up voluntarily for reconstruction purposes. Liquidator, Mr. E. H. Sherrey, Cherry Street, Birmingham.

Trafford Power and Light Supply (1902), Ltd.—Claims must be sent by May 31st to the liquidator, Mr. C. Cooper, 60, Spring Gardens, Manchester.

Wright Brothers & Maidment, electrical engineers and contractors, 164, Sloane Street, S.W., and elsewhere. Messrs. H. T. and C. Wright and Mr. P. C. Maidment, have dissolved partnership. Mr. P. C. Maidment will attend to debts in respect of the business at Sloane Street, S.W., and Messrs. H. T. & C. Wright will attend to debts in respect of the business carried on under the style of Wright Bros. & Co., at 257, Fulham Road, S.W.

Swedish Price Advance.—It is announced that all the Swedish electrical engineering works have just made increases in the prices of generators, motors, &c., on account of the growth in the cost of raw materials, and the introduction of the eight-hour day. The demand for motors is said to be particularly great at present, partly because of the extension in the use of electricity in agriculture, and partly because of the development of Swedish industries.

Trade Announcements.—Messrs. Building Products, Ltd., have acquired the sole selling rights of "Prufit" cement waterproofing paste and "Prufitol" liquid waterproofer, as manufactured by Messrs. Rogers, Welch & Co., Ltd. The latter concern will continue to manufacture these specialities, but all sales will be effected through Messrs. Building Products, of 44-46, King's Road, Sloan Square, S.W. 3.

Mr. A. C. Wiley, the West of England representative of the Macintosh Cable Co., Ltd., has removed to Colston Yard, Colston Street, Bristol.

Mr. Harrold Stead having retired from the firm of Stead and Senior, electrical engineers, of 103, King Cross, and 48, Pellor Lane, Halifax, the business will be continued by Mr. R. F. Senior.

Messrs. Belco, Ltd., who have had a showroom in Kingsway since their foundation in 1913, are now exhibiting on their premises there (Windsor House) a variety of electric light fittings, electrical heating and cooking and other appliances. Semi-indirect bowl fittings are on view with Belcolux, Luxtral, and Holophane glassware. A large stock of their standard-type half-watt fittings is carried, and a pamphlet describing these has been issued. They also carry stocks of Burns's pattern telephone brackets—the "Hilo," which is adjustable for height or length, and an ordinary and cheaper pattern which is adjustable to differing lengths, and swivels radially on the front rod. A pamphlet relating to these has also been issued.

Mr. J. C. Elvy, consulting engineer, has now secured an office at 12, Tavistock Street, Covent Garden, W.C. 2, to which all communications should be addressed.

Mr. H. Hodgkins, of 81, West Road, Westcliff-on-Sea, informs us that he is the sole agent for the South, West and East of England and Wales below Northampton, excluding London, for the "Lotoc" electric bell.

German Lamp Prices.—The united electric glow lamp works in Germany have raised prices from 150 to 250 per cent. over the pre-war quotations.

A Danish Company.—The Avanti, Dansk Elektromekanisk Fabrik, of Kalundbore, reports that 1919 was a difficult period for the company, as well as for others in the metal industry, and the inconsiderable surplus earned has been carried forward. In the meantime the prospects for 1920 are specially favourable, and orders are in hand for everything that can be produced for the whole of the year.

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LIGHTING AND POWER NOTES.

Africa.—Electricity Ordinance.—According to the *African World*, Mr. E. W. Cowan, consulting engineer, of Westminster, who is at present in British East Africa, has written a memorandum on the B.E.A. Electric Power Ordinance of 1918, in response to an invitation by the East African Section of the London Chamber of Commerce, in which he deals with the effect of the Ordinance upon progressive application of electric power in the Protectorate, and its effect upon existing installations. Mr. Cowan is of opinion that progress in the general use of electrical energy outside the townships and the residential areas is much more likely to take place along the lines of private supply rather than those of public supply. He does not contend that the procedure adopted under the Ordinance is in any way inappropriate in cases of application for a licence to provide a public supply of electrical energy, but submits, however, that the procedure is not appropriate in cases of private supply. And he points to the obvious difficulty, if not impossibility, of the procedure in the case of two or more estates desiring to adopt a joint use of power. "In many such cases," he adds, "communications must pass between proprietors and officials in England before the scheme can be completed. The fact that the machinery will generally be purchased in England involves necessarily a large part of the work being done there.

"The delay in endeavouring to conform with the procedure outlined in the Ordinance, when the greater part of the necessary information must be obtained from manufacturers and others in England, must be very serious, and in many cases so detrimental to the interests of the estates concerned as to result in abandoning the use of electric power and substituting some other of the many forms of power which, though less efficient and economical, will be free from Government intervention."

Australia.—Launceston.—Year's Working.—The city electrical engineer of Launceston, Tasmania, in his report for the year ended June 30th last, states that the total revenue amounted to £33,810 and the expenditure to £21,631, leaving a gross profit of £12,179, distributed as follows:—Interest on loans, £8,390; sinking fund, £1,780; general account, £1,800; and reserve fund, £209. The net profit fell from £4,086 in 1917-18 to £2,009 last year.

Ayr.—Bulk Supply.—The question of a bulk supply from Kilmarnock Corporation is being considered, and the Council has been advised to dispose of its present plant. The proposed charge for a bulk supply is £3 per kw. of annual maximum demand, plus ·5d. per unit, the Ayr Corporation to provide the necessary sub-station.

Bedford.—Year's Working.—The recently-published report for the year ended March 31st, 1919, shows that the revenue accruing to the electricity undertaking was £49,983, and the expenditure £38,084, leaving a gross balance of £11,899. Payment of loan interest, &c., resulted in a deficit of £2,791.

Broadstairs.—Street Lighting.—The Urban District Council has accepted the offer of the Thanet Electric Light and Tramways Co. for public lighting where mains are already laid, at a yearly charge of £4 each for 100-watt, and £10 10s. for 300-watt lamps.

Clacton-on-Sea.—Extensions Approved.—The Urban District Council has been informed that it can proceed with the purchase of electrical plant, for which a loan of £9,500 is required, without waiting for the formal sanction of the Electricity Commissioners.

Clayton.—Street Lighting.—The District Council has received a letter from the District Coroner expressing the opinion of a jury that a recent fatal tramway accident was partly due to the absence of street lighting. The Council decided to attend to improvements.

Continental.—Sweden.—According to the *Engineer*, there are at present about 1,000 co-operative electrical societies distributing electricity in Sweden. The State erects the main cables and the transformers, the remainder is installed by the societies. The State has this year started an electrical power fund of one and a-half million kronor to facilitate the erection of power systems, and a power-station fund of two and a-half million kronor to facilitate the building of power stations. The State Pension Board Local Saving Banks and the Post Office Savings Bank also lend money to would-be introducers of electricity. Some of the distribution systems which were installed during the war have to be renovated, as such substitutes as zinc and iron wires were used, and found to be unsuitable.

France.—La Société de Transport de Energie des Alpes is the name of a new concern which has lately been organised in Lyons, with a capital of 2,000,000 fr., to establish plant in South-Eastern France to utilise water power for the generation of electricity.

The Compagnie Dijonaise d'Electricité has secured a concession of waterfalls and storage reservoirs on the River Lemme, on undertaking to supply light and motive power to the canton of Planches-en-Montagne, the city of Poligny and neighbourhood, setting up a distribution station there; and to the city of Dôle and district.

Belgium.—In order to meet the increasing demand for electricity, the Société des Centrales Electriques des Flandres is increasing the capacity of its generating station at Langerbrugge to 11,000 kw. The zone of supply of this station extends round the town of Ghent and along the banks of the Terneuzen maritime canal in an agricultural and industrial district which offers ample scope for further developments.

Darlington.—Rate Relief.—Instead of again carrying forward the whole of the profits on the electricity undertaking, £4,000 is being applied to the relief of the rates. In 1914 the electricity department contributed £4,205, and during the 1915-20 period £7,600.

At a recent meeting of the Corporation it was stated that the electricity charge was now only ½d. per unit above the pre-war price, and compared favourably with any other town in the country.

Doncaster.—New Plant.—The Corporation has received official sanction to proceed with the installation of two additional 3,000-kw. sets and water-tube boilers, &c., involving an expenditure of about £120,000.

Dublin.—Lighting During Strike.—During the recent general strike the street lighting was maintained upon the whole, but one or two parts of the city were in darkness.

Glasgow.—New Station.—The Corporation's new power station at Dalmarnock will be put into commission in about four weeks' time when one of the five generating sets will be in working order. Part of the load upon the St. Andrew's Cross station will then be transferred to the new plant.

Hereford.—Extensions.—The Electricity Committee has recommended application to the Electricity Commissioners for sanction to the installation of additional transmission lines, &c., at a total estimated cost of £81,407.

Leith.—Extensions at Docks.—Leith Dock Commissioners have approved a proposal by their superintendent for a tunnel under the Albert and Imperial docks, through which hydraulic, electric, gas, water and oil mains may be led. It is to cost about £10,000. The Commissioners have also authorised an expenditure of £10,000 on new electrical apparatus. Although they have large new schemes on hand, the Commissioners are not neglecting the improvement of their present undertaking.

Limerick.—Year's Working.—At a recent meeting of the Corporation, it was stated that a loss of £14,000 had been incurred in connection with the electricity undertaking.

Liverpool.—New Plant.—The Electric Power and Lighting Committee recommends the purchase of a new rotary converter for the Pumpfields station.

London.—Fulham.—The Finance Committee recommends application for a loan of £13,276 for the purpose of providing sub-stations, transformers, mains, &c., to cover the cost of "linking-up" with the Hammersmith undertaking.

Loughborough.—New Plant.—While not approving the whole of the scheme of extensions submitted to them by the Town Council, the Electricity Commissioners admit that extensions are necessary, and have sanctioned the installation of a 3,000-kw. generator. It is stated that the possibilities of a bulk supply from Leicester are very remote.

Nelson.—Loan Sanctioned.—The Electricity Commissioners have signified their approval of extensions to the electricity works, and have sanctioned the borrowing of £152,000.

New Zealand.—Coal Shortage.—The inadequacy of coal supplies has forced the Auckland City Council to consider the curtailment of the electricity supply or a temporary suspension of part of it. The requirement of the undertaking is 180 tons a day, and supplies have fallen so low that only about a day's reserve is held, the Council relying upon a daily delivery to keep the station running.

Stretford.—Loan.—The Urban District Council is applying for sanction to borrow £200,000 for the purpose of extending the electricity undertaking.

Stockton-on-Tees.—A Technical Advisory Committee has been formed, on the recommendation of the National Trade Advisory Committee for Electricity, Power, and Light.

Thames Valley.—Bulk Supply.—Arising out of correspondence between the Twickenham and Teddington Electric Supply Co., the Electricity Commissioners, and the Barnes District Council, the electrical engineer of the latter Council reports that it is felt that steps should be taken to provide a bulk supply station to deal with the demands in the whole of the Thames Valley area. Edmundson's Electricity Corporation feels that it would be wasteful to install further plant at the Twickenham generating station, and as it is certain, states the engineer, that in the near future a large number of the existing stations will be closed down, the necessity for providing a bulk supply station at the earliest possible date will arise. The Borough of Ealing feels the necessity for closing down probably more acutely than others in the neighbourhood, and it in consequence will welcome any proposal that will cheapen the cost of supply in its area. The Electricity Commissioners ask the engineers operating in this area if they think it worth while to prepare a preliminary scheme for submission to the Commissioners.

Tullamore.—Electric Lighting.—In connection with the recently formulated proposals, a site has been secured for a power station, and over £15,000 has been subscribed.

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Walsall.—Industrial Requirements.—The Corporation has been refused permission to augment the generating plant until it is seen how the Electricity Supply Act will be applied in the district. Many industrial concerns are accordingly unable to obtain adequate power supplies, and the Chamber of Commerce has passed a resolution calling the attention of the Government to the harm that is being done through the delay.

Warrington.—Extensions.—The Corporation has made an application to the Electricity Commissioners to sanction a loan of £183,433 for the purpose of extending the existing plant at Howley. The electrical engineer has reported that the Commissioners have intimated that a new generating station at Warrington is not desirable at present, but the installation of a further generator will receive favourable consideration.

Whitehaven.—Revision of Charges.—With a view to simplifying the accounts, the Town Council has decided to charge domestic consumers a flat rate of 3½d. per unit for lighting to consumers who pay on the fixed charge system, instead of 2d. plus 52½ per cent.; and a flat rate of 1½d. to heating and cooking consumers, instead of 1d. plus 40 per cent.

Woolwich.—House Lighting.—The Borough Council has decided to have electric lighting installed in all the houses being erected on the new estate at Kidbrook, and to have the roads illuminated by electricity.

TRAMWAY AND RAILWAY NOTES.

Australia. — Launceston.—Year's Working. — The accounts of the Launceston, Tasmania, tramway system for the year ended June 30th, 1919, show a total revenue of £27,717, and against this an expenditure of £17,730, leaving a gross balance of £9,987. After payment of interest on loans, &c., the result was a deficit of £17, comparing favourably with the previous year's loss of £1,283.

Bolton.—Wages.—The Corporation's tramway employés have asked for double pay for the four days of the Royal Lancashire Agricultural Show in August. The Tramways Committee is considering the matter at its next meeting.

Continental. — France.— In spite of the enormous amount of work entailed the Société des Tramways de Lille has succeeded in putting 47 km. of the system in working order, and 63 cars are serving the various routes. In addition to this, power is being supplied to about 80 works in the district, and it is confidently anticipated that by the end of the present year the Société will be generating 10,000 kw., sufficient to meet all requirements.

Darlington.—Change of System.—After a four months' experiment with a 9-minute tramway service, it has been decided to revert to a 12-minute service. It was estimated that if the 9-minute service continued the loss would be £10,000 at the end of the financial year; the loss to the present time was put down at £5,500.

Egypt.—Tramway Strike.—For the fourth time in 12 months the Heliopolis tramway employés are on strike. The reason for their action is stated to be the suspension of a driver for insolence.

India.—Tubes for Calcutta.—The chairman of Calcutta Coporation, in outlining the scheme to the Communications Committee, wrote that there should be no serious obstacle to the construction of a tube under the Hugli, and in this way the suburb of Howrah could be linked up with Calcutta. The poorer classes were being crowded out of Calcutta by the increase of rents and land values, and would readily migrate to the suburbs if cheap and rapid transit were available. An estimate of cost given was £650,000 per mile. While the scheme is not yet formally adopted, the Committee approved the views expressed in the chairman's letter.—*The Times.*

Manchester. — Strike Settlement. — The tramway strike in Manchester and Salford has been settled. The terms are acceptance of the national award of 5s. a week advance, with an immediate review of base rates.—*Daily Telegraph.*

Middlesbrough.—Women Employes. — The Tramways Committee has instructed the manager, when engaging conductors, to employ a proportion of two-thirds men to one-third women.

Newcastle-on-Tyne.—Fare Revision. — In view of growing expenses, the Town Council has decided to revise the tramway fares on the basis of one mile for 1d., two for 1½d., and three for 2d., without overlapping-fare stages; the abolition of most of the ½d. terminal fare stages; revision of workmen's fares; and abolition of certain free-travelling facilities. An additional income of £60,000 to £70,000 is anticipated.

Runcorn. — Light Railway. — The Light Railway Commissioners have granted the application of Messrs. Castner-Kellner Co., Ltd., for an order to allow them to construct a branch light railway line giving direct access from their works at Weston Point, near Runcorn, to the L. & N.-W. Railway Co.'s system at Runcorn. A guarantee is required from the company that the line shall be so constructed as to be fit to carry passengers as well as goods, and it is probable that the line will be extended to connect with the neighbouring system.

TELEGRAPH AND TELEPHONE NOTES.

Australia.—Wireless Rates.—The postal authorities, says the Sydney *Sunday Times*, advise that approval has been given for the adoption forthwith of a Pacific Marconi service, at a rate of 2d. per word less than the rate in force previously (2s. 10d., instead of 3s.) for full ordinary traffic only between Australasia and the United Kingdom, *viâ* Pacific and Marconi Trans-Atlantic Wireless Service. The Amalgamated Wireless (Australasia) Co. states that when the permission of the Federal Government to erect new high-power transmitting stations is received, charges will probably be reduced to 2s per word.

Bradford. — City Exchange. — The city electrical engineer recommends that the existing telephone system within the Town Hall be scrapped and a new system installed, to cost about £3,300. When the Town Hall was extended 15 years ago, a central exchange was contemplated, but this was not built, and each department has had its own exchange wires, with a separate intercommunication system inside the Town Hall. The Finance Sub-Committee has decided to have a further report on the desirability of establishing an exchange within the Town Hall, in connection with the Post Office service, before coming to any conclusion on the matter.

China.—Wireless Stations.—Under the supervision of a British engineer, wireless telegraph stations are being established between Pekin and the farthest limits of Chinese territory in Turkestan.—*The Times.*

Germany.—Increased Postal Charges.—The new postal laws and regulations were adopted on April 17th by the German National Assembly. The charges for inland letters and telegrams are to be considerably increased, whilst telephone conversations are to cost double, and everyone who possesses a telephone will have to pay 1,000 marks for each line.

Telegraph Rates.—Proposed Increase.—Under the new Budget it is proposed to increase the telegraph rates from 9d. and ½d. for every additional word, to 1s., with ½d. per additional word over 12. An extra charge of 6d. will be made for every telegram handed in between midnight on Saturday and midnight on Sunday. The porterage on telegrams, now 3d. per mile from the limit of free delivery, is to be doubled. Telephone rates are to be increased at a later date.

Japan.—Wireless Telephony.—In 1919 the Japanese Department of Communications made a series of experimental wireless telephonic communications between land and sea, the land apparatus being at the Kobe Central Telephone Office. These experiments proved a success. The Department accordingly appears to have decided to provide two wireless stations at Kobe and Yokohama from the next fiscal year to open the wireless telephone business for the general public. Mr. Sayeki, the expert of the Department, is quoted by the Japanese papers as stating that the Kobe station will be opened from April next. Though no regulations have been framed, it is probable that the fee will be fixed at about 30 to 50 sen for a conversation.—*Economic Review.*

London.—Telephone Service.—During the last financial year there have been laid over 50 miles of single underground pipe line and 50,000 miles of underground wire, which brings the total length of London's underground telephone piping to 3,625, and the length of wire in it to over a million miles. The total pole mileage is 2,780, and the length of open wire on poles in London is over 60,000 miles. In laying underground pipes the needs of the areas are estimated for 15 years ahead. The present cost of this work is between £50 and £75 per yard.

New Zealand. — Telephone Shortage.—The Postmaster-General recently stated that the inability of his department to install the necessary telephones required by a great many people was due to shortage of supplies arising out of war conditions. Difficulties had been increased by the changing over from the existing system to automatic working. The position was now improving, and it was hoped to accomplish a great deal in this direction during the year.

Poland. — The Polish Administration notifies the suspension of all private telegraphic correspondence with the outside world from April 17th to 26th inclusive.

South America.—Concessions to French Company.—Concessions have been made to the French South American Cable Co., says the *Board of Trade Journal*, for the establishment of telegraphic communication between Monte Video and Buenos Aires, and a submarine cable between Monte Video and Rio de Janeiro. The *Diario Official* of Monte Video of February 2nd contains a decree as under, giving the terms of the concessions:—The necessary authority is conceded to the French Cable Co. to establish and work submarine and terrestrial telegraphic communication between Monte Video and Buenos Aires, and a submarine cable between Monte Video and Rio de Janeiro. For each of the above concessions the company has deposited a sum of £3,260. The company will not enjoy any privilege, preference, or exemption, from national or municipal taxes. It will be subject to the different obligations, requirements, responsibilities, and penalties established by the Law of October 17th, 1919, and to the jurisdic-

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tion of the Law Courts in accordance with the aforesaid Law. The company will also be subject to the other Laws of the Republic unless they affect the clauses of the concession. The company must present plans of the line followed by the cables in territorial waters and national territory, showing the landing sites, the testing office, and situation of buoys, signals, &c.

United States.—The annual report of the American Telephone and Telegraph Co. states that in co-operation with the Cuban-American Telephone & Telegraph Co., plans have been made to lay telephone cables to Havana, so that the principal places in Cuba will be in telephonic connection with the principal places in the United States.

Many mechanical labour-saving devices have already been adopted to meet the shortage of unskilled labour, and other devices are being constantly studied and adapted to the needs of the business. The department of development and research during the year has actively prosecuted work upon more than 500 improvements in the telephone art. The patent holdings of the Bell System have increased fully 12½ per cent. during the year, and it now owns or controls, or is licensed under, more than 5,000 United States letters patent and applications therefor.

At the end of the year the report shows that in the United States there were approximately 11,000 separate telephone companies. Of them, 36 are associated companies of the Bell System, 9,403 independent companies whose telephone stations are connected with the Bell System, and about 1,500 independent companies whose telephone stations are not connected with the Bell System. There is also a large number of rural lines and associations operated mainly on a mutual or co-operative basis, and not rated as companies. Of these lines and associations there are 26,184 which connect with the Bell System. At the end of the year the number of telephone stations which constitute the Bell System in the United States was 11,795,747, of which 7,739,159 were owned by the associated companies of the Bell System. The increase in the total number of stations in the Bell System during 1919 amounted to 729,748. There were 209,860 employés in the Associated Bell Companies at the end of the year, operating 24,162,999 miles of wire, of which 94·6 per cent. was copper. The net additions to the Bell-owned plant during the year were over $73,000,000. For the whole Bell System, with all duplications excluded, the total income, including compensation, after the deduction of expenses, amounted to $79,650,186, from which over $27,000,000 was paid in interest and $39,000,000 in dividends, leaving over $12,000,000 surplus. The surplus earnings in the last five months of the year since the end of Federal control have been $7,000,000. The capital stock, bonds, and notes payable of the Bell Telephone System outstanding in the hands of the public at the close of the year were $1,060,000,000, while the net assets devoted to earning return on these outstanding securities amounted to over $1,448,500,000. This is due to the fact that surplus and reserves of over $388,500,000 had been invested in productive property. For the American Telephone and Telegraph Co. the net earnings of the year were over $60,000,000. In round figures, the interest charges were $15,000,000; the dividends, $35,000,000; and the resulting balance, $9,000,000, of which $5,000,000 was appropriated to reserve for contingencies and $4,000,000 added to surplus. The company and its predecessors have paid dividends to the public at the rate of at least $7·51 per share each year for the past 38 years, and during the past 13 years the rate has been uniformly $8 per share. The number of shareholders in the American Telephone and Telegraph Co. was on December 31st, 1919, 120,460, an increase of 8,000 during the year. To this number should be added some 9,000 employés of the Bell System, who are paying for stock out of their wages.—*T. and T. Age.*

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the Electrical Review *in which the "Official Notice" appeared.)*

OPEN.

Auckland (N.Z.).—September 1st. Harbour Board. For the supply of electric capstans and spares. Messrs. W. & A. McArthur, Ltd., 18-19, Silk Street, Cripplegate, London, E.C.2.

Australia.—Perth.—May 3rd. Postmaster-General's Department. Insulators, bolts, brackets, &c. Schedule 673. (April 2nd)

May 14th. Government of Western Australia. One 7,500-kw. turbo-alternator and condensing plant. (April 9th.)

Melbourne.—June 18th. City Council. Gas-filled metal-filament lamps. City Electrical Engineers' Office, Town Hall, Melbourne.

Belgium.—Antwerp.—May 21st. Municipal authorities. Tenders for 10,690 metres of armoured cables, required in connection with the electrical equipment of the Nos. 2 and 3 docks. Particulars may be obtained for one franc from the Hotel de Ville, Antwerp.

Cardiff.—April 29th. Corporation. One 5,000-kw. turbo-alternator and condensing plant. (April 9th.)

Carlisle.—April 27th. Electricity Department. One 1,000-kw. converter, switchgear for converter, E.H.T. feeder switchgear. (April 16th.)

Dartford.—April 26th. Urban District Council. One water-tube boiler and mechanical stoker; bus-bars. (April 16th.)

Dublin.—April 24th. Electricity Supply Committee. Seven truck-type switch cubicles for use on a three-phase 50-period 5,000 v. system. (April 16th.)

Edinburgh.—April 26th. Electricity Supply Department. E.H.T. paper-insulated lead-covered cables. (April 2nd.)

Lincoln.—May 24th. Electricity Department. Coal-handling plant. (See this issue.)

Leigh (Lancs.).—Electricity Department. One 2,500-kw. turbo-alternator; E.H.T. & L.T. switchgear; one 500-kw. rotary converter. (April 16th.)

London.—Shoreditch.—The Lighting Committee is inviting tenders for one turbo-generator, one water-tube boiler, and H. and L.T. switchgear.

Manchester.—April 27th. Tramways Committee. Electrolytic copper and bronze trolley wire; steel fishplates for tramway rails. Mr. J. McElroy, General Manager.

April 28th. Education Committee. Electric lighting installation at Birley Street, Beswick, and Princess Road, Moss Side, municipal schools. Education Offices, Deansgate.

Nuneaton.—May 5th. Electricity Department. 3 core and 4-core, L.T., paper-insulated cables. (See this issue.)

Portsmouth.—April 26th. Board of Guardians. Electrical installation at the Children's Home, Milton. (April 16th.)

Sheffield.—Corporation Water Works. Electric haulage winch, pug mill. (See this issue.)

South Africa.—Mossel Bay.—Electric lighting equipment. Contract No. 1.—High-speed superheated steam engines, boilers, air and circulating pumps, condensers, steam piping, valves, alternators, switchboard. Contract No. 2.—Poles, cross arms, lightning arresters, street lamps, brackets, repair tower, meters, conduit work, cables, &c. Particulars of general conditions, tender forms, &c., can be seen on application to the Department of Overseas Trade in London (Room 48, telephone extension No. 4). Copies can be lent in rotation to those firms in the Provinces having no representative in London.

Spain.—May 30th. Construction and working of an electric tramway between the Plaza de la Bonanova and the Monasterio de Pedralba, Barcelona. The Direccion General de Obras Publicas, Madrid.

Sunderland.—April 28th. Electricity Department. Water-tube boilers, superheaters, stokers, economisers and chimneys; one 1,000-kw rotary converter. Specifications, &c. (£1 each), from General Manager, Electricity Works, Dunning Street.

Tasmania.—Launceston.—June 7th. City Council. One 1,000-k.v.a. hydro turbo-alternator, with switchgear. City Electrical Engineer, Town Hall, Launceston.

Uruguay.—August 7th. Department of Posts, Telegraphs and Telephones. Construction of a national telephone system for the Department of Montevideo. Particulars from the Uruguayan Legation in London, 3, Elvaston Place, South Kensington, S.W.

Whitby.—Electricity Department. Replacing economiser, boiler feed pump, pipework; conversion of old dry duct into cooling pond. (April 16th.)

CLOSED.

Bootle.—Town Council. Accepted:—

Two 8½-ton electric vehicles, £2,545.—Ransome, Sims & Jefferies, Ltd.
Two 5-ton electric vehicles, £2,810.—Electromobile (Leeds), Ltd.

Edinburgh.—Messrs. Redpath, Brown & Co. were the lowest bidders for the steelwork at the boiler house of the Portobello power station, with an offer of £54,000, and the contract has been placed with them.

London.—Hackney.—Electricity Committee. The Committee recommends the cancelling of the contract with the Rees Roturbo Manufacturing Co., Ltd., for circulating pumps, at £1,708, the firm having given notice that the prices would be increased by 15 per cent. The electrical engineer, in view of the considerable increase in price, does not favour increasing the number of small pumps, but he may prefer to continue with the four existing pumps, and add, with the proposed extension, larger pumps, each with a capacity of 10,000 kw.

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Fulham.—Electricity and Lighting Committee. Recommended coal supply:—
6,000 tons Pooley Hall small nuts, £11,175; 2,000 tons ¾ pea slack, £3,425.—Foster & Co.
8,000 tons ¾ Midland slack, £14,633.—J. H. Gilman & Co.
3,000 tons Derbyshire nutty, £5,787.—Harrison's, Ltd.

Shoreditch.—Lighting Committee. Accepted:—
1 mile 3/·036 twin telephone cable, £96.—Edison Swan Elec. Co., Ltd.
2½ miles 7-core pilot cable, £750.—Union Cable Co., Ltd.

Margate.—Town Council. Installing the electric light at the Municipal offices, Town Hall:—

E. C. Spray (accepted)	**£148**
J. Owen & Sons	175
H. S. Tett & Co., Ltd.	188
W. J. Cannon	190
Glumart, Cox & Co.	196
Thanet Electric Co.	198
E. A. Pinto	228

Sunderland.—Town Council. Electricity Committee. Accepted:—
B. I. & Helsby Cables Co., Ltd.—House service cable and E.H.T. and L.T. cable.
Brush Electrical Engineering Co., Ltd.—Two 250-K.V.A. transformers.
Joseph Thompson & Co.—Creosoted redwood capping and cable troughing.
Ferguson, Pailin & Co., Ltd.—Switchgear.

FORTHCOMING EVENTS.

Institution of Mechanical Engineers.—Friday, April 23rd. At the Institution, Storey's Gate, S.W. At 6 p.m. General meeting.

Physical Society of London.—Friday, April 23rd. At the Imperial College of Science, South Kensington, S.W. At 5 p.m. Fourth Guthrie lecture on "The Anomaly of the Nickel-iron Alloys," by Mr. C. E. Guillaume.

Royal Institution of Great Britain.—Saturday, April 24th. At Albemarle Street, W. At 3 p.m. Lecture on "The Thermionic Vacuum Tube as Detector, Amplifier and Generator of Electrical Oscillations," by Prof. W. H. Eccles. (Lecture II.)

Royal Society of Arts.—Monday, April 26th. At John Street, Adelphi. At 8 p.m. Cantor lecture "Aluminium and its Alloys," by Dr. W. Rosenhain, F.R.S.

Electrical Trades' Benevolent Institution.—Monday, April 26th. At the offices of the Electrical Contractors' Association, 11, Southampton Row, W.C. At 2.30 p.m. Annual general meeting.

"Dynamicables."—Tuesday, April 27th. At the Connaught Rooms, Gt. Queen Street, W.C. At 7.15 p.m. Anniversary dinner.

Institution of Civil Engineers.—Tuesday, April 27th. At Great George Street, S.W. At 5.30 p.m. Annual general meeting.

Institution of Electrical Engineers.—Thursday, April 29th. At 6 p.m. At the Institution of Civil Engineers, Gt. George Street, S.W. Paper on "Automatic Protective Devices for Alternating-current Systems," by Mr. A. E. McColl.

(East Midland Sub-Centre).—Tuesday, April 27th. At the Technical College, Loughborough. At 7 p.m. Lecture on "The Electrical Equipment of Ships," by Mr. C. H. Wordingham, C.B.E.

(Scottish Centre).—Friday, April 30th. At Dundee.

(Students' Meeting).—Friday, April 30th. At Faraday House, Southampton Row, W.C. At 7 p.m. Paper on "Tidal Power," by Mr. J. E. Holmstrom.

Association of Engineering and Shipbuilding Draughtsmen.—Thursday, April 29th. At Chesterfield Grammar School. At 7.30 p.m. Paper on "Gas Producer Plants," by Mr. J. J. Nicholson.

North-East Coast Institution of Engineers and Shipbuilders.—Friday, April 30th. At the Literary and Philosophical Society, Newcastle-on-Tyne. At 6.15 p.m. Paper on "A Modern Power Station and its Development," by Mr. J. S. Watson.

Junior Institution of Engineers.—Friday, April 30th. At 39, Victoria Street, S.W. At 7.30 p.m. Social evening.

NOTES.

E.D.A.'s Age.—Referring to our leaderette of last week, Mr. J. W. Beauchamp points out that the Electrical Development Association started on June 2nd, 1919, and therefore is not only less than two years old, as we said, but has not even attained to its first anniversary. All the more credit to its efforts; it is a lusty infant, but needs ample nourishment—many pounds a day—and it is up to the electrical industry to feed it.

Cardiff Turbo-Alternator Tenders: Correction.—By a printers' error in our advertisement pages last week we credited Cardiff Corporation with inviting tenders for a 50,000-KW. turbo-alternator. The plant required is, of course, of 5,000 KW. capacity.

Electricity v. Gas.—At a meeting at Bradford, on Saturday last, members of the Yorkshire Junior Gas Association attempted to console themselves with regard to the general demand for electric lighting in the new housing schemes, by referring at length to the supposed advantages of gas as a heating and cooking agent. In a paper by Mr. E. L. Oughton, of Huddersfield gas undertaking, tables were given which purported to show that in heating and cooking gas was "a long way ahead of electricity," but in the discussion some members disputed the striot logic of the figures. Mr. Roper, of Bradford, said that in his district the gas people were up against a very serious proposition in the electricity charges for domestic consumption, which were merely ¾d. per unit, with a basis charge of 15 per cent. on the rateable value of the house. He greatly doubted whether gas could meet that on the question of cost, and pointed out that the charge included everything, lighting or otherwise.

The Electrical Trades Benevolent Institution.—The annual general meeting of this Institution will be held at the offices of the Electrical Contractors' Association, 11, Southampton Row, W.C. 1, on Monday, April 26th, 1920, at 2.30 p.m.; Mr. J. Y. Fletcher will take the chair, and it is hoped that members will show their interest by turning up in force. The meeting will receive the report of the Committee and the accounts for the year 1919, and elect members of the Committee of Management. The following members retire by rotation, and are eligible for re-election:—Messrs. W. B. Esson, E. Garcke, T. E. Gatehouse, C. E. Hunter, W. Ratcliffe-Small, Sir Ernest Spencer, and Mr. G Sutton.

Norwegian Water Power.—The *Technical Review* quotes from *Teknisk Ukeblad* a statement that the Government is providing a sum of one and a-half millions sterling for the regulation of rivers, in order to increase the value of waterfalls. The work is to be completed in 1922.

Electrical Power Engineers' Association.—The first annual dinner of the Northern Division was held in the Albion Hotel, Manchester, on April 17th, under the presidency of Mr. H. E. Annett, A.M.I.E.E., chairman of the division.

After the toast of "The King," Mr. A. L. Lunn, past-president of the Association, proposed the toast of "The Guests," and said he was pleased to see so many chief engineers present, as representatives of undertakings, as well as Ald. Walker, chairman of the Joint Board. He contrasted the large gathering with the first meeting of the Association which was held in Manchester, and said the progress was due, in some measure, to the sympathetic attitude of the great majority of chief engineers.

Ald. Walker, in replying to the toast, said he had ground for hostility to the E.P.E.A., seeing that he was spending every Saturday and Sunday, not in well-earned rest, but on the Joint Board endeavouring to find solutions to problems of rates, hours, and conditions. The electricity supply industry was THE key industry, and by the work of the Joint Board, the result of which would be attained at no distant date, he hoped they would create feelings of satisfaction amongst the staff. It could not be denied that many of those in authority in the electricity supply industry did not appreciate the technical knowledge necessary for those responsible for the generation and distribution of electrical energy.

Mr. J. F. Heslop, A.M.I.E.E. (vice-president of the Association) proposed the toast of the "Institution of Electrical Engineers," and Mr. J. A. Robertson (chairman, N.W. Centre of the I.E.E.), in replying, said he had watched with pleasure the progress and good work of the E.P.E.A. in improving the status of the engineer. There were so many conflicting interests represented in the I.E.E. that for it to undertake the function of a protective organisation would be its own destruction. Instead, the I.E.E. endeavoured to bring the various sections together. The local Centre had set up a committee to formulate a scheme for the training of station engineers. Technical education and training should be available for and accessible to the children of the poorest people. There was too much specialisation; he would have engineers change from generation to distribution and to sales, rather than wait for promotion in their own department.

Mr. P. P. Wheelwright, M.I.E.E., proposed the toast of "The E.P.E.A.," suggesting a formula: Enterprise+Perseverance+Energy=Awards, which expressed his own view of the characteristics of the members who had made it such a success. Mr. J. H. Parker (president, E.P.E.A.), in replying, referred to the early difficulties of the Association. It was a baby which required nutrition, but the doctor told it to suck his thumb. This did not help, and it was decided to try a new food, "Bonus food builds bonny babies." This met with success, and an addition was prescribed. The baby was now making rapid progress, and a new food, "Basic rates," would be ready shortly. The Association was a most democratic organisation; its members occupied an intermediate position, being both workers and managerial, and he looked forward to the time when it would hold the balance against trouble in the industry. In conclusion, he said that if the members worked together, nothing could restrain them from what they set out to do.

Standardisation in Germany.—In Germany the Association of German Engineers has, according to the *E.T.Z.*, set up a powerful organisation in the "Standardisation Committee of the German Industry" [*Normenausschuss der Deutschen Industrie*]. Standardisation falls into two main sub-divisions, namely, Regulation (*Regelung*) and Normalisation (*Normung*). The former is concerned with the drawing-up of regulations for the estimation of the capacity and behaviour of apparatus. The Committee holds that it is of the highest importance in view of the English and American activities in this sphere that the German regulations should be elaborated as quickly as possible, so as to strengthen the German position in respect of export. The latter relates to the specification of sizes in manufacture with the object of facilitating repetition work in respect of component parts, definition of types, and the determination of overriding standards such as normal sections, normal voltages, &c. The Committee referred to above comprises a number of sections composed of specialists in various branches, and it is proposed to add to these sections as the needs arise.

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Railway Signalling.—The report of Major Hall to the Ministry of Transport on the collision which occurred between a passenger train and a goods train at Soothill Wood Colliery, on the Leeds-Batley branch of the Great Northern Railway, early in February, states that the severe storm at the end of January had resulted in extensive damage to block telegraph and telephone wires over a large area in this district, and traffic was still, on this branch, being operated under the block telegraph regulations. Major Hall agrees with the opinion, expressed in a recent report by Colonel Pringle, that the temporary installation of telephone block working by means of insulated cable run out from reels would be of the greatest value pending restoration of normal conditions.—*The Times.*

The Educational Activities of Glasgow Electricity Department.—The Works Continuation School of the Electricity Department of Glasgow Town Council has introduced during the past winter various classes for employés. A very successful session has just been completed, when Mr. R. B. Mitchell, general manager, presented prizes gained by past students. The classes met four nights in each week, and included the following subjects:—Practical training in instrument making, arithmetic and algebra, and generation and distribution of electrical energy. The latter class was for the clerical staff, and all were conducted under the auspices of the Local Education Authority.

On April 12th the session of the Glasgow Town Council Electricity Department Engineering Society was concluded, Mr. R. B. Mitchell presiding over an attendance of 88 members. Mr. C. W. Marshall read a paper on "Transformation of Electrical Energy from A.C. to D.C.," and an interesting discussion followed. The chairman intimated that arrangements were well in hand for the next sessions' syllabus.

Mine Locomotives.—It is stated that the Home Office has been approached with a view to permitting the use of electric locomotives in coal mines. At present, in accordance with General Regulation No. 136, haulage by electric locomotives on the overhead trolley wire system is prohibited in any mine in which coal is worked, but haulage by storage-battery locomotives may be used in any mine, with the consent in writing first obtained of the Secretary of State and subject to such conditions affecting safety as may be prescribed by him. The use of internal-combustion locomotives is prohibited by the Act. The Department has laid down certain conditions, of which the most important is that the locomotive shall not, under any circumstances, spark in such a manner as to set up the danger of firing a mine. Designs have now been submitted to the Home Office for approval.—*Colliery Guardian.*

Electric Vehicle Progress.—The Bristol Town Council proposes to purchase six electric tipping wagons for the collection and removal of refuse. The estimated cost is placed at £6,600, and the sanitary authority hopes that as a result of displacing horse vehicles by electrics a saving of £1,000 a year will be effected. At the inquiry held by the Ministry of Health respecting the application to borrow the money to meet the cost of the vehicles, the city engineer explained that since 1914 the expense of keeping a horse had risen from 12s. 10d. to 42s. per week, mainly due to the high price of fodder. The men's hours also had been reduced from 61½ to 48 per week. In 1914 the cost per load of 25 cwt. of refuse was 4s. 4d., and it was now 14s. At one of the destructors there was surplus electricity, and the Council thought it could charge these wagons every night with that surplus electricity. One firm of electric vehicle manufacturers stated that if the Council did not save a shilling a ton on the first month's working, it would take the wagons back. The sanitary authority hoped to save £1,000 a year by means of electric wagons.

The Derby local authority has placed an order with Newton Brothers, Ltd., for the supply of two electric vehicles.

The Ministry of Health has sanctioned the borrowing of £7,520 by the Edmonton Council for the purchase of electric vehicles and motor vans.

Sanction has been received by the Hackney Corporation in respect of the application to raise a loan of £5,418 for the purchase of four electric vehicles (two 2-tonners and two 3½-tonners) for refuse-collection purposes.

The Leeds Corporation has accepted a tender by Electromobile (Leeds), Ltd., for the supply of an electric tipping wagon at a cost of £1,610.

Plymouth Corporation has reported favourably on the adoption of electrics for the sanitary services. The Committee is to purchase three electric vehicles for refuse removal, a pioneer sweeper and loader, and two tipping wagons, which can also be used as water tanks for street-watering purposes. To cover the estimated cost of the vehicles and the adaptation of stable buildings as a garage, it was resolved to seek sanction for a loan of £12,840.

The Rotherham borough engineer has been authorised to obtain tenders for the supply of two electric vehicles for use by the Highways Department.

The Wakefield Electricity Department has had one electric vehicle in use for some considerable time, another is on order, and the purchase of a third is under consideration.

The Wolverhampton Corporation is to experiment with an electric vehicle for the local public services.—*Electric Vehicle.*

New Electric Clock at St. Pancras.—In these days of long deliveries it is refreshing to hear of somebody who can make a prompt shipment of goods. A case in point is the large clock under the Arcade of the Midland Railway Terminus at St. Pancras, London. Travellers have doubtless noticed for some months that this clock has been out of commission. On March 20th, Messrs. Gent & Co., Ltd., Leicester, received instructions to electrify this clock, and install one of their "Waiting-Train" movements behind the dial, and, although no preparatory work had been done, by the afternoon of March 26th the large face had been cleaned, the hand mechanism adjusted, a new "Waiting-Train" movement installed, and the whole of the electrification of the clock completed, and going by 4 o'clock on that day. This clock, which appears to be of ordinary size, 6 or 7 ft. in diameter, is in reality 18 ft. across, only a few feet smaller than Big Ben of Westminster. As a single-dial clock it is the largest electric clock in London. The "Waiting-Train" mechanism used for driving this dial is a small compact piece of apparatus, occupying a space about 18 in. square. The motive power for driving the hands is obtained from the pendulum, through the medium of a ratchet-wheel and the usual crown gear. The accuracy of the time-keeping is not, however, dependent upon this, but the pendulum is arranged to have a slight gaining rate, and moves the hands with a steady motion through a half-minute space on the dial in about 27 seconds. At this point a masking pawl comes automatically into operation, and stops the drive. Exactly on the half-minute the impulse from the master transmitter releases the masking pawl, and allows the drive to continue. The hands, therefore, do not proceed in half-minute impulses, as in the case of small clocks, but at a uniform rate, with small periods of "waiting." The pendulum is self-maintaining, and is capable of developing up to nearly 30 times its normal power, so that wind or snow pressure on the hands of the clock cannot affect its time-keeping qualities.

Educational.—FARADAY HOUSE.—The following appointments to Entrance Scholarships at Faraday House Electrical Engineering College have been made:—To Frank Douglas Goodchild (County School, Beckenham), a Faraday Scholarship of 50 guineas per annum, tenable for two years in College and one year in engineering works; to George John Moody (Alleyn's School, Dulwich), a Maxwell Scholarship of 50 guineas per annum, tenable for one year in College and one year in engineering works.

MANCHESTER UNIVERSITY.—We have now received a copy of the "prospectus" of the issue of the Manchester University "bonds" referred to in our columns last week. This novel publication has all the appearances of the usual method of publicity adopted by company promoters. It announces that "no copy of this prospectus has been filed with the Registrar of Joint Stock Companies," and the title assumed is "Lancashire Development Unlimited—The University of Manchester." The "capital" is divided into "425,000 cumulative participating ordinary bonds of £1 each," and 1,500,000 cumulative participating people's bonds of 1s. each. The "terms of subscription" are:—On application—"As much as possible" and on allotment payment may be spread over three years, at option of subscriber. A form of application is enclosed. Apart from the undoubted worth of the University to the country, this new departure, in attracting the attention and support which is essential to its continuation, deserves sympathetic consideration and response.

Vehicle Lights.—The Departmental Committee on Lights on Vehicles, of which Sir Henry Maybury is chairman, has made two interim reports to the Ministry of Transport, which have been published as a White Paper [Cmd. 659, 2d. net]. The subjects dealt with are lighting-up times, the number of lamps to be carried on various types of vehicles, and the restriction of the use of dazzle headlights. It is agreed that some of the headlights now in use are unnecessarily powerful, and that inconvenience and frequently danger arise from their use. The Committee has examined a large number of devices to reduce or eliminate dazzle. "While it is quite easy to avoid dazzle, the effect of most of the devices which do this satisfactorily is to produce an unsafe driving light," besides wasting a large percentage of light. The Committee recommends that the light given by all headlights should comply with some standard of illumination ascertained at various points. With a view to fixing such a standard, it proposes to subject all ideas and devices submitted to it to a series of practical road tests. Pending this investigation, the Committee suggests the limitation of the size of clear glass apertures of head-lamps to 7 in. diameter on motor cars, and 5 in. on motor cycles. Not more than two headlamps should be allowed; not more than four lamps showing a light to the front to be permitted on any vehicle (except in the case of a vehicle with a load that overhangs laterally); not more than one separate rear light to be used except in the case of projecting loads; all lamps showing a light to the front shall have clearly and indelibly marked thereon their capacity or power, and shall not exceed 24 C.P.; if more than two lamps showing a light to the front are used, two of them must be side lights not exceeding 12 C.P. each. Legislation and special provisions are recommended.

The Electrical Purification of Air.—A note presented to the Académie des Sciences by Messrs. D'Arsonval, Bordas, and Touplain, and reproduced in the *Revue Générale de l'Electricité*, describes experiments on the purification of contaminated air by electrical means, the air being drawn through a copper tube in the axis of which was a wire maintained at a negative potential of 50,000 volts with regard to the tube. Although the air was proved to contain originally 150 microbes per $m.^3$, after electrification it was absolutely sterile. As experiments with dust particles had shown that the best results obtainable did not exceed a deposition of 95 to 97 per cent. of the particles, the authors concluded that the destruction of the microbes was partly due to the action of ozone, and their researches will be directed to this aspect of the matter.

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Inquiries.—Makers of "Etcholite" and of the "Pulvo" vacuum cleaner are asked for.

Identification Marks on Motor Vehicles.—The Metropolitan Police have issued an emphatic warning with regard to faulty identification marks on motor vehicles. Warnings were given in 1917 and 1918, and some 6,000 offences were reported in the Metropolitan Police District in the latter year. A further warning is now given, for the last time, that the Police will insist on these marks being in compliance with the law.

Strike at Port Sunlight.—Electrical Trades Union men employed by Lever Bros. at the Port Sunlight works, who came out on strike on Wednesday of last week, owing to the employment of three men who are members of the Electrical Power Engineers' Association, have not, up to the time of writing, returned to work. Negotiations between the firm and the Union have been held, and a settlement may not be very distant.

Engineering Golfing Society.—The spring meeting will take place, by the courtesy of the Golf Club, at Coombe Hill, Kingston Hill, on Tuesday, May 11th. A medal round will be played in the morning, and a four-ball foursome competition against bogey in the afternoon. Entries close on Monday, May 3rd. A match play tournament will commence early in May; entries close on Monday, April 26th. The hon. secretary, Mr. W. L. Mansergh, 5, Victoria Street, Westminster, S.W.1, will be glad to furnish application forms and other particulars, to any members of the engineering profession who belong to recognised golf clubs, and wish to join the society.

Appointments Vacant.—Shift engineer (90s.) for the Hoylake and West Kirby Urban District Electricity Department; telegraph inspectors (£200 + £65) for the Posts and Telegraphs Department in the Tanganyika Territory; assistant lecturer in electrical engineering (£350) for the Manchester Municipal College of Technology; staff engineer (£234) for the Doncaster Corporation Electricity Department; full-time teacher of engineering (£350 to £450) for the Birkenhead Technical School; installation assistant (£250) for the Ipswich Corporation Electricity and Tramways Departments. See our advertisement pages to-day.

The Diesel-Electric Propulsion of Ships.—In the Shipbuilding and Marine Engineering Section of the *Times Engineering Supplement* for April, it is stated that the Diesel-electric system has many advocates in America, where a number of ships of 10,000 tons deadweight are being equipped with Diesel-driven D.C. generators, of 5,000 B.H.P. each, supplying current to the propeller motors. The engines are of the simple non-reversing type, running continuously at constant speed, and owing to the intervention of the electrical gear, can be run at higher speeds than when directly coupled to the propeller shaft, thus economising space and weight. The system lends itself well to the development of very large powers without the risks attendant on the use of large cylinders.

Spark Plugs.—Brass has often been assumed to be superior to steel for sparking-plug shells because of its greater heat conductivity. The measurements described in Report No. 52, U.S. National Advisory Committee for Aeronautics, prove the contrary, showing that the interior of a sparking plug, having a brass shell, is from 50° to 150° C. (90° to 270° F.) hotter than that of a similar steel plug. Consistent results were obtained in both an aviation and a truck engine, and under conditions which eliminated all other sources of difference between the plugs. It is to be concluded that steel is to be preferred to brass for sparking-plug shells.—*Technical Review.*

INSTITUTION NOTES.

Institution of Electrical Engineers.—The annual general meeting of the NORTH-WESTERN CENTRE was held on April 13th, at the Engineers' Club, Manchester, Mr. J. Robertson presiding.

The annual report, read by the honorary secretary, Mr. A. Ellis, stated that 11 general meetings had been held, including the Kelvin Lecture, and the attendance averaged 120. A noteworthy feature was the number of new speakers, including several visitors; on the average, eight speakers took part in the discussion at each meeting. There was an increase in every class of membership, the greatest being in the Student Section, where the figures were 222, against 128 last session, and the aggregate was 984, compared with 830. The Liverpool Sub-Centre had held five meetings and the Preston Sub-Centre six.

The Chairman, in replying to a vote of thanks, said they had every reason to feel proud of the work which had been done by the Centre, and also by the Institution as a whole. There was a tendency to bring together various interests, including the manufacturing interest, which, he was sorry to say, was ignored for many years by the Institution, to reconcile conflicting views, and to enable those who were apparently in opposition to one another to work together for the common good of the Institution and the industry as a whole. Personally, he had tried to emphasise the importance of the Students' Section and the necessity of encouraging it in order to maintain the strength of the Institution.

Thanks were voted to Mr. Ellis for his services as honorary secretary, and to the Committee of the Engineers' Club for allowing the meetings to be held on the club premises.

There were nine candidates for membership of the Committee, and a vote was taken by ballot, the successful candidates being Mr. H. A. Ratcliff, Mr. B. Welbourn, and Mr. J. H. Wood. The election of Mr. J. Frith (chairman), Alderman W. Walker and Mr. A. S. Barnard (vice-chairmen), and Mr. A. Ellis (honorary secretary) was agreed to unanimously.

The meeting was followed by a smoking concert.

SOUTH MIDLAND CENTRE.—The hon. secretary of the Centre informs us that the authorities of the Technical College, Loughborough, and the Brush Electrical Co., Ltd., have extended an invitation to the members to visit their respective establishments. May 14th has been suggested as a suitable date for the visit, and a programme has been arranged. Members of the Centre desirous of taking part are asked to communicate with the hon. secretary (Mr. J. D. Morgan) not later than April 24th. The probable cost of the visit will be 10s. per member, as a motor-'bus is being hired for the occasion.

SCOTTISH CENTRE.—Lecturing on "Highland Water-Power" to this Centre of the Institution in Glasgow, on April 14th, Mr. J. M. M. Munro dealt with the nature, need, and urgency of a preliminary investigation of the entire field of national portable and power water supply, and the organisation necessary to undertake it. The problem, he pointed out, was to utilise fully and distribute equitably the whole water resources of the country for the maximum benefit of all. The preliminary inclusive general survey could most quickly be accomplished under the auspices of interim district water committees, appointed by groups of county councils. Schemes ripe for accomplishment could be undertaken by permanent area water boards. A Government contribution towards cost would probably be necessary, but the main capital would be borrowed through local authorities and others interested in water or power supply. These boards would not distribute beyond their area, but would sell water there to local authorities and electrical energy to the district electricity authorities. At the same meeting office-bearers for the year were appointed as follows:—Chairman, Mr. J. E. Sayers; vice-chairmen, Mr. C. F. Goslin and Mr. Alex. Lindsay; hon. secretary, Mr. Joseph Taylor; assistant hon. secretary, Mr. W. F. Mitchell; chairman, Students' Section, Mr. F. H. Whysall. Mr. Roger T. Smith, President of the Institution, delivered an interesting address.

Institution of Civil Engineers.—On Tuesday last the "James Forrest" lecture was delivered by Sir Dugald Clerk, F.R.S., the subject being "Coal Conservation in the United Kingdom." After a preliminary survey of the coal resources of the country, the author took as his text the report of the Coal Conservation Committee of the Board of Trade, and severely criticised the statistics put forward, and the economies ascribed to the scheme of electricity supply. He then compared the relative efficiencies of gas and electricity in terms of the heat units contained in the coal, and maintained that where heat was required, gas was far superior to electricity, while in a few years' time its superiority would be vastly increased. He saw little prospect of improvement in electrical plant, though, by abandoning condensation and using the exhaust steam from turbines for heating purposes, he considered that a very high thermal efficiency was obtainable. A suggestion of Lord Kelvin's that large quantities of low-temperature heat could be obtained with a small expenditure of energy by utilising the reversible properties of the Carnot cycle between narrow limits, Sir Dugald declared, was not a fallacy; it offered a promising opening for new developments. For lighting purposes he stated that electricity was more economical than gas. The advantages of gas for generating power, in preference to steam, were emphasised, and the lecturer concluded with a brief reference to the use of water-power.

The Council, in response to requests from various parts of the country, has decided to form local associations. These will, at first, only be instituted in centres where Associations of Students are already in existence, and the grant made by the Institution to these Students' Associations will be continued if the latter are incorporated with the newly-formed bodies. Various other rules regarding this matter have been formulated by the Council.

Liverpool Wireless Association.—A meeting was held on April 14th, at which additional new members were elected. A paper was given by a member with regard to valve action and circuits, followed by an instructional article on the construction of a standard wave-meter. The following gentlemen were elected as members of Committee:—Messrs. Grindon, Henderson, Coulton, Moore, Hyde, Saunders, and Williams. Mr. G. Irvine was elected hon. treasurer, and Mr. S. Frith, 6, Cambridge Road, Crosby, Liverpool, was re-elected as hon. secretary. The next meeting is on Wednesday, April 28th; all interested in wireless are cordially invited.

Birmingham and District Electric Club.—At the final meeting of the session, on April 17th, a paper was read by Mr. F. D. Davidson on "The History and Development of Electric Heating and Cooking." The author gave a short history of the experiments and difficulties of the pioneers in America, Germany and England, referring particularly to Franklin, Lane-Fox and Carpenter in America, and to Crompton and others in England. He expressed the opinion that for the purpose of water boiling and the like, the mica wire strip element, bolted in close contact with its work, was the most efficient heating element yet devised, and for heating purposes the porcelain former type of fire-bar was the most effective. A plea was made for some attempt at the standardisation of heating elements, and the suggestion was put forward that the most useful size of element for general purposes was an element 5 in. long by 1¼ in. wide, and not more than $\frac{1}{16}$ in. thick; this could be used singly or in suitable numbers for practically all forms of apparatus, the loading and voltages being varied to suit requirements.

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OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Mr. GEORGE J. HOLLYER, chief assistant electrical engineer at the Walthamstow Electricity Works, has resumed duties after his recent illness.

Mr. ARNOLD HUGHES, Falkirk Corporation electrical engineer, has been granted three months' leave of absence for health reasons.

Mr. THOMAS CLIMIE has been appointed assistant electrical engineer by the Falkirk Town Council at £330 per annum.

The Hull Electricity Committee has unanimously agreed that the salary of Mr. H. BELL, the electrical engineer, be increased from £700 to £1,000 a year, dating from April 1st, 1919. In a letter to the committee Mr. Bell pointed out that his present salary was identical with that he received seven years ago. He also submitted an official scale of payments by units, and said that under this scale he would be entitled to £1,410 per annum. During his absence at the war the whole question had been in abeyance.

Mr. R. C. HILL, late of the Admiralty Salvage Department, has recovered sufficiently from a long and serious illness to enable him to undertake duties once more on the staff of the Gloucester Corporation Power Station, where he formerly held the position of Engineer-in-Charge.

Lieut.-Colonel A. SIMPSON has been appointed director; Capt. P. J. Edmunds, physician; Mr. H. N. Swinstead, traffic manager, and Capt. R. W. Hawl, instructor, wireless branch, Indian telegraphs.—*Indian Engineering.*

Mr. H. A. NEVILLE, chief electrical engineer of the Wakefield Corporation for the past 16 years, has been appointed electrical engineer and manager of the Peterborough Corporation electricity works at a salary of £750, rising by annual increments of £50 to £1,000.

Mr. R. COLLINS has resigned his position as engineer and manager of the Galway Electric Co., Ltd., on taking up an appointment with an engineering concern in Dublin. Mr. A. H. Pemberthy, manager of the Ruthin Electric Supply Co., has been appointed to succeed him. Mr. Pemberthy was formerly on the staff of the B.T.H. Co., Rugby.

Mr. W. E. MILLER has resigned his position as manager of the Carron Co.'s electrical cooking and heating department, and has taken over the electrical cooking and heating department of Messrs. Archibald Low & Sons, Ltd., of Partick, Glasgow, who intend to develop this particular branch very considerably in the near future.

Whitehaven T.C. has increased the salary of the borough electrical engineer to £450 a year. He had applied for £500, the recognised scale, but it was thought advisable not to pay this scale until the publication of the balance sheet at the end of the year.

At the Aylesbury electricity works, on April 9th, Mr. A. T. ATKINSON was presented with a silver cruet stand from the staff and employés, on the occasion of his marriage. Mr. Turnbull, the borough electrical engineer, made the presentation.

Commissioned Electrician W. Ross has been appointed to H.M.S. *Repulse* from the 3rd inst.

Mr. J. H. BOLAM, borough electrical engineer at Weymouth, has secured an appointment in India.

Mr. R. F. DIXON, works superintendent of the Southampton Corporation Tramways, who is leaving to become general manager and engineer to the Mansfield Light Railway Co., has been presented by the staff with a silver cake dish and a china fruit dish.

Mr. G. H. THURSTON, on retiring from the staff of the Isle of Wight Electricity Co., has been presented by his colleagues with a cake casket.

Mr. W. WETHERER, a lineman for nearly 50 years on the L. & N.W. Railway at Stafford, has been the recipient of a purse of money and an armchair from the members of the electrical department of the Stafford district.

Mr. S. G. MARSTON has resigned his position as mains engineer at Stoke-on-Trent, after 16 years' service with the Corporation, to take up an appointment as distribution engineer at Sunderland.

The *Times* states that Signor MARCONI has resigned his position as Italian delegate at the Peace Conference.

Mr. C. LE MAISTRE was married on April 16th at the Chapel Royal, Savoy, to Irene, younger daughter of Mr. and Mrs. Ernest van der Beeck, of Turpington, Bickley, Kent.

On Thursday last a farewell dinner was given by a number of his friends to Mr. E. C. BARTON, M.I.E.E., who is about to return to Australia after carrying on a strenuous campaign in support of decimal coinage and the metric system of weights and measures, and performing a variety of work of national importance during the war. Mr. Theodore McKenna presided, and amongst those present were Mr. Harry Allcock, Mr. G. L. Addenbrooke, Mr. Percy Rosling, Mr. Lee Murray, and Mr. W. L. Madgen, as well as many other men of eminence in scientific and commercial circles. Mr. Barton stated that hitherto Australia and New Zealand, whilst anxious to adopt the decimal system, had waited for the home country to lead the way; however, in view of the report of the Royal Commission on Decimal Coinage, he would endeavour to persuade them to wait no longer, but to carry out the reform independently of Great Britain.

Mr. J. R. D. NORRIE has resigned his position as electrical engineer to the Park Prewitt Asylum, Basingstoke. The appointment of a successor has been deferred for the present; the leading fitter and electrician will be responsible, under the direction of the medical superintendent, for the satisfactory working of the plant.

Mr. H. F. MARSHALL, charge engineer at the Barrow-in-Furness Corporation electricity works, has been presented with a dressing case by the works employés. He leaves England on April 24th to take up an appointment in Shanghai.

Obituary.—MR. H. W. ROBINSON.—The death occurred on April 14th of Mr. Herbert W. Robinson, local district superintendent for Messrs. Christy Bros. & Co., electrical engineers, of Chelmsford. He was 43 years of age, and had been with the firm for over 23 years.

MR. A. H. HIORNS.—There passed away on Saturday last Mr. Arthur H. Hiorns, who for about 40 years was head of the Metallurgical Department of the Birmingham Technical School.

PROF. J. A. MCCLELLAND, F.R.S.—We regret to record the death on April 13th, in Dublin, of Prof. J. A. McClelland, Professor of Experimental Physics in University College, Dublin. During the war Prof. McClelland was a member of the Inventions Committee and of the Committee for Organisation of Industrial Research.

PROF. A. K. HUNTINGTON.—The death occurred suddenly on Saturday last of Prof. Alfred Kirby Huntington, who was from 1879 until October, 1919, Professor of Metallurgy at King's College.

PROF. L. T. O'SHEA.—On Sunday last there passed away, suddenly, at Sheffield, Prof. L. T. O'Shea, for many years Professor of Applied Chemistry at Sheffield University. For more than 25 years he made a special study of the chemistry of fuel, especially in connection with coke-oven developments and the preparation of fuel for industrial purposes.

MR. T. VAIL.—We regret to record the death of Mr. Theodore Vail, which occurred on April 16th at the Johns Hopkins Hospital, Baltimore, from heart failure, at the age of 75 years. It seems that he had been in failing health for the past year. He was one of the best-known electrical men in the U.S.A., and he had also been prominently connected with important electrical concerns in South America, interests which brought him into personal contact with electrical men and others in London. An account of his career by "a correspondent" appeared in the *Times* of 19th inst. The writer says: "During the ten years of Mr. Vail's presidency of the American Telephone & Telegraph Co. the 'Bell' telephone system in the United States was increased from below 6,000,000 stations to nearly 12,000,000 stations, and the range of the telephone was increased until it covered the whole Continent, and New York was able to talk to San Francisco. Such a remarkable expansion of a complicated system of communication and such an extraordinary technical feat as the transmission of the human voice over a circuit more than 3,000 miles long required a highly scientific organisation. It is to Mr. Vail's recognition of the importance of scientific research that the great expansion and high efficiency of the American telephone system are due. . . . Many industries get their improvements from outside, but the telephone industry has almost consistently been improved from within by the inventions and advances of the research department of the American Telephone & Telegraph Co. . . . Mr. Vail had retired from the active presidency of the American Telephone & Telegraph Co., though remaining chairman of the board and retaining his active interest in the great work of telephone development.

Will.—The late Sir John Jackson, the well-known contractor, left £501,764 net personalty.

NEW COMPANIES REGISTERED.

Berrite, Ltd. (166,397).—Private company. Registered April 14th. Capital, £30,000 in £1 shares. To take over the business carried on by the Copal Varnish Co., Ltd., as dealers in insulating materials and compositions under the style of "Berrite," including the trade mark "Berrite." The subscribers (each with one share) are: E. H. Barchard, 22, College Hill, E.C., solicitor; P. M. Sanderson, 22, College Hill, E.C., solicitor's managing clerk. The subscribers are to appoint the first directors. Solicitors: Janson, Cobb, Pearson & Co., 22, College Hill, E.C.

Cooke & Segal, Ltd. (166,470).—Private company. Registered April 15th. Capital, £10,000 in £1 shares. To carry on the business of lighting, glass and hardware merchants, &c. The first directors are: W. E. Cooke, 22, Randolph Crescent, Maida Vale, W.; J. Segal, 94, Fairholt Road, Stoke Newington, N.16. Secretary: A. W. Wale, 93, Capel Road, Forest Gate, E. Registered office: 21-23, Gray's Inn Road, W.C.1.

E. B. C. Electrical Co., Ltd. (166,347).—Private company. Registered April 13th. Capital, £70,000 in £1 shares (20,000 preference). To carry on the business of manufacturers of and dealers in electric lighting and starting sets and accessories and equipment of all kinds for motor and other vehicles, vessels and aircraft, engineers, &c., and to enter into an agreement with S. L. Price. The first directors are: S. L. Price, 62, Eagle Street, High Holborn, W.C.; L. C. Harvey, 25, Victoria Street, Westminster; W. H. Carey, 78 and 80, High Holborn, W.C.; C. A. M. Buckley, 17, Drewstead Road, Streatham, S.W. Solicitor: F. S. Fleuret, 27, Chancery Lane, W.C. Registered office: 62, Eagle Street, High Holborn, W.C.

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J. E. Slack, Ltd. (166,227).—Private company. Registered April 9th. Capital, £30,000 in £1 shares. To carry on the business of manufacturers of and dealers in tubes, pipes, conduits, mains, retorts, bends, elbows, flanges and accessories for tubes, pipes and conduits, &c. The first directors are: J. E. Slack, 343, Holloway Road, Holloway, N., director, Ferguson Superheaters, Ltd.; A. H. Spearing, Eversfield Road, Reigate, director, Ferguson Superheaters, Ltd., and Goodrich & Hamlyn, Ltd. Secretary: J. E. Slack. Registered office: 60, Queen Victoria Street, E.C.

Chesterfield Tube Co., Ltd. (166,341).—Registered April 13th. Capital, £435,000 in 75,000 shares of £1 each and 1,440,000 shares of 5s. each. To carry on the business of manufacturers of steel and iron tubes of wrought iron, steel or other metals, iron plates and fittings of all kinds, mechanical and electrical engineers, founders, machinists, &c., and to adopt an agreement with the Chesterfield Tube Co., Ltd. (incorporated in 1900). The first directors are: A. F. Nicol, Uplands, Woldingham, Surrey; C. C. Hatry, 36, Upper Brook Street, W.; P. Haig-Thomas, 43, Princes Gardens, S.W.; G. Hooper, Readings, Five Ashes, Sussex; A. Mitchelson, Holme Park, Rotherfield; H. W. Pelham-Clinton, 53, Eccleston Square, S.W.; W. A. Woodeson, Nevar House, Clowdene Bank, Low Fell, Gateshead (director, Clarke, Chapman & Co., Ltd.). Minimum cash subscription, £7. Secretary: J. G. Dinan. Registered office: 6, Austin Friars, E.C.

Don Engineering Co., Ltd. (166,456).—Private company. Registered April 14th. Capital, £200,000 in £1 shares. To take over the business of consulting, mechanical and electrical engineers, physical and scientific consultants, patentees, metallurgists, engineering experts, manufacturers of motor cars, cycles, scooters, 'buses, lorries, taxi-cabs, &c., and to adopt an agreement with Dr. A. M. Low. The subscribers (each with one share) are: Hon. C. N. Bruce, 1, Lowndes Square, S.W., barrister; Hon. N. M. Upton, The Holme, Balmaclellan, N.B., engineer. The subscribers are to appoint the first directors. Solicitor: T. Outer, 17, Throgmorton Avenue, E.C.

H. T. Hazzledine, Ltd. (166,208).—Private company. Registered April 9th. Capital, £10,000 in £1 shares. To carry on in the U.K. or elsewhere the business of electrical engineers and contractors, manufacturers of and dealers in electrical apparatus and appliances, &c. The first directors are: H. T. Hazzledine, The Cottage, Lucknow Drive, Nottingham; J. T. H. Barwood, 582, Berridge Road, Nottingham. Solicitor: S. J. Burnie, Moot Hall Chambers, Wheeler Gate, Nottingham. Registered office: 5, Talbot Street, Nottingham.

Bower & Taylor, Ltd. (166,193).—Private company. Registered April 9th. Capital, £5,000 in £1 shares. To take over the business of an automobile and electrical engineer carried on by J. A. Bower at 17-21, Thurlow Park Road, West Dulwich, S.E., as "Motor and Electrical Industries." The subscribers (each with one share) are: J. A. Bower, 42, Thurlow Park Road, West Dulwich, S.E., engineer; H. G. Stimson, Salisbury House, E.C.2, solicitor; W. J. Billing, 17, Oliver Road, Sutton, Surrey, clerk. The subscribers are to appoint the first directors. Registered office: 7-8, Great Winchester Street, E.C.

British Plugs, Ltd. (166,340).—Private company. Registered April 13th. Capital, £500 in £1 shares. To carry on the business of makers of sparking plugs, &c. The first directors are: D. F. Linstone, 45, Aberdare Gardens, N.W.6; S. Jacobs, The Briars, Park Hill, Moseley, Birmingham. Registered office: 86, Church Street, E.1.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

L. J. Healing & Co., Ltd. (97,137).—Return dated June 3rd, 1919 (filed January 20th, 1920). Capital, £100,000 in 5,000 preferred and 5,000 deferred shares of £10 each. 1,301 preferred and 5,000 deferred shares taken up. £13,010 paid. £50,000 considered as paid. Mortgages and charges, nil.

Bray, Markham & Reiss, Ltd.—Particulars of £8,000 debentures created March 24th, 1920, filed pursuant to Section 93 (3) of the Companies (Consolidation) Act, 1908. The whole amount being now issued. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trustees.

Venezuela Telephone and Electrical Appliances Co., Ltd.—Satisfaction in full on March 1st, 1920, of charge dated December 7th, 1908, securing £30,000 prior lien debentures.

Pinckney & Forster, Ltd.—Deposit on March 1st, 1920, of deeds of freehold premises at Newcastle-on-Tyne, to secure all moneys becoming due from company to Barclay's Bank.

British Union Lamp Works, Ltd.—Satisfaction to the extent of £2,299 on March 3rd, 1919, of mortgage or charge dated May 7th, 1913, securing all moneys not exceeding £3,000 for which the charges may become liable under a guarantee to company's bankers.

Fredk. R. Butt & Co., Ltd.—Particulars of £10,000 debentures created March 29th, 1920, filed pursuant to Section 93 (3) of the Companies (Consolidation) Act, 1908. The whole amount being now issued. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trustees.

Wilson-Wolf Engineering Co., Ltd.—Mortgage on certain land and buildings at Peterborough, dated March 22nd, 1920, to secure all moneys due or to become due from company to Lloyd's Bank, Ltd., Bradford.

United Flexible Metallic Tubing Co., Ltd.—Satisfaction in full on February 28th, 1920, of mortgage dated November 22nd, 1907, securing £2,020.

CITY NOTES.

Callender's Cable and Construction Co., Ltd.

Sir J. Fortescue Flannery, Bart, M.P., presided at a special meeting on April 15th at which it was resolved to subdivide the £5 shares into five shares of £1 each, making a much more marketable security, and to increase the capital from £900,000 to £1,300,000. In the course of his speech, the chairman said that trade had increased in such a way that they could not cope with the orders offered without providing special means for dealing with them. They had erected new works, enlarged some of the shops, and provided new machine tools. The turnover in money in proportion to the turnover in manufactured tons was very greatly increased. The average wage per man per week was 2½ times that of 1914. The weekly hours of working were then 53 and to-day they were 47, so that both as regarded the total amount of wages and the hours worked in return, there had been a change involving a very much larger outlay per ton of manufactured goods. There were several causes which made an increased capital necessary. In the first place there were the increased charges for buildings and fixed plant; secondly the increased cost per ton of manufactured cable; thirdly, the increased volume of orders; and fourthly, the increased facilities of a financial character which their customers expected, as compared with the Government, for whom they had been working during the last five years. They proposed to increase the working capital by £400,000 in the form of 400,000 £1 7½ per cent. cumulative preference shares, which would be called "B" shares, and would rank after the 6½ per cent. preference shares already in existence and in priority to the ordinary shares, both those which had already been issued and the balance which it was now intended to issue. They had fine business contracts both at home and abroad awaiting execution, and they looked forward to a satisfactory future. There were great developments of a scientific character—higher pressures, larger loads, longer distances for transmission and extension of the telephone system. Business in the Dominions across the seas and in foreign countries continued to expand, and they believed that the electrical industry had a very fine future.

Sir T. O. Callender said that in view of the great extension of electrical distribution throughout the country, he looked forward to a prosperous career for the company.

Swedish Companies.

The Elektriska A.B. K.B. Fréed reports net profits of 80,000 kr. for 1919, and a dividend at the rate of 10 kr. per share.

The Svenska Ackumulator A.B. Jungner has declared a dividend at the rate of 18 per cent. on the preference shares for 1919, and 10 per cent. on the ordinary shares.

The Elektriska A.B. Eck, of Partille, reports a loss of 905,000 kr. for 1919, as compared with net profits of about 1,000,000 kr. in the previous year, when a dividend at the rate of 12 per cent. was paid on the share capital of 6,000,000 kr. The loss is attributed by the directors to the necessity for making special provision for depreciation of manufactures and installation materials, and is to be covered partly by absorbing the balance brought forward from 1918, and partly by drawing upon the reserve fund.

The Allmänna Svenska Elektriska A.B., whose report and accounts for 1919 were summarised in our last issue, decided at the annual meeting on April 12th to pay, not 10 per cent. as recommended, but 12 per cent. In explanation, it was stated that the discount rate had been increased since the report was prepared, and this was causing difficulties to some of the shareholders who had mortgaged their shares. It was resolved to draw upon the profit equalisation fund for the amount of the difference of 2 per cent.

Brush Electrical Engineering Co., Ltd.

The report for 1919 shows a balance of £148,685, plus £34,714 brought forward. Depreciation of buildings and plant absorbs £9,400; depreciation of patents and goodwill £600; in addition to the 6 per cent. paid on the prior lien participating second debenture stock a further 4 per cent. is paid, £2,044; there is put to general reserve £70,000; 15 per cent. is to be paid on the ordinary stock, requiring £15,787, and £85,568 is to be carried forward. After the war the company quickly resumed its normal manufacturing operations. Important industrial contracts have been completed, and numerous others are in hand, in both the engineering and the car-building departments. £54,164 was expended on capital account during the year. In order to extend the works and to build houses for employés the capital is to be raised to £600,000 by 344,200 new ordinary shares of £1 each, part of which new capital is to be issued at an early date. It is considered that before any fresh capital is raised the present ordinary shareholders, in view of former reductions of capital, are entitled to benefit by the improvement in the company's position, and it is recommended that £105,244 of the reserve be capitalised and distributed to present holders in the proportion of £1 of new stock for each £1 now held. The demand for Brush-Ljungstrom power plant and auxiliaries has developed so satisfactorily as to necessitate a further enlargement of manufacturing capacity, and important extensions of buildings and plant for this purpose are in progress.

Calcutta Electric Supply Corporation, Ltd.—Final dividend for the last half of 1919, 6 per cent. actual, making 10 per cent. for the year, on the ordinary shares, with a bonus of one preference share for every ten ordinary shares held. A permanent increase of dividend on the preference shares from 5 per cent. to 6½ per cent. is recommended.

Hastings & District Electric Tramways Co., Ltd.—After paying 3 per cent. on the preference shares on account of 1919, £2,500 is put to depreciation and £526 carried forward.

Electrical Utilities Corporation.—Quarterly dividend of 1¼ per cent. on preferred stock.

English Electric Co., Ltd.—The report issued just as we go to press recommends a dividend of 8 per cent., less tax, on the ordinary shares for 1919, carrying forward £45,302.

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British Electric Transformer Co., Ltd.—Mr. A. F. Berry presided at the meeting held on 14th inst., at Hayes, at which the resolution was passed increasing the preference dividend from 6 per cent. to 7 per cent., and increasing the capital to £1,000,000 by the issue of 137,500 preference shares. He referred to the enormous dimensions of the electrical industry, in which 150 millions had been invested. It was neither a hot-house plant nor a war creation. Manufacturing firms of all kinds depended largely upon a supply of power through the Berry transformers. They were also required largely for electrified railways and wireless telegraphy. The domestic demand for electricity was developing at an unprecedented rate. It was that which was making such a call on the company's manufacturing capacity for patented and perfected appliances on view at 50, Oxford Street. He hoped that the time was not far distant when they could pay more than 12½ per cent. on the ordinary shares. The company, during the war and since the armistice, had not earned so large a percentage of profit on its output as it had done in the best pre-war time. It was their intention to maintain their pre-eminence over other countries, and the increased scale of operation on which they worked would, he hoped, make it possible to out-distance still further their rivals.

Auckland Electric Tramways Co., Ltd.—Mr. C. G. Tegetmeier presided at a meeting of shareholders held at Auckland several months ago, at which he explained the terms upon which the undertaking had been acquired by the City Council. The amount payable was £1,227,200, which the company would receive in debentures for £834,400 at 5½ per cent., and for £392,800 at 5 per cent. The whole of them were payable on July 1st, 1940. Those debentures constituted the sole assets of the company, and the question to be considered was how they could be dealt with in the best interests of the shareholders. After discussion the meeting passed a resolution which the chairman promised to intimate to the London board, to the following effect: (1) That the company be wound up as speedily as expedient; (2) that, in distributing the assets of the company, the liquidator be requested, if practicable so to do, to propose a scheme whereby the debentures of the Auckland City Council be distributed among the shareholders of the company.

West India Electric Co., Ltd.—Capital expenditure during 1919 $7,554 in connection with the expansion of lighting and power business, necessitating additions to the wiring system in Kingston, St. Andrew, and Spanish Town. Gross earnings $383,665, an increase of $88,940. Total operating expenses increased by $92,360. Operating expenses 64.54 per cent. of the receipts, against 51.99 per cent. in 1918. New rolling stock being needed to keep pace with increased traffic, the car bodies were made at the company's works in Kingston, the trucks, wheels, and electrical equipment being imported. After deducting fixed charges, bond interest, &c., $83,567 and $16,500 interest on Canadian investments have been added to surplus. After debiting $40,000 distributed to the shareholders, the credit balance on surplus account now stands at $627,076.

Cuba Submarine Telegraph Co., Ltd.—Total receipts for 1919 £78,852; expenses £26,603. After providing £2,584 for cable repairs, £6,300 for income tax, £15,000 on account of excess profits duty for 1918, the balance is £28,364, plus £22,486 brought forward. £10,000 has been added to general reserve and £2,500 to pension fund. Dividends 10 per cent., less tax, on the preference shares, and 5 per cent., free of tax, plus a bonus of 4s. on the ordinary, leaving £21,150 to be carried forward subject to excess profits duty. The cable repairs referred to above have been in shallow water.

Stock Exchange Notices.—The Committee has specially allowed dealings in the following under temporary regulation 4 (3):—

British Aluminium Co., Ltd.—400,414 ordinary shares of £1 each, fully paid, Nos. 900,621 to 1,301,034.

General Electric Co., Ltd.—41,666 ordinary shares of £1 each, fully paid, Nos. 2,033,335 to 2,075,000.

Canadian General Electric Co.—Profit for 1919 $1,617,989 from which $524,668 is deducted for depreciation. Dividends 8 per cent. on the common stock and 7 per cent. on the preference; $313,300 carried to credit of profit and loss. The proceeds of the issue of $1,000,000 last December are to be applied to extensions of manufacturing and distributing properties.

City of London Electric Lighting Co., Ltd.—At a special meeting, held on 14th inst., it was resolved to increase the capital to £2,000,000 by the creation of £800,000 shares, and to subdivide the £10 preference and ordinary shares into shares of £1 each.

Alldays & Onions, Ltd.—It is proposed to increase the capital to £650,000 by the creation of 375,000 further ordinary shares. The whole will not be issued at the moment, but negotiations are in progress for issuing immediately 250,000 of the shares. The new capital is needed owing to the higher price of all commodities, and the great increase in business offering.

Johnson & Phillips, Ltd.—Dividend at the rate of 12½ per cent. per annum, less income tax, on the ordinary shares.

Buenos Aires Port & City Tramways, Ltd.—Meetings of the bondholders and debenture stockholders are to be held on April 26th for the purpose of considering proposals for the realisation of the property and assets forming the securities of those holders. A scheme has been prepared by Sir William Plender, the receiver and manager, having for its object, in the event of failure to realise the properties and assets for a sufficient cash sum, their acquisition by a new company to be formed for the purpose.

Merthyr Electric Traction & Lighting Co., Ltd.—Dividend 6 per cent. per annum on the ordinary shares; to reserve £1,200; to renewals £5,000; carried forward £581.

Fairbairn Lawson Combe Barbour, Ltd.—Dividend 7½ per cent. on the ordinary shares for 1919. To reserve £20,000; carried forward £32,982.

Bath Electric Tramways, Ltd.—After paying debenture interest, and preference dividend, £12,500 is put to contingencies and renewals account, and £4,251 is carried forward to provide for contingencies and replacements.

South Staffordshire Tramways Co.—Dividend of 4 per cent. on the preference shares for 1919, carrying forward £683

STOCKS AND SHARES.

Tuesday Evening.

The Stock Exchange markets accorded the Budget something of a mixed reception. Certainly it is a relief to the investor to hear there will be no more national loans on the grand scale for the purpose of raising "new" money. On the other hand, the expectation of excess profits duty being abolished is sadly dashed by the tax going up to 60 per cent., while the new burdens thrown upon limited liability companies do not conduce to satisfaction on the part of shareholders. The immediate effect has been to cause a fairly general decline amongst industrial shares. At the same time, the question arose as to whether the 20 per cent. additional E.P.D. may be regarded as a useful excrescence when the inevitable modifications of the Budget come up for discussion.

With every prospect of a further big rise in the price of coal, it is natural that the harassed householder should turn to electricity and ask whether he cannot obtain some relief from his bills by greater use of the current. Though the latter depends upon coal, it is already being examined from the standpoint of domestic economy, and this will doubtless be an incentive to the electricity supply companies to demonstrate afresh the various advantages it offers over coal. In the meantime, however, prices of the London companies' shares are not exciting to the proprietor. Westminster ordinary changed hands the other day as low as 5⅛, which is but the fraction above the par value of the shares, and this in spite of the recent rise to 10 per cent. in the dividend. City of London ordinary are 10s. lower at 12½, the "arrears" of dividend in this case being a neglected factor. County ordinary have lost their small gain of last week. Several preference issues are slightly lower, though this is due more to monetary considerations than to anything else. The rise last week in the Bank Rate to 7 per cent. has predisposed all fixed-interest investments to dulness, and it requires little offering of stock to make a marked effect upon such securities. It is known that there are many newcomers that may be appealing before long for money, in spite of the Budget disabilities, and they will have to offer terms so tempting as will give the older stocks an expensive appearance by comparison. The public recognise this clearly enough, and this explains, of course, to a large extent the abstention of capitalists, large and small, from the Stock Exchange markets.

One department where firmness stands out is that for cable stocks and shares. The closing of the lists for application in respect of the new issues made by the Eastern group has already brought about recovery in the senior shares. Improvements have occurred in Eastern ordinary, "China" shares, Globes and Westerns, the first-named now standing highest in the quartette. Globe preference, however, are lower at 9, following the general trend of fixed-interest securities. Indo-Europeans are down £4 on account of the reduction of 3 per cent. in the dividend. Anglo-American Telegraph preferred receded to 79¼, part of the loss being represented by the dividend deduction from the price. Marconis gave way to 3¾, the market reason for the setback being the condition of the Italian rate of exchange. United River Plate Telephones are 2s. 6d. better, and Orientals continued their recovery with a similar rise.

The Brush Electrical report makes a fine showing. Profits have risen substantially, and the figures justify the recent improvement to 120 in the price of the ordinary stock. Dealings have taken place within the past few days in the 4½ per cent. debenture stocks, the firsts being 65 and the seconds 59¼. Edisons are a good market, with a rise to 1 3-16, but other manufacturing shares are quiet and uninteresting. Metropolitan-Vickers preference at 2 7-16 and Henleys 2⅛ are

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both ex dividend. Callender's have slipped back to 8¼. British Aluminium drooped to 23s. 1½d., and amongst engineering shares, Babcock & Wilcox went back to £3. Telegraph Constructions remain dull at 24½. It is assumed in the market that the large sums just raised by the new issues of stock by the Eastern Companies will be spent, at least in part, upon work in which various manufacturing concerns will share, and if this turns out to be so, the latter should have plenty of contracts for some time to come.

British Electric Traction ordinary is lower at 33½. The revised scale of tramway fares which came into operation last Sunday has not sent buyers exactly rushing into the market, where, indeed, dulness is still the order of the day. Undergrounds are weak. The 6 per cent. Incomes have shed 4 points to 68, and the £10 shares retreated to 2⅜, while Metropolitan ordinary stock at 20½ is the fraction down. Districts shed a point.

Foreign traction stocks have again declined. Anglo-Argentine Tramways are easier, and Mexicans incline to the lower side. Mexican Light First Bonds have lost 5, at 39. Brazil Tractions have recovered a point, but except for this, the foreign group offers no consolation to stockholders. Bombay Electric ordinary are now ex their dividend of 49s., and the shares changed hands at 125 a couple of days before the dividend was taken off the price. Rubber shares move in sympathy with the dwindling tendency shown by the raw material, and in the armament group there is no fresh activity. It will take a week or two for the effects of the Budget to wear off, and business is hardly likely to revive to any noticeable extent until the Chancellor's provisions become more familiar and more digested. Meanwhile, it is the Excess Profits Duty which is worrying the markets more than anything else.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1918.	Dividend 1919.	Price April 20, 1920.	Rise or fall.	Yield p.c.
Home Electricity Companies.					
Brompton Ordinary	8	12	6½	—	£9 4 8
Charing Cross Ordinary	4	7	8½	—	9 0 8
do. do. do 4½ Pref.	4½	4½	2½	—	8 8 8
Chelsea	3	4	3	—	6 8 4
City of London	8	10	12½	— ¼	8 0 0
do. do. 6 per cent. Pref.	6	6	8½	— ½	6 9 8
County of London	7	8	9¼	— ¼	8 18 10
do do. 6 per cent. Pref.	6	6	8½	— ½	6 17 2
Kensington Ordinary	6	7	5	—	7 0 0
London Electric	Nil	2½	1⅜	—	5 2 6
do. do. 6 per cent. Pref.	6	6	8½	—	9 4 8
Metropolitan	5	6	5⅝	— ⅛	8 5 6
do. 4½ per cent. Pref.	4½	4½	2½	—	8 0 0
St. James' and Pall Mall	10	12	6¾	—	8 16 10
South London	5	6	2½	—	7 12 8
South Metropolitan Pref.	7	7	18/9	— 1/-	7 0 0
Westminster Ordinary	8	10	5⅛	— ¼	9 6 0
Telegraphs and Telephones.					
Anglo-Am. Tel. Pref.	6	6	79¼xd	— 2½	7 11 0
do. Def.	35/6	1½	18½	—	8 0 0
Chile Telephone	5	6	6¾	—	*4 12 2
Cuba Sub. Ord.	7	7	10	—	*7 0 0
Eastern Extension	8	10	15½	+ ¼	*6 9 1
Eastern Tel. Ord.	8	10	160¾	+3	*6 5 0
Globe Tel. and T. Ord.	8	10	15½	+ ⅛	*6 7 0
do. do. Pref.	6	6	9	— ¼	6 13 4
Great Northern Tel.	21	—	22½	—	9 15 6
Indo-European	13	10	44½	— 4	5 12 4
Marconi	25	—	3⅛	— 1/8	6 15 6
Oriental Telephone Ord.	10	—	2[illegible]	+ ⅛	8 11 0
United R. Plate Tel.	8	—	7⅞	+ ⅛	*5 1 7
West India and Panama	1/8	—	1	— 1/8	6 5 0
Western Telegraph	8	10	15½	+ ½	*6 7 0
Home Rails.					
Central London Ord. Assented	4	4	47⅛	—	8 8 6
Metropolitan	1	1½	20½	— ½	6 2 0
do. District	Nil	Nil	18	— 1	Nil
Underground Electric Ordinary	Nil	Nil	2⅜	— ⅛	Nil
do. do. "A"	Nil	Nil	7/-	—	Nil
do. do. Income	5	4	68	— 4	5 17 8
Foreign Trams.					
Anglo-Arg. Trams. First Pref.	Nil	Nil	8½	— ⅛	—
do. do. 2nd Pref.	—	—	8½	—	—
do. do. 5 Deb.	5	5	60½	— 1½	8 5 4
Brazil Tractions	—	—	51	+ 1	—
Bombay Electric Pref.	6	6	17½	—	8 8 7
British Columbia Elec. Ely. Pfce.	5	5	56½	— 8	8 17 0
do. do. Preferrred	2½	5	49¼	—	10 10 6
do. do. Deferred	Nil	3	42½	—	7 1 2
do. do. Deb.	4½	4½	55½	— 1	7 18 2
Mexico Trams 5 per cent. Bonds	Nil	Nil	35½	—	Nil
do. 6 per cent. Bonds	Nil	Nil	29½	— 1½	Nil
Mexican Light Common	Nil	Nil	12½	—	Nil
do. Pref.	Nil	Nil	22½	—	Nil
do. 1st Bonds	Nil	Nil	39	— 5	—
Manufacturing Companies.					
Babcock & Wilcox	15	—	3	— ⅛	*5 0 0
British Aluminium Ord.	10	10	1[illegible]xd	— ⅛	8 13 2
British Insulated Ord.	12½	15	1[illegible]	—	7 14 8
Callenders	25	—	8½	— ¼	7 11 6
,, 5½ Pref.	6½	6½	4¾	—	6 16 10
Castner-Kellner	20	—	4	—	—
Crompton Ord.	10	—	22/-	—	9 1 10
Edison-Swan, "A"	10	—	1[illegible]	+ ⅛	8 8 6
do. do. 5 per cent. Deb.	5	5	79½	—	6 5 9
Electric Construction	10	—	23/-	—	8 18 10
Gen. Elec. Pref.	6½	6½	18/6	—	7 0 6
do. Ord.	10	—	1[illegible]	—	*5 14 4
Hanley	25	15	2[illegible]xd	—	7 1 2
do. 4½ Pref.	4½	4½	3[illegible]	—	6 4 2
India-Rubber	10	—	13[illegible]xd	—	*7 8 2
Met.-Vickers Pref.	—	8	2[illegible]xd	—	6 11 2
Siemens Ord.	10	10	27/6	— 6d.	*7 5 6
Telegraph Con.	20	20	24½	[illegible]	*4 18 0

* Dividends paid free of Income Tax.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Tuesday, April 20th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Oxalic	per lb.	2/10	1/5 inc.
a Ammoniac Sal	per ton	£100	...
a Ammonia, Muriate (large crystal)	,,	£92	...
a Bisulphide of Carbon	,,	[illegible]	...
a Borax	,,	£42	...
a Copper Sulphate	,,	£52	...
a Potash, Chlorate	per lb.	1/-	1d. inc.
a ,, Perchlorate	,,	1/8	...
a Shellac	per cwt.	£28	£11 dec.
a Sulphate of Magnesia	per ton	£18	..
a Sulphur, Sublimed Flowers	,,	£28	...
a ,, Lump	,,	£25	...
a Soda, Chlorate	per lb.	6d.	...
a ,, Crystals	per ton	£12	...
a Sodium Bichromate, casks	per lb.	...	...
METALS, &c.			
g Babbitt's Metal Ingots	per ton	£118 to £345	...
c Brass (rolled metal 2" to 12" basis)	per lb.	1/8½	½d. dec.
c ,, Tubes (solid drawn)	,,	1/6 to 1/6½	½d. dec.
c ,, Wire, basis	,,	1/3⅜	½d. dec.
c Copper Tubes (solid drawn)	,,	1/8½	½d. dec.
g ,, Bars (best selected)	per ton	£163	£3 dec.
g ,, Sheet	,,	£163	£3 dec.
g ,, Rod	,,	£163	£3 dec.
d ,, (Electrolytic) Bars	,,	£118	£4 dec.
d ,, ,, Sheets	,,	£156	...
d ,, ,, Wire Rods	,,	£128	£14 dec.
d ,, ,, H.C. Wire	per lb.	1/4½	½d. dec.
f Ebonite Rod	,,	8/-	...
f ,, Sheet	,,	2/6	...
n German Silver Wire	,,	3/-	...
h Gutta-percha, fine	,,	13/-	...
h India-rubber, Para fine	,,	2/3½	...
i Iron Pig (Cleveland Warrants)	per ton	Nom.	...
l ,, Wire, galv. No. 8, P.O. qual.	,,	£57	...
g Lead, English Pig	,,	£40 10/-	£2 10/- dec.
g Mercury	per bot.	£25 10/-	40/- to 50/- dec.
e Mica (in original cases) small	per lb.	6d. to 4/6	...
e ,, ,, ,, medium	,,	5/- to 10/-	...
e ,, ,, ,, large	,,	12/6 to 25/- & up	...
g Phosphor Bronze, plain castings	,,	1/7 to 1/11	...
g ,, ,, rolled bars and rods	,,	2/2 to 2/6	...
g ,, ,, rolled strip & sheet	,,	2/8 to 2/9	...
d Silicium Bronze Wire	per lb.	1/11½	...
r Steel, Magnet, in bars	,,	1/8	...
g Tin, Block (English)	per ton	£343 to £344	£4 inc.
n ,, Wire, Nos. 1 to 16	per lb.	5/8	2d. dec.
White Anti-friction Metals	per ton	£90 to £345	...

Quotations supplied by—

a G. Boor & Co.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
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A.C. Haulage Signals.—In a paper by Mr. A. Lees, read before the Association of Mining Electrical Engineers, and reprinted in the *Iron and Coal Trades Review*, the use of D.C. for working signals in mines is stated to have been the cause of much lost time. The employment of accumulators means periodical charging in many cases at a station situated some distance from the signalling apparatus, and a man with a certain amount of skill and experience in the work is required to look after them. Motor-generators also require skilled attention, and a breakdown usually affects several haulages. The writer has conducted numerous experiments in an endeavour to arrive at a satisfactory method of employing A.C. of low frequency for this class of work. Rectifiers were found satisfactory in so far as D.C. bells require less power than A.C. The construction of rectifiers must be very substantial, and they should be able to rectify both waves of a whole period. The writer recommends the use of small transformers, as they give very little trouble, and are most reliable. Anti-sparking devices are dealt with, and tests described; a relay system is favoured, although it is pointed out that there is a limit to the number that can be employed in any one circuit. The transformers employed by Mr. Lees in his trials were 500 volts primary with tappings for 25, 20, 15, and 10 volts on the secondary. In concluding his paper, the writer sums up the principal advantages following upon the use of A.C. for signalling in mines, which are:—(1) No electrolysis at the bell wires; (2) The source of current is reliable; and (3) The cost of maintenance is low. Against these must be set higher first cost, but taking into consideration the time lost on D.C. systems, and the cost of maintenance, the bigger outlay is amply justified.

Electrical Engineering Service in the Navy.—The Navy Estimates for 1920-21 provide for various votes for electrical services, amongst these being the Department of Electrical Engineering, the staff of which is composed as follows:—Director of Electrical Engineering, £1,063 per annum; two assistant directors, £1,700; three electrical engineers of the higher grade, £2,025; 16 first assistant electrical engineers, £5,100; one examiner of accounts, £383; technical staff, 43 in number, £8,763; clerks, £537.

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CAPITALISTS ALL!

By H. R. TAUNTON.

(*Concluded from page* 486.)

Their chance of decreased dividends on their actual capital value is certainly comparable with that of the ordinary shareholder. Apart from sickness (which affects the earnings of the workmen) they run the risk of reduced earnings by temporary unemployment. If the firm does badly, the same causes which reduce the dividends of the ordinary shareholders reduce those of the employés, for they are put on short time or are discharged in time of slackness; and their capital is depreciated by association with a firm that fails, and by long periods of unemployment. On that score alone they deserve the same consideration as the ordinary shareholders.

But they have a further merit which he has not. For it is entirely due to their right use, not only of their own capital but of his, that there are any surplus profits to discuss. They are the active agents in the prosperity of the firm; he, merely a sleeping partner.

If every employé be worth to the firm exactly what he is paid, no more and no less, then the firm will earn just sufficient to pay its preference holders, and its ordinary shareholders at the same rate. And the employés, considered as shareholders, will also have received their dividends, at the same rate. Every member of the firm, in such a case, will have received equal remuneration, in proportion to his merits.

It might be argued, indeed, that the employés would be doing their fair share if they earned the standard rate of interest on their own capital only; and that by earning additional interest on the really unproductive capital of the shareholders, they are doing more than their share. But unless they did that, the nominal shareholders would receive nothing at all. It is part of the employés' contract that they earn dividends on all the capital in the firm, the nominal shareholders' as well as their own; and the value of their holdings—or in other words, their pay—is assessed on their ability to do so. If they fail to do so, their own value is reduced, and with the failure of the company, they lose, at least temporarily, their dividends. And it must be remembered that, in return for this obligation on them to earn dividends for their sleeping partners, they have the privilege of receiving their dividends first, and at short intervals, in the shape of their weekly or monthly pay. Only after their claims are satisfied are those of even the preference holders considered.

So we come back to our former proposition that, when the body of employés produces just sufficient to pay all the shareholders, themselves included, the standard rate of interest, their annual value to the firm is precisely the total of their pay. There may be, of course, individual cases of over- or under-valuation, but they are foreign to the argument.

But if they produce *more* than the profit sufficient to afford equal remuneration proportionate to each member's capital holding, then it is obvious that they are doing more than their fair share. Their value to the firm is more than they have been assessed at. And the greater the surplus profit, the greater is this disparity.

The merit of realising that surplus profit belongs entirely to them, and in no wise to the shareholders. And yet it all goes to the shareholders, and they get nothing. They so use their capital—brains and muscle—as to increase the shareholders' capital—money—by more than the standard rate of increase, and so earn for them more than the market value of their money. This is more than they contracted to do. Then, they should receive more than their normal rate of pay, which is based on their ability to earn for the shareholders the standard rate of interest only.

And they don't receive it. Our firm gives an extra £12 to the ordinary shareholder, whose only merit is the taking of a slight risk; and gives nothing at all to the employés, shareholders too, who also take a risk, and have the additional merit of using the resources of the firm to such advantage that there is a surplus to divide. The facts have only to be considered in the light of a logical sequence of arguments for the injustice to be obvious. It clamours for correction. And its correction is a simple matter, if we proceed on the agreed hypothesis that every member of the firm, nominal shareholder and employé alike, is a capitalist, each with a holding in the firm, represented either by cash, or the capitalised value of services.

On this basis, the preference shareholders are paid the market rate for the use of their capital, say, 8 per cent.

The employés are paid the same rate for the use of *their* capital; and in consideration of the fact that they earn the surplus available for distribution, they receive their dividends first, and in frequent instalments.

After they and the preference holders are paid, the ordinary shareholders have admittedly a claim on the surplus to the extent of the market rate, 8 per cent., for the use of their money.

There is still, we are supposing, a surplus to be divided, equal to 12 per cent. on the ordinary shares. For the sake of argument, say the ordinary shares in this particular company are half the total nominal capital, or £125,000; so that our present surplus is £15,000.

We have now two classes of claimants to this surplus: the ordinary shareholders, whose claim is the risk they run of a deficit; and the employés, whose claim is that the surplus was earned by their efficient use of the firm's capital. Morally, the latter claim is the stronger, and they should receive the larger proportion. But it would be difficult to decide what that proportion should be; and, on this side of Utopia, it will be convenient—and policy—to treat the claims as equal.

The surplus, then, should be divided between the ordinary shareholders and the employés in proportion to their respective holdings, remembering that they are all capitalists. The total holding of the ordinary shareholders is £125,000; that of the employés is £1,000,000, based on the previously assumed pay roll of £80,000 per annum. The shareholders, therefore, should get one-ninth of the surplus (or £1,666), and the employés the remaining eight-ninths. In other words, the shareholders get an extra $1\frac{1}{3}$ per cent. on their capital, and the employés get $1\frac{1}{3}$ per cent. on theirs; the former in consideration of their "risk," and the latter on account of their efficiency. So that our old friend, Brown, whose capital holding we calculated to be £2,500, would get at the end of the year an extra dividend of £33 odd. No great sum, indeed, but an increase of one-sixth of his income.

In the same way, the office boy would get £4 6s. 8d. extra; the £500 a year manager £83 odd; and the managing director at £1,500 a year, something like £250, in addition, of course, to his dividends as an ordinary shareholder.

It will be seen that no employé, from high to low, gets a sum which could be called an exaggerated remuneration for his super-normal efficiency. But it is more than capitalist employers have hitherto been willing to offer; and it has the great merit that it is not a *limited* sum. The limit being removed, there is a real inducement to the employé to do his utmost to increase the next year's profits, and his resultant extra dividend.

If, for example, the surplus be sufficient normally to pay 40 per cent. on the ordinary shares (and such

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dividends are not rare nowadays), each member of the firm would get an extra dividend of 3 5/9 per cent. on his capital holding. The ordinary shareholders would thus get 11 5/9 per cent. on their money; and the employés would find their annual earnings increased by about 45 per cent. The advantage to them increases rapidly as the profits increase beyond the point necessary to pay the standard rate of interest all round.

High rates of profits would be commoner under such a system of unlimited incentive than they are now. Under the half-hearted co-partnership or bonus schemes so far put forward, with small and uncertain rewards, strictly limited, the employé—more especially the workman—feels, even though he does not consciously express his feeling, that it pays him better to spin out his job, and get the extra money so earned, than to finish it quickly on the problematical chance of sharing in a microscopic bonus which, at the best, cannot exceed a certain low limit.

Remove this limit; let him realise that he is a shareholder with every right that the ordinary shareholder has of participation in the profits, and you give him the incentive hitherto lacking to increase his output, and so increase the profits of which he will receive his fair share.

And national reconstruction will become a tangible reality, instead of a vision obscured by the nightmare of class jealousy.

Of course, such a scheme as here outlined depends for its fair working on a just assessment of each man's capital value, which, in turn, means fair wages and salaries. There would be a natural tendency on the part of employers to underpay their staff; partly on the ground that their pay would be made up to normal by their extra annual dividend, but principally in order that their capital value might be underestimated to the benefit of the ordinary shareholders.

So far as the workmen are concerned, the danger is not a great one. They have their trade unions to protect their interests and fix their standard rates of pay. The clerical staff, however, have no such organisation, and they would be the most likely victims of unscrupulous employers, more particularly in the higher grades.

On the other hand, there are opportunities of injustice in the opposite sense, in the case of managing directors and others, who have been known to receive salaries and fees out of all proportion to the value of their services.

However, there would be an easy means of checking such irregularities, and one which is a natural development of the principle that every employé is also a shareholder. As such, he is entitled to a voice in the control of the company, and that in proportion to his holding. It would, therefore, be a predominant voice (in the majority of industrial concerns), and that being so, employés would naturally elect directors who would safeguard their interests. They would thus have a direct control over the amounts paid to themselves and their fellow members on the staff.

However, the correlated question of the participation of the employés in control is outside the scope of the present article, which is primarily concerned with their participation in the profits.

Such a scheme as that outlined above is unfortunately likely to prove neither grateful to employers and capitalists, nor acceptable to organised labour. Labour will look with the suspicion engendered of past experience on any scheme that seeks to increase the output of the workers on whatever specious pretext. They will look askance on the gifts of the Greeks, and will need much convincing that that increased output will primarily benefit the workers. They will sniff, too, at the idea of co-operating with directors and managers; and will be very indifferent to the claims of the clerical staff to advantages equal to those of the manual workers. And they will say the scheme does not go far enough; why allow an equal share—why any share—to the capitalist? But until we can reintroduce the golden age of barter, money is a tool as essential to labour as the lathe in an engineer's shop, and Labour must be prepared to pay the fair price for its use. It is simply a matter of justice, to which even a capitalist is entitled; and, on lower grounds, of policy.

The capitalist, on the other hand, will say the scheme goes too far. The men will earn too much money—awful thought!—and the shareholders too little. To upset the ancient fetish of the supremacy of money; to put the value of brains, and character, and skill, on an equal footing with it, will be to invite financial disaster. To admit as a right what they have hitherto grudged as a favour—full co-partnership; and to submit to the corollary, employés' co-operation in the management, will be to them as revolutionary as, a hundred years ago, the claim of the common people to a share in the government of the country must have seemed to the squirearchy of those days.

But this revolution, like that, will as certainly come in the natural development of free thought. Better to co-operate willingly in the inevitable, than to be forced to accept it in its harshest aspects.

Again, acceptance of the principle of such a scheme, though to the man of money it may appear to involve the reversal of all his privileges, and the loss of a large part of his easy earnings, will find its compensation in added security, increased output, and greater national wealth. True, the individual capitalist would never again have his disproportionate share of it; but better an equal share than no share at all, which may be his lot if he continues his opposition till triumphant Labour dictates it. And there is such a thing as altruism . . . though, to be sure, 'tis a quaint word to use to a shareholder!

And there is justice. No sophistries or special pleading can discount the justice of the employés' case, as here set forth; no opposition prevent it from ultimately prevailing. *Fiat justitia, ruat coelum.* Let justice be done, though all the little heaven of the men of money crash about their ears!

HINTS ON TENDERING.

By "INTERESTED."

How peculiar are some of the manners adopted by business firms when tendering! Looking through a batch of tenders received, the first impression from one cursory glance perhaps creates in the mind visions of a huge factory and workshops with hundreds of employés, and then one "comes to earth," as it were, by reading that delivery cannot be guaranteed until, say, a month later than the time stated in most of the other offers, and no explanatory note is enclosed giving any excuse or reason for the lengthy time required before being able to execute the work. In another instance, there is one which sticks hard and fast to the exact letter of the printed contract form, with but a curt note submitting the tender; nothing further is offered, although one part, or one schedule, is omitted and not quoted.

Again, an estimate will arrive offering all manner of goods except those required, and enclosures proceed at considerable length to explain details of the goods or jobs not desired.

At various times it has fallen to my lot to report upon batches of tenders received for many different lines of engineering goods reaching most branches of the trade, and a few suggestions may afford some guidance to persons interested.

First, if you cannot supply that for which the inquirer asks, say so without hesitation, and politely invite from him another inquiry at a later date should any business be likely to result. By that I do not mean that no alternative offer should be made for a different make of goods, other than that suggested in the specification or, in certain circumstances, with a slight difference in size, pattern or type.

Secondly, state clearly on both form of tender and covering

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letter what extras are included, and do not leave to the prospective customer what often amounts to a vexatious trouble—searching out the sum of those items.

Again, the delivery date should be definitely stated, or else properly qualified reasons should be given, together with an estimate, for any probable delays.

When an inquiry includes certain labour for erection and setting to work, particular attention should be paid to any "fair wages" clauses and, before quoting, details of wages in force in that particular locality in which the work is to be undertaken should be ascertained.

In those circumstances where it is necessary to quote sums fluctuating according to the metal market, the tenderer should see that the basis figure is distinctly shown, and that the percentage, or sum to be added (or deducted) against the rise or fall in market prices of each metal, is given and not grouped. Such grouping sometimes works out to the detriment of the contractor, and not always against the customer.

When dealing with public authorities, it should be remembered that the time and date given as "not later than—" is strictly adhered to, as five minutes late generally ensures the quotation being marked "Received too late for consideration." That is the customary practice, notwithstanding a special explanatory note accompanying the tender, and an assurance given that the offer will be placed before the Committee. The tender is duly brought to Committee, but is not considered.

Alternative offers usually receive consideration provided they have not the effect of materially altering plans already decided upon.

Quite a good plan is to follow up the tender by a representative call, not, however, without first writing and inquiring if the proposed call is convenient, and giving as the reason a desire to explain more fully certain details incorporated in the offer submitted.

There are many real live business houses that have no need for suggestions such as these, but even at the present time many examples arise of those things being done which ought not to have been done, and estimates, quotations or tenders in such cases are just waste of good time and paper.

Finally, prompt attention and just consideration to the wants of a prospective customer usually bring in return fair and proper consideration.

THE STABILISATION OF SHIPS BY MEANS OF GYROSCOPES.

By P. R. JACKSON.

(*Abstract of paper read before the* Institution of Naval Architects.)

The present paper describes some recent developments which demonstrate the practicability of theories previously discussed by the members of this Institution.

The simplest wave system is a long ocean swell such as is encountered in deep water after a gale, and the profile of such a system of waves probably very closely approaches a sine curve. Actual wave formations as met with in rough weather, however, do not conform to this profile, because the period does not remain constant for any length of time. In a confused sea rapid changes in phase of the waves occur, due to several wave systems being imposed on one another.

In order to obtain definite data an instrument was constructed to draw a curve of the actual oscillations of a vessel when rolling freely under wave impulses. If we examine one of these diagrams (fig. 1) we see that the roll gradually increases by comparatively small successive increments, then dies down again, and almost immediately commences to build up again. These times of increasing roll represent the state of affairs when the period of the wave impulses approaches the natural period of oscillation of the ship, and is in phase with the ship's oscillations; when the impulses become markedly out of phase with the ship's roll the amplitude is reduced.

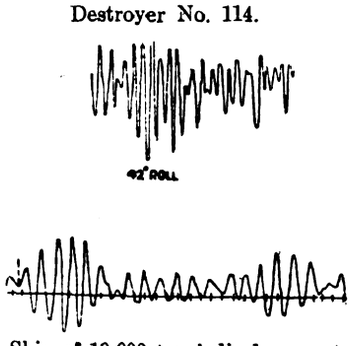

Fig. 1.—Natural Roll of Vessel.

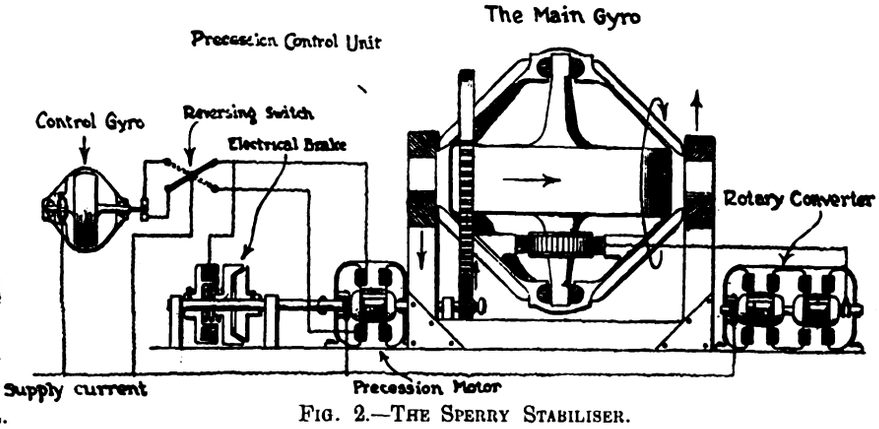

Fig. 2.—The Sperry Stabiliser.

About 25 years ago Sir John I. Thornycroft stated before this Institution that in his opinion ships could be prevented from rolling by means of forces which would neutralise the wave impulses, as distinct from attempts to destroy or reduce the rolling motion of the ship after it had obtained angular momentum. In the system under consideration Mr. E. A. Sperry has worked along these lines, and has produced a machine capable of opposing the roll-producing couples by a series of equal and opposite couples and with practically no lag between the roll-producing couple and the opposing stabilising couple. The magnitude of the forces which have to be impressed on the vessel are comparatively small, amounting only to the magnitude of the impulse received from a single wave as shown in the rolling diagrams. By thus preventing the roll from building up, the vessel is maintained within 2 deg. of the vertical.

Fig. 2 illustrates the system in diagrammatic form. The main stabilising gyro is shown with its spinning axis vertical, and so mounted that it can be precessed in the plane at right angles to the paper by means of the circular rack engaging with the pinion of the precession motor. The directions of spin, precession, and resulting couple are shown by the arrows. At the side of the diagram appears a small gyroscope with its spinning axis horizontal. This gyro is so mounted that the slightest acceleration of the vessel in the rolling plane will cause it to precess and close an electrical contact, which by means of suitable relay switches operates the main precession motor, and thus causes a stabilising couple to be applied to the vessel just sufficient to neutralise the impulse which was causing the angular acceleration in the rolling plane. Immediately this acceleration ceases, the control gyro stops the precession motor, and is ready to deal with the next wave impulse.

It is obvious that all gyroscopes sufficiently large effectively to stabilise a vessel must have considerable gyroscopical inertia. It is for this reason that the method of control is so important, as by its great sensitiveness it enables the wave impulses to be dealt with before the vessel has attained any considerable angular momentum, the precession motor overcoming the gyroscopical inertia and so keeping the stabilising couples in phase with the wave impulses

The stabilising gyro system may consist of one or two gyroscopes, according to the power required. If one gyro only is used, it is placed with its spinning axis vertical and mounted so that it can precess in the fore-and-aft plane of the vessel. If two gyros are employed, their spinning axes are placed horizontal, but the direction of spin of one gyro is opposite to that of the other. The precession plane is also horizontal, but the gyros are precessed in opposite directions, so that the stabilising couples act in the same direction.

The stabilising gyros are designed to apply a roll-quenching

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couple sufficient to suppress the greatest single increment of roll that the waves would produce under conditions of free rolling. The precession velocity of the gyroscope is in practice made about 10 per cent. greater than the rolling velocity of the ship, and the maximum precession angle of the gyro is fixed at from 60 deg. to 70 deg. each side of the centre position. When stabilising a vessel against wave impulses which are just equal to its capacity, the stabilising gyro makes one complete movement in the precession plane from, say, 60 deg. on one side of the central position to 60 deg. on the other side in 9/10 of the vessel's natural half-period, although the vessel will not move more than 2 deg. from the vertical.

The intensity of the stabilising couple is proportional to the velocity of precession, and since the rate and direction of precession are always completely under control and capable of almost instantaneous reversal, we have a source of energy by means of which we can either apply a regular sinuous couple in the exact rolling period of the vessel, or an irregular series of stabilising moments, as may be required in order to counteract the roll-producing forces of the waves.

For a 10,000-ton steamer two cast-steel wheels were used, each 9 ft. in diameter, and each weighing about 25 tons. The wheels must be accurately machined all over and accurately balanced both statically and dynamically, which is done by means of balancing plugs. The rotor disk is not pierced in the centre, but is attached to its shaft stubs by means of collar studs. One of the shaft stubs carries the rotor of a three-phase A.C. motor for spinning the wheel, the stator being attached to the gyro casing. The peripheral speed of the wheels is about 500 ft. per second, and in order to reduce the driving power the wheels run in a partial vacuum.

Fig. 3, showing the two stabilising gyros being put on board the vessel and the precession bearings on the top of the gyro casings, illustrates the relative size of the ship and the stabiliser.

Fig. 4 is an autographic record of the behaviour of a vessel fitted with a stabiliser. First we see the roll when the vessel is allowed to oscillate freely, amounting to 22 deg.; the stabiliser is put into operation, and almost at once the vessel settles down to an amplitude of about 2 deg. As soon as the stabiliser is cut out up goes the roll again—in one instance to 31 deg., which the stabiliser promptly reduces to 3 deg.

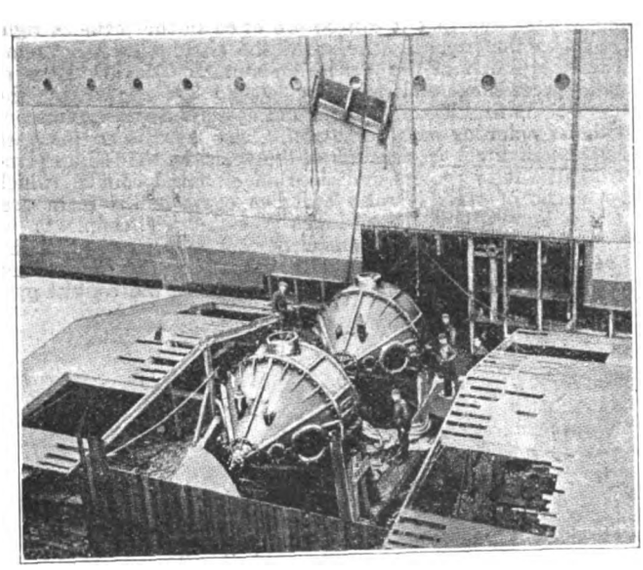

Fig. 3.—Stabiliser for a 10,000-ton Steamer.

The total weight of equipment necessary for a normal type of vessel amounts to only about 1 per cent. of the displacement.

By throwing over a switch the stabiliser can be made to roll the ship as shown in fig. 5. When a roll of about 10 deg. has been obtained in still water, the precession motor is stopped, and the natural frictional extinction curve of the vessel is obtained. By again rolling the vessel to 10 deg. and then reversing the precession motor and stabilising the vessel, we see the vessel brought to rest in one complete period.

By means of this test the actual roll-quenching power of the equipment can be obtained. This roll-quenching capacity is the number of degrees of roll quenched by the stabiliser per half period minus the number of degrees per half period shown on the natural extinction curve.

The advantages of stabilising a ship are many. It has been suggested that seas would break over the vessel; exactly the reverse is the case, the vessel becoming dry and much more seaworthy, simply because she never has any angular velocity to be destroyed when meeting a wave, and consequently merely rises and falls on the waves as they pass under her. When stabilised a vessel will make almost as good speed in rough weather as in calm, and will steer with very little helm because the yawing which always accompanies rolling is entirely eliminated. It is of course quite unnecessary to fit bilge keels to a stabilised vessel, with a consequent saving of as much as 6 per cent. of the total propulsive power of the ship.

The primary object of stabilisation, however, is not the reduction of the necessary propulsive power for a given speed, but the elimination of rolling *per se*. The steadier a ship is the better she is, and in the case of passenger vessels, naval vessels, and those ships which carry live stock, the advantage of being able to maintain the vessel practically on an even keel under all conditions is enormous.

The Sperry system has proved entirely practical and successful in operation. Installations in actual use ranging from

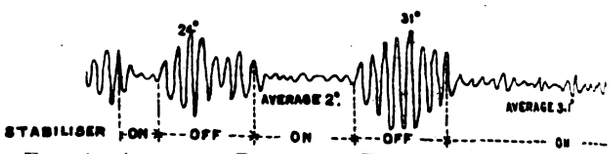

Fig. 4.—Automatic Record of Rolling with and without Stabiliser (S.Y. "Aramis").

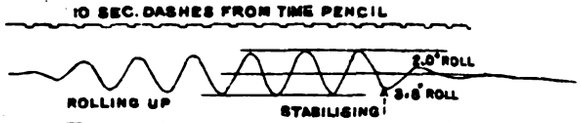

Fig. 5.—Rolling a Vessel with the Stabiliser.

vessels of 150 tons' displacement to 10,000 tons have demonstrated that this system is no longer in the category of an experiment, but that with a very moderate weight of equipment a vessel may be maintained within 2 deg. of the vertical, the power necessary for operating the equipment being a mere fraction of the energy dissipated by the extra resistance caused by the free rolling of the ship under the action of the waves.

ELECTRICITY AND AGRICULTURE.

The recently-published Report of the Departmental Committee of the Ministry of Agriculture and Fisheries on Agricultural Machinery (Cmd. 506) includes statements by Mr. J. F. Crowley, D.Sc., B.A., M.I.E.E., and Mr. T. Smith, A.M.I.E.E. The former drew attention to the possibilities of using electric power in agriculture, particularly in connection with the cultivation of the land. The advantages claimed for the use of electricity in agriculture, where motors and accessories were designed for the work they had to do, and the most suitable types were chosen, were as follows:—

Simplicity in design; first cost low; no expensive foundations required; motors readily started; greater portability; very little power absorbed when running idle; large overhead capacity to deal with fluctuating loads; small wear and tear; little care required in running beyond lubrication, and even turning torque and freedom from reciprocating movement and its accompanying shocks.

Dr. Crowley said that the German farmer before the war had at his disposal electrical material designed especially to meet his conditions. Several of the larger electrical manufacturing firms in Germany designed and manufactured ploughs suitable for working with the electrical apparatus they supplied. The development in Germany followed upon the erection of generating stations of considerable size. The development of electric ploughing and other work in agricultural districts helped the generating stations distributing in rural areas to maintain an even distribution of their load throughout the year. This enabled the central stations to develop and supply energy at a cheap rate. While attempts had been made to construct electric agricultural tractors, these had not yet passed the experimental stage, and had not been very successful; cable ploughing by two stationary motors or a stationary motor and winch had, however, had a very considerable measure of success on the Continent. Dr. Crowley said that the extent to which electricity could be used for ploughing and other farm work (apart from lighting and driving small stationary machines) depended almost entirely upon the erection of central power stations and the construction of a network of transmission lines. Electricity could, however, be employed only within a comparatively short distance of the transmission lines—a belt of five miles would probably represent the limit of efficient service—but subject to this limitation the method was a feasible one. He agreed that German statistics, and particularly pre-war statistics, could not be applied to this country, but he urged that there was a *primâ facie* case for investigation. The question was one of comparative cost, and it was necessary, before a decision could be made, to investigate all the factors as they applied in the United Kingdom.

Mr. Smith, who submitted written information and who has had 25 years' experience of the development of water

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power and the application of electricity to farming, said that so far as the needs of the agricultural and rural community were concerned, electrical energy would be required mainly for operating farm machinery, corn-grinding mills, wood-working mills, and for lighting purposes. Closely connected with the farm industry was that of large creameries, small textile factories, seed dressing mills, together with heating and cooking by electricity. The demand for power on the farm was continually increasing. The difficulties in the way of a scheme the development of water power might not be be summarised as follows: (*a*) The unsuitability of existing laws regarding the uses of water; (*b*) the uncertainty as to whether the owner would secure compensation for the outlay on the plant on termination of tenancy; (*c*) the power given to adjoining riparian owners and "down stream" users to prevent others from altering in any way the flow of water in its ordinary channel.

Mr. Smith suggested that the State should take development work under its immediate control, as in the early stages of a scheme the development of water power might not be a paying proposition. Any scheme of work would involve at the outset comparatively heavy capital expenditure, towards the repayment of which the revenue during the first few years' operation would in all probability prove inadequate. It would be necessary ultimately to control water courses so that the properties of the streams could be utilised in the most efficient manner.

He also suggested that action by the State might be somewhat on the following lines: (*a*) Amending existing laws in their relation to the use of water, keeping in view the idea that its energy-producing properties should be utilised to the full as well as its irrigational properties; (*b*) taking over all sources of water, and assuming control from the mountain to the sea. Where energy was being wasted, the right for its development should be taken over or leased; (*c*) assisting in the development of power schemes by giving advice, preparing plans, supplying capital if necessary, and even installing the plant on a system of hire purchase; (*d*) making it compulsory to develop all sources of available power.

Mr. John Allen, O.B.E., Governing Director of the Oxford Steam Plough Co., Ltd., asked as to the possible application of electricity to cable ploughing in this country, said he was aware that in Germany electrical cable ploughing was successfully undertaken on farms specially laid out for the purpose, where the same land had to be so ploughed every year, but in this country, where the same field required steam ploughing usually only every four years, the application of electricity for the purpose would only be practicable if there were a development of large power houses and transmission systems all over the country.

Mr. J. Nugent Harris said he had made inquiries in both Denmark and Sweden, and he found that while the belligerent countries were occupied with the war, Scandinavian countries were equally busily occupied in developing their latent and other resources, as well as considering their available sources of energy. Sweden and Norway possessed an abundant source of energy in their water power. The respective Governments realised that by harnessing this power and developing electrical energy they would not alone benefit industries, but might revolutionise the most important industry of all—agriculture—and go far to solve the labour problem. At present Sweden possessed three great State hydroelectric stations, at Trollhätten, Porjus, and Alfkarleby, which jointly developed about one-third of the electrical energy of the kingdom. There were also three limited companies developing electrical energy. Electric power was transmitted by the State generating stations to Denmark, and this, being derived from water-power, was cheaper than the electricity developed in Denmark itself, which was produced (in the absence of water-power) from coal, peat, wood, sawdust, &c. In rural Denmark electricity was produced and distributed mainly on the co-operative system. As a result of the remarkable developments in the production of electrical energy, both Denmark and Sweden were rapidly being covered with a network of wires, and it seemed probable that before long practically every estate and farm in those countries would be supplied with electric power. Apart from the considerable reduction in manual labour brought about in connection with such operations as threshing, chaff and root cutting, elevating, pumping, &c., the provision of electric power had a great influence on the comfort and well being of the farm workers, and in inducing them to remain on the farms. Mr. Harris referred specifically to a visit he had made to a farm of 800 acres in the province of Sudermansland, in Sweden. On this farm practically every machine, except those used for cultivation, was electrically driven. The farmer stated that previous to the electrification of the farms he had to employ for his threshing operations five pairs of horses, 16 men and four boys, whereas under the electrified system, for the same work, he employed one horse, seven men and two boys. To this he added the enhanced value of the product, due to the smoother working of the electrical machinery, and he estimated a total saving of £5 a day on this farm in respect of the threshing operations. Further, it was possible to thresh much earlier, thus obtaining an enhanced price for seed corn and avoiding injury to the stack by rats and mice. The farmer estimated the cost of the whole electrical plant on his farm at about £1,250, and he was convinced that, even with the high prices prevailing when it was installed, the plant not only yielded interest on the outlay, but would in about 15 or 20 years pay for itself. Mr. Harris had visited one of the co-operative supply stations in Denmark, and was informed that it was being tapped by about 3,000 farmers, besides shopkeepers and others, and that the demand was so great that another station of greater capacity was being erected.

Mr. Jones-Davies, J.P., suggested that the possibilities of harnessing water-power to generate electricity on the farms should be explored. He had been struck very forcibly by the large amount of power which was being wasted in the Welsh streams.

Mr. J. R. Bond, B.Sc., pointed out a similar waste of power in Derbyshire.

The Committee includes among its recommendations one that the Ministry of Agriculture should further consider the question of the application of electricity to agricultural operations, including the working of light railways and the lighting of villages and farmsteads.

POWER FROM BLAST FURNACE GAS.

At Newcastle-on-Tyne, on March 22nd, Mr. S. H. Fowles's paper (an abstract of which appeared in our issue of March 26th) was read and discussed before the North-Eastern Centre of the Institution of Electrical Engineers.

Mr. A. P. Pyne opened the discussion, and said the author's figures might err on the optimistic side a little, but his main contentions were absolutely correct. He supported the author's paper by supplementary remarks, somewhat coloured by the discussion that had recently taken place in London. He found, for instance, that an impression existed in the minds of more than one speaker that blast-furnace gas was being made good use of in this country; that the iron masters were fully alive to the advantages of properly employing the waste gases, and that they had no surplus available for outside purposes. It was one thing to be alive to the value of a product, however, and quite another to utilise it properly when to do so many problems had to be solved, and when considerable capital outlay was involved. The fact remained that a considerable source of power had been largely wasted in the past, and they had had to rely on the Germans to show them how to utilise it efficiently. The advantages to be derived from cleaning the gas were always considerable, and sometimes enormous, and the cleaner the gas the better. When clean gas was used a large surplus was available for purposes other than at the blast furnaces. He pointed out that in the case of the power station described by Mr. Fowles, the total power needs of a large steel works, shipyard, engine works, boiler works, and several other establishments were supplied, and a considerable surplus remained available. The gas not required by the blast furnaces could be used for generating electricity either by means of steam boilers and turbo-generators or directly by gas engine generators. Given the right plant, the gas engine proposition was equally as reliable as was the steam proposition. Steam plant was lower in first cost than was the gas engine plant, but having regard to the greater economy of the latter its adoption was fully justified provided suitable up-to-date plant was installed. Neither gas engines nor gas cleaning plant had reached finality, and the developments stopped by the war would in all probability be resumed. Exhaust gases might be used for providing the steam in the preheaters of the Halberg-Beth plant or driving steam turbo-pumps for the scavenging plant. Other economies of a similar character remained to be investigated. With regard to gas-cleaning plant great scope existed for developments. The electro-static plant had not in this country proved itself superior to the filter plant. There was also the Swartz disintegrator plant, of the wet type, which showed promising results, combined with reliability and simplicity, but did not lend itself to potash recovery. A very simple process seemed to be meeting with success in America—the Kling Weidner system, which was dry, and involved no loss by sensible heat. Gas blowing engines for some blast furnaces had frequently to run for considerable periods at from half to three-quarters load. For this purpose the 2-cycle engine possessed advantages over the 4-cycle, inasmuch as the use of scavenging plant with separate gas and air pumps resulted in higher efficiency and better control at the lower speeds than was the case with the 4-cycle engine.

Mr. Waites welcomed the paper as being especially interesting to those concerned with the generator side of the question. He referred to the 30 per cent. efficiency of the engine, and questioned whether it compared favourably with the turbine.

Mr. Hewson said he viewed the matter from the point of a blast-furnace engineer. Hitherto all the gases leaving the blast furnace had been utilised—or wasted—on the blast furnace and auxiliary plant, and what was used was mostly wastefully used. When it was remembered that there were 300 blast furnaces in this country in operation, it was easily seen what a serious loss of fuel there was going on, whereas if they took the heat energy from the furnace top there would be 7½ million tons of coke available for other purposes. He thought all concerned—the gas engineer and the elec-

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trician—should work together for the general good in the utilisation of that waste heat and power. He explained that stoves could work at a higher temperature with clean gas than with dirty gas.

Mr. Rosen said the paper seemed to have been written from the gas engine point of view, and he asked if turbines had been considered for use with gas. The question of floor space in a power station seemed a serious matter. He thought some of the figures of cost were higher than would be the case if a turbine were installed.

Mr. Heslop also spoke in favour of the turbine as being more economical; the standing charges for gas would be very much higher. The cost of the gas plant was put down at £165,000, that of the turbine he put at £37,000. The capital charges at 15 per cent. for the gas engine were £24,750; that was equal to 0.17d. per unit; the capital charges for the turbine at 12 per cent. were £4,400 or 0.03d. per unit.

Mr. Fowles, in reply, said it was not a question of ranging the gas engine against the turbine, but it was a question of having the whole important matter thoroughly discussed by all parties interested.

REVIEWS.

Principles of Transformer Design, by Alfred Still. Pp. xii +216; 67 figs. London: Chapman & Hall, Ltd. Price 10s. 6d. net.

It is always a pleasure to make acquaintance with a new book by Prof. Still. His writings have a character of their own, and have none of the flavour of compilations based on other people's ideas which attaches to many modern text-books, especially those which cover a wide ground in the field of electrical engineering practice. Prof. Still always seems to approach his subject in an original way, which he has thought out for himself and has reduced to the simplest terms of logical reasoning; he never allows conventional rules or subsidiary matters of any kind to obscure the essential and fundamental principles governing the matter under discussion.

The routine work of the designer of standard types of electrical machinery is generally so largely based on sets of formulæ and rules and reference to tables of data obtained from previous experience that it is apt to become conventionalised and more or less stereotyped. As a consequence, rules of procedure are often followed because they have become habitual and are found to lead to satisfactory results within the range of machines with which the designer is concerned.

In this way it is only natural that many young workers in the designing office get into the habit of using rules and formulæ without troubling themselves to understand—or at least to keep in mind—the fundamental principles which underlie the rules they are constantly using. Obviously, this may lead to unfortunate results when some case arises where the conditions are no longer those of the assumed standard practice, and, in any case, the young designer who slips into such habits is not likely to be in a position to suggest improvements or economies in the machinery with which he deals.

It is somewhat in consonance with the practice to which we have been referring that a number of books have appeared containing rules and tables of data which seem to the inexperienced youth to contain all that is necessary to enable him to prepare designs for any standard type of machine for which he may be asked. When, as is often the case, the full reasons and theoretical considerations underlying the data and formulæ are not given, it is evident that the young engineer may be greatly deceived in his confident use of the results. Such books may, of course, be of the utmost value to the experienced designer, but to him alone.

On the other hand, there is a type of text-book which, while professing to be a book on design, is, in fact, mainly a discussion of the theoretical principles on which design should be based without a full and detailed treatment of the practical matters which would enable the student to carry out an actual design of a machine capable of meeting the actualities of commercial use.

Prof. Still seems to have hit the happy mean between these two extreme types, and has produced a book which, while dealing clearly and thoroughly with principles, does not pass over the practical matters which need to be dealt with when designing a transformer which is not to be merely a college exercise but is to be capable of working efficiently under the conditions of real life.

The book is written primarily for the advanced college student, but we have no hesitation in saying that many a young engineer engaged in practical work as a designer will find a great deal in it which will help him in his work, and make him a better designer.

Turning to a more detailed description of the contents of the book, the first chapter contains a clear summary of the elementary theory of the simple transformer, and gives an outline of the construction of the main types, with a calculation of the mechanical stresses set up in the windings and clear diagrams of the methods adopted for giving the coils adequate support.

Chapter II deals with insulation, and summarises the most important principles of this difficult subject in such a simple and logical way as to give an excellent insight into the problems of designing the insulation of windings and terminal bushes. References to more specialised publications enable the student to seek further information on special points, but as a clear presentation of the main principles of insulation design this chapter is quite admirable. Beginning with the conception of the dielectric circuit, the author proceeds to apply the principle to the simple condenser and condensers in series, later on showing how the various forms of insulator used in practice are to be studied in the light of the theory thus discussed. The results obtained by the consideration of these fundamental principles, together with the estimation of surface leakage, are later on applied to the calculation of various forms of terminal bushing. Practical rules are given for the insulation of transformer windings and the clearances necessary in air and with oil immersion.

In Chapter III, devoted to the efficiency and heating of transformers, we have first the usual calculations of efficiency and losses, with some useful curves and figures obtained from actual practice and then a careful and detailed treatment of the flow of heat in the transformer, cooling medium and case, with the various methods adopted for cooling and constants or curves given for such practical matters as the effective radiating surface of corrugated wrought-iron cases with various forms of corrugation.

Chapter IV deals with magnetic leakage, reactance and the determination of regulation. There is perhaps less scope for originality of treatment here, but the chapter is quite worthy of the standard set by the rest of the volume.

The next chapter contains a description of the procedure to be adopted in carrying out an actual design, and includes the calculations for a 1,500-k.v.a. single-phase transformer, with detailed specification and a complete tabulated design sheet drawn up in a useful form with full description of the methods used for obtaining all the constants and data enumerated on the sheet.

The final chapter discusses transformers designed for special purposes, *e.g.*, for very large currents at low pressure, constant current transformers, instrument transformers, auto-transformers and induction regulators.

Unfortunately there is no discussion of the important subject of costs—a matter which is often of special significance in connection with transformer design, even when we use the term "design" in its most restricted sense. The financial aspect is, of course, the determining factor in the adoption of transforming devices with regard to type, capacity and location when the "design" of schemes is being approached in the broader sense.

In conclusion, the reviewer can cordially recommend this little book to all students and young electrical engineers who are at all interested in the subject of transformer design. Few of those who read it will fail to gain fresh information and clearer insight into the subject from a study of its pages. Its perusal is made the more pleasurable by the excellence of the diagrams, drawings and letter-press, while the two indices and the list of symbols employed add much to its value for purposes of reference. C.F.S.

Automobile Batteries. By H. H. U. Cross. Pp. v + 101; 24 figs. London: E. & F. N. Spon, Ltd. Price 4s. net.

The author of this interesting little volume leads off with the undeniable statement that "the modern motor-car is becoming more 'electric' every day." Since this electrical equipment always includes a battery which is generally the least understood and most severely tried portion of the whole car, there is no doubt that practical information such as is contained in the volume under review is badly needed. The book contains 100 pages divided into five chapters, and a short appendix of technical terms, &c., the sub-title being, "A practical handbook on the construction, charging, repair, and maintenance of ignition, starting, lighting, and electric vehicle batteries: 'dry,' lead, and alkaline types." On the whole, this rather ambitious field is fairly well covered as far as it can be in a book of the size, although very little is said of the special problems relating to electric vehicle batteries, about which alone a whole volume could be filled.

Chapter 1 deals mainly with the primary battery in its 'dry' form as used a good deal in America as a stand-by for the ignition system, though not much in evidence in England. A recent contributor to the Electrical Review remarked that on his car, an American, the reserve battery of five dry cells had dried up three years ago (literally "dry" cells in this case), and as it was never required, he removed it and its wiring bodily; and a similar fate probably attends many other spare dry batteries. However, the action of the primary cell is interesting, and is useful to know in so far as it forms the basis of the action of the secondary battery. This action is well explained, and a good deal of practical information given as to the use, testing, and capabilities of dry batteries under various conditions. Some actual figures showing the internal resistance of dry batteries in various sizes might have been included for the sake of comparison with corresponding figures relating to secondary batteries.

Chapter 2, on the lead storage battery, contains clear information on the principles, theory, and construction of this type, all of which is useful. A table is given from a manufacturer's catalogue showing the enormous currents that are momentarily

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called for from the battery at starting, but no discharge curves are reproduced to indicate the discharge from automobile batteries under various conditions of load. A reference might have been made to the "block" form of construction.

Chapter 3 relates to charging batteries, not under running conditions on the car, but separate charging in the garage or otherwise. Full instructions are given for this, as to the first and subsequent charges, mixing acid, testing, &c. The different methods of charging from dynamos, from primary batteries, and from house mains are also discussed. Charging from alternating current supplies is also mentioned, and various rectifiers described, though the kind most commonly used, the Nodon valve, is only dealt with in a short paragraph.

Chapter 4 is devoted to the repair of lead batteries, and this subject is dealt with very fully. Detailed instructions are given for the repair of all parts of the cell, the treatment of sulphated plates, &c., and the fitting of new plates into a cell.

In chapter 5 an interesting and instructive account is given of the alkaline battery, both the American Edison and the Swedish NI-FE types being referred to. The theory and construction are explained, and general notes given on the subject. In the comparison of the two batteries, acid and alkaline, one statement given is open to misapprehension. It is stated that the alkaline type has "double the capacity weight for weight." The author doubtless means capacity in ampere-hours only, but if watt-hours are taken for comparison, as they should be, the statement is by no means correct.

A few diagrams are given, and these are clear and well drawn, but a good many illustrations are from catalogue blocks, some being rather "back numbers," which tend to give the book a somewhat out-of-date appearance not justified by the text.

A few typographical errors occur, mostly unimportant, but "Nocton" for Nodon valve, on page 60, should have been corrected, and also the statement on page 98 that an accumulator is the synonym of a "strange" battery.

The comments given above are by no means intended to disparage the value of this book, which undoubtedly contains much valuable and badly-needed information, particularly to the student or to those undertaking repairs to batteries. It is clearly written, and the matter is well arranged; the type is easily read, so that the information can be assimilated without undue effort. It bears the stamp of being written by one having a practical and first-hand knowledge of his subject.

F. H. Hutton.

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

A Safety Hand Lamp.

Mr. George J. Duckett, of "Hillcrest," Oakbank Avenue, Moston, Manchester, has developed a new form of portable lamp designed to prevent unauthorised interference by introducing a locking arrangement so that the inside of the lamp cannot be got at by other than authorised persons.

The ring carrying the safety cage is notched on the threaded portion, and engaging with the notches is a catch A C, fig. 1. The catch is pivoted, the opposite end forming an armature A, and this in turn is held in such a position by the spring as to ensure that the catch A C is always in engagement with the notches in the safety cage ring.

It will be seen that it is impossible to unscrew the cage ring until the catch has been disengaged, and for this purpose an electro-magnet E M is employed.

The case of the lamp, which is of ferrous metal, forms one pole of the magnetic circuit, and in order to restrict the lines of force through the armature A the iron plug I P is surrounded by non-magnetic metal.

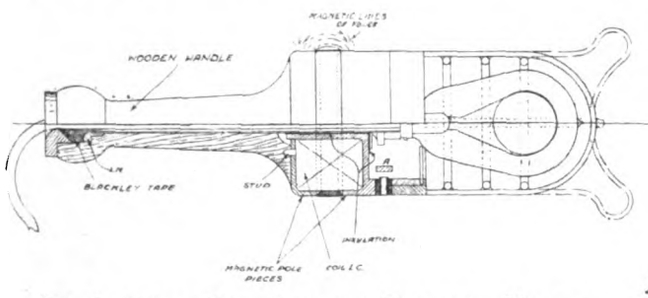

Fig. 1.—Safety Hand Lamp and Unlocking Magnet.

When the electromagnet is energised the lines of force are restricted, and are directed through the armature to the case of the lamp. As the armature is free to move it is drawn towards the iron plug, and the catch is withdrawn from the notches in the cage ring.

In order to facilitate quick repair or renewal of lamps in the workshop, the electrician in charge can carry about with him a small electro-magnet supplied with an adapter plug.

The body portion of the lamp has been constructed in the form of an electro-magnet, in order that the lamp may be placed near or against any magnetic material, and held in position, until forcibly pulled away by hand.

The holder is insulated from the metal portions of the lamp, which are held in position by the locking nut L N at the base of the handle.

In order to overcome any excessive pull on the terminals of the lamp the flexible jumper is locked by binding it round with adhesive tape, after which it is compressed by a locking nut.

A New Vibration Galvanometer.

A new form of vibration galvanometer is described in a recent scientific paper (No. 370) of the U.S. Bureau of Standards (fig. 2). In this device the electromagnet is placed outside the gap of the permanent magnet, but in a position in which an appreciable amount of flux from the latter passes through the cores of the former. The arrangement is the same in principle as earlier types, the chief difference in detail being the weaker field to which the core is subjected. The two principal advantages of putting the electro-magnet outside are: First, the instrument will be most sensitive when the core is working at the point of maximum differential permeability, and secondly, with low-frequency vibrators, which must be of very small diameter, the effect of a strong magnetic field upon the frequency of the vibrator introduces practical difficulties in tuning, since the magnetic forces combine with the elastic force to change the total restoring force, thus altering the frequency. The best results have been obtained with cores of sheet silicon transformer steel. The vibrator is mounted on a small soft steel base, and is held in place magnetically by merely placing the base on the face of the magnet. For convenience in changing vibrators for different frequencies, an aluminium wire handle is fixed in the base.

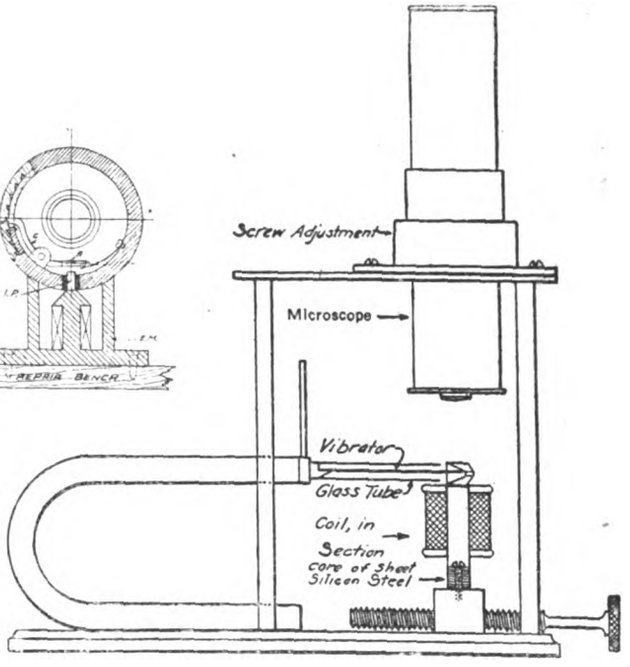

Fig. 2.—Vibration Galvanometer.

If the vibrator is polished and illuminated by a horizontal beam of light, a sharp line of light may be obtained in the microscope. Satisfactory readings may also be made by viewing the wire in the ordinary way.

The Woods Earthing Device.

A simple device for earthing pipes and lead-covered wires of all sizes has been put on the market by Messrs. Faulkner and Co., of 5, Market Street, Manchester. It consists of a strip of bare copper, with holes punched in it at 7/16-in. centres. By lapping the strip round a pipe and drawing it tight with a 3/16-in. bolt and nut, through the holes that serve best, with specially shaped washers, an excellent grip

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and a satisfactory contact are obtained with the minimum of trouble. The same strip may be clamped to any number of adjoining pipes, and serves also as a terminal to which an earthing wire can be clamped, any desired length being cut off the strip to suit the requirements.

A Loud-speaking Marine Telephone.

Among the latest manufactures of Messrs. Siemens Bros. & Co., Ltd., Palace Place Mansions, Kensington Court, W. 8, is a series of loud-speaking marine telephones, one of which is illustrated in fig. 3. This instrument is provided with a

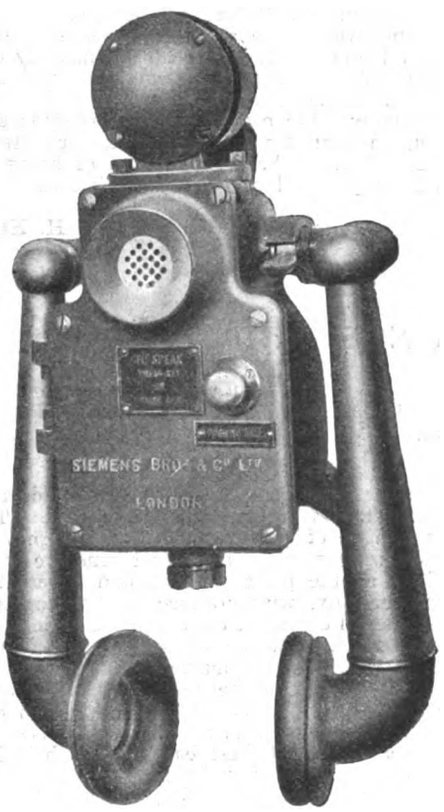

Fig. 3.—Loud-speaking Marine Telephone.

standard watertight capsule transmitter and two sound trumpet tubes. It is unnecessary to raise the tubes to obtain loud-speaking effects, but in particularly noisy situations the tubes, which are fitted with pneumatic rubber ear pads, can be raised to the ears to exclude external sounds.

NEW PATENTS APPLIED FOR, 1920.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. Sefton-Jones, O'Dell and Stephens, Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

9,590. "Electric lamps for motor cars, &c." F. Hanmer. April 6th.

9,612. "Carrier for electric-lamp, &c., shades, &c." A. P. Rutherford. April 6th.

9,616. "Eectrical resistance apparatus." C. J. Margerison and F. J. Shenton & Co. April 6th.

9,629. "Electric relays." M. D. Dimitrievitch. April 6th.

9,631. "Electrical change-over switch apparatus." T. Rabjohns and G. Vickery. April 6th.

9,647. "Telephone-call recorder." H. M. Stevenson. April 6th.

9,670. "Permanent magnets and permanent-magnet motors." S. I. Hitchcock. April 6th.

9,673. "Telephone systems." Automatic Telephone Manufacturing Co. April 6th. (United States, August 20th, 1919.)

9,679. "Fuses for electric currents." J. T. Callaway and R. F. Crouch. April 6th.

9,680. "Dynamo-electric systems for automobiles." British Lighting and Ignition Co. and E. O. Turner. April 6th.

9,681. "Electric switches, sockets, &c." H. J. Cash and G. Gorringe. April 6th.

9,686. "Electric furnaces." E. Assie. April 6th. (France, August 9th, 1917.)

9,687. "Electric welding." Wilson Welder & Metals Co. April 6th. (United States, April 22nd, 1919.)

9,693. "Adjustable standard for electric lamps." L. S. Hammarback. April 6th. (Sweden, April 4th, 1919.)

9,707. "Direct-current dynamo-electric machines." B. J. Shillito. April 7th.

9,708. "Step-by-step mechanism for electric motor starters." C. C. Garrard, A. H. Railing and W. Wilson. April 7th.

9,721. "Spark plugs." L. S. Flatau. April 7th.

9,742. "Electric lighting." W. Charles. April 7th.

9,750. "Automatic device for compensating for effects of temperature in electrical circuits." F. W. Curtis. April 7th.

9,763. "Electric measuring instrument." E. C. R. Marks. (Nagel Electric Co.) April 7th.

9,799. "Spark plugs." A. E. Watts. April 7th.

9,800. "Arrangements for transmission of electric currents by liquid conductors." F. Aigner and R. Erban. April 7th. (Austria, March 11th, 1919.)

9,801. "Magneto-electric couplings." R. Erban. April 7th. (Austria, March 13th, 1919.)

9,809. "Sparking plugs." T. B. Broad and S. J. Plummer. April 8th.

9,812. "Commutator for Ford cars and Fordson tractors." A. W. Fellows and W. A. Gardner. April 8th.

9,816. "Means for supporting porcelain, &c., electric-light fittings." G. P. Dennis. April 8th.

9,822. "Flexible pendant electric-light fittings." W. Broadbent. April 8th.

9,852. "Brush-lifting and short-circuiting means for induction motors." A. Parkinson. April 8th.

9,860. "Electrical generating systems." Industrial Research Corporation. April 8th. (United States, April 8th, 1919.)

9,861. "Electrical generating systems." Industrial Research Corporation. April 8th. (United States, April 28th, 1919.)

9,867. "Ventilating systems for dynamo-electric machines." British Thomson-Houston Co. (General Electric Co., U.S.A.) April 8th.

9,884. "Electric soldering apparatus." E. Martin. April 8th. (France, April 8th, 1919.)

9,899. "Combined electric switch and meter for motor-cycles, &c." Powell & Hanmer, W. A. Shepherd and E. F. Wilson. April 8th.

9,900. "Electrical cut-outs." Powell & Hanmer, W. A. Shepherd and E. F. Wilson. April 8th.

9,929. "Eectric heaters." J. K. Soden. April 9th.

9,950. "Heating chamber for removing necks of lamp bulbs, &c." P. V. Castell-Evans. April 9th.

9,963. "Electric motors of the unwound armature type." Barr & Stroud and J. W. French. April 9th.

9,968. "Sparking plugs." A. W. Armstrong. April 9th.

9,974. "Dynamo-electric machines." British Thomson-Houston Co. and F. P. Whitaker. April 9th.

9,997. "Electric furnaces." W. E. Moore. April 9th.

10,061. "Telegraph circuits." A. Orling and Orling's Telegraph Instruments Syndicate. April 10th.

10,063. "Alternating-current motors." F. Punga. April 10th. (Germany, March 26th, 1919.)

10,068. "Electrical measuring instruments of the moving-coil type." R. F. Hamilton, R. F. Hamilton & Co., F. S. J. Pile and H. Smith. April 10th.

10,105. "Electrical switching-apparatus." J. F. G. Hartmann. April 10th.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1917.

12,373. Electrically-driven gramophones. D. Branson. August 29th, 1917. (140,108.)

1918.

6,029. Sparking plugs. Clerget, Blin et Cie. January 19th, 1917. (116,265.)

14,106. Primary galvanic batteries with unalterable electrolyte. E. W. Jungner. September 4th, 1917. (118,843.)

14,458. Telephone apparatus. M. Latour. September 5th, 1917. (140,123.)

17,514. Telephonic apparatus. M. Latour. October 3rd, 1917. (Addition to 140,123.) (140,133.)

18,754. Dynamo-electric machines. British Thomson-Houston Co. and F. P. Whitaker. November 15th, 1918. (140,134.)

20,375. Electric muffle furnaces. A. Imbery. June 4th, 1919. (140,138.)

21,638. Group switching arrangement for automatic or semi-automatic telephone exchanges. C. A. W. Hultman. December 24th, 1917. (121,957.)

1919.

3,231. Electrodes for vacuum discharge devices. British Thomson-Houston Co. (General Electric Co.). February 10th, 1919. (140,166.)

3,808. Sparking plugs for internal-combustion engines. V. Bonde. February 15th, 1919. (140,172.)

4,214. Electric switches. J. A. Crabtree. February 20th, 1919. (140,179.)

4,215. Electric switches. J. A. Crabtree. February 20th, 1919. (140,180.)

4,219. Electric switches. J. A. Crabtree. February 20th, 1919. (140,181.)

4,221. Electrical switches. J. A. Crabtree. February 20th, 1919. (140,182.)

4,710. Electric motor cars. K. H. O. Lubeck. February 25th, 1918. (123,767.)

7,981. Machine for winding magneto-armatures, coils and the like. R. W. Humphrey. March 31st, 1919. (140,215.)

8,177. Excitation of dynamo-electric machines. British Thomson-Houston Co. (General Electric Co.). April 1st, 1919. (140,220.)

8,733. Means for preventing sparking in appliances for making and breaking electric circuits. H. H. Hill. April 7th, 1919. (140,227.)

15,085. Regulating systems for alternating current circuits. British Thomson-Houston Co. (General Electric Co.) June 16th, 1919. (140,285.)

18,001. Magnetos. J. H. Runbaken and W. Torrance. July 18th, 1919. (140,298.)

21,829. Contacts for electric switches, fuses and the like. H. J. Dean and W. Redmayne. September 5th, 1919. (140,318.)

24,575. Electrical protective devices. Western Electric Co. (Western Electric Co.) February 14th, 1919. (Divided application on 135,389.) (140,332.)

27,904. Electric lighters. B. L. Dechelle. March 22nd, 1919. (Addition to 129,653.) (140,346.)

29,889. Electromotor with self-contained reducing gear. H. Schroder. September 16th, 1914. (136,153.)

A Note We O,Cl. — "SLI Humour.—In one of the lighter columns of the *Commercial Motor* we recently noticed the remark, 'Let's have a squint at your X-eyed battery.' Evidently this is intended to test our gravity. We wonder whether there is any charge? Probably the answer is in the negative, and our Publicity Manager's capacity for free advertisement cannot be reckoned in ampere-hours. . . . He might tell the *Commercial Motor* that we realise that if the power behind the motor is in the Exide battery, the power behind the *sells* is in the Advertisement."—From the *Chloride Chronicle*.

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THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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THE ELECTRICITY SUPPLY BILL: ADDENDUM.

WHEN the Government declared its intention, in December last, of introducing an amending Bill to enact the—shall we say—penal clauses that were omitted from the first version of the Electricity (Supply) Bill of 1919, we doubted whether it would be as good as its word. For one thing, the Act as it stood, shorn of its most controversial features, was acceptable, for what it was worth, to every branch of the industry; true, there were those who desired the compulsory clauses—but there were practically none who objected to the clauses actually passed into law. Further, it seemed to us, and not to us alone, that the unexpected loss of the additional powers would prove a blessing in that it would allow the Commissioners to look round and take stock of the position, and to acquire some experience of the procedure by which they could best attain the desired ends—first, and most important, economy of fuel: secondly, but as a means of attaining the first, the provision of a cheap and abundant supply of electric power to all parts of the country.

However, for once a Parliamentary pledge has been redeemed, and the Bill is before the House of Commons, embodying with but little change the provisions that were struck out by the House of Lords. Its progress will be a thorny one; its re-introduction affords an unhoped-for opportunity of making good the errors of the past session, and no stone will be left unturned by the opponents of the measure to retrieve their losses. The issue is now a plain one, between the representatives of private ownership and communal ownership respectively. The main principle of the original Bill—State Control—has become the law of the realm: but the secondary purpose of some of its promoters—to drive out private enterprise—has not yet been achieved. Why should it be? We have often expressed the view, for which there is abundance of sanction in the success attained in the United States and elsewhere, that private enterprise under State control is the most efficient and progressive method of conducting a great business undertaking such as that of electricity supply, and we adhere to that opinion. The fruits of national ownership are familiar to all observers; amongst the many lessons of the war, that has been one of the most painful to learn and most costly to the individual, who has also learnt that it is most difficult to rid himself of the incubus, once he is in its clutches.

Not only did the original Bill foredoom the private company to extinction, with few and unimportant exceptions; it also proposed to accomplish that achievement by methods which were hardly one step removed from fraud. The terms of purchase of generating stations and main transmission lines were so flagrantly unjust, that even the Government, for very shame, had to provide a partial remedy—but the cure was little better than the disease; the companies were offered the alternatives of staying in the business as distributors, with an utterly inadequate degree of compensation for the loss of their plant, or going out of business altogether in order to secure the return of their capital, at the sacrifice of their goodwill and the opportunity to recoup themselves for their early losses. The fact that they were protected from such an eventuality by a definite agreement with Parliament, which ought to have been regarded as binding upon any Government, is undeniable; they were to have a concession for 42 years, and at the end of it to receive the fair market value—the then value—of their plant, if it were purchased by the local authorities. Their plant is now worth nominally twice its original value,

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and to return to them their capital outlay, in terms of the present depreciated currency, is a manœuvre unworthy of any Government. If justice is to be done, a way must be found for the companies to remain in existence on tolerable terms, unless they wish to leave the business; to force them out of it by imposing upon them confiscation terms is robbery.

There are two points, therefore, which to our mind require amendment. The first is the terms of compulsory purchase; this should not be put in force until and unless it is necessary in the interest of economy and progress, but when it is, it should be on the basis of justice and equity. The other item is the price of bulk supply. Under the present Act, the whole benefit of any reduction in the price is to enure to the consumer; it is, however, certain that if the present undertakers were permitted to continue generating electricity and extending their plant, they would be as well able as the District Boards to reduce the generating costs, sharing the benefits with the consumer, and this is included in their rights under the Parliamentary agreement. Under the Act they are deprived of this right, without compensation in any shape.

It is up to the supporters of private enterprise now to see that it is afforded a fair opportunity of justifying its existence, and of entering into voluntary co-operation with other agencies for the purpose of economising fuel and labour. The chance will never recur.

Confidential Communications.

An echo of the Report on the Electric Lamp Industry was heard at the meeting of the Grand Council of the Federation of British Industries, last week, as reported in *The Bulletin*. A letter from the Electric Lamp Manufacturers' Association pointed out that the Committee had published information which was supplied by the manufacturers on the understanding that it would be treated as confidential. A resolution proposed by Mr. D. N. Dunlop, director of the B.E.A.M.A., declaring that the publication was a breach of the Profiteering Act, and was most detrimental to the interests of British industry, was carried unanimously.

While no one will deny that, in the interests of truth, it is essential that the Committees inquiring into questions of profiteering shall be furnished with full information on the points with which they deal, it is no less certain that the unauthorised publication of such data, when obtained under the seal of confidence, is the most effective method imaginable of inducing manufacturers and traders to endeavour in future to withhold them from the Committees. In this case the mischief has been done, but an unmistakable warning has been issued to manufacturers in other branches of industry that they cannot rely upon the integrity, or even the discretion, of such committees, and they will not be slow to learn the lesson. It is absurd that measures intended for the benefit of British industry should thus be turned to the advantage of our foreign competitors by affording them priceless information regarding manufacturing costs and other conditions obtaining in this country.

At the same meeting a resolution was adopted that steps should be taken to ensure the appointment on such committees of members possessing technical qualifications. While we agree that the *personnel* should include some members competent to guide the Committee to correct conclusions, we would not have them all, or even a majority of them, experts in the subject of their inquiry. It would in many cases be exceedingly difficult to constitute a committee of experts that would not be even more objectionable to the industry concerned, and it will be admitted that the specialist, however upright and worthy, is not likely to be able to occupy a position of judicial detachment and impartiality. It is the established practice of the British law courts to submit highly technical patent cases, for example, to a judge who has no personal interest in the subject of dispute, and the results of this procedure have not proved unsatisfactory. It is, however, most desirable that the members of committees should be men of affairs and accustomed to the exercise of judicial functions, which is certainly not the case as a rule.

The Budget and Increase in the Inland Telegraph Rate.

On November 1st, 1915, the Government substituted and brought into force a minimum of 9d. per telegram of 12 words, and ½d. each additional word, for a 6d. minimum which ruled before, an increase of 3d. per telegram. The present Budget proposals provide for a further increase in the rate to 1s. minimum, and 1d. for each additional word, making a 100 per cent. increase over the pre-war rate. No doubt the public have dismissed the subject with the unpleasant reflection that inland telegrams are to cost more, but they probably have not realised the far-reaching effect the increase is likely to have on international telegraph rates. When the increase to 9d. became effective in 1915, cable and telegraph companies maintained their rates, but as they will now have to face a rate that has doubled, it is an open question if they will adopt the same attitude. Working and maintenance expenses have, like those of other concerns, risen enormously, and, notwithstanding the additional burden, rates have not been increased on this account so far. To arrive at a rate from point to point various charges per word and per message have to be added together, and in this way a fixed rate from any place in the United Kingdom can be arrived at to any place abroad. It stands to reason, therefore, that the increased inland rate must affect international rates if it be applied to such traffic, and is not merely local in effect. The Western Union Telegraph Co. has also increased landline rates in North America by 20 per cent., and this increase, in addition to the one proposed here, may well lead to all-round alterations. It may be that the rate, say, from New York to London and any other city to which the cable companies lease their own landlines can be maintained at 1s. per word and the inland rate added to places where the companies have not their own offices, but if, in addition, rentals for leased lines, tubes, &c., are increased to any extent, the 1s.-per-word rate may have to be increased to all places to meet the extra demands of the private and Government landline systems. The mercantile community will, no doubt, have to be prepared for changes.

Temporarily, at all events, the realisation of our hopes for cheaper communication throughout the world may have receded, but we cannot believe that it will be long before it is secured. It is, of course, true that the cost of new cables and working expenses are greatly increased, but wireless will play an important part in the near future. If we limit inter-Colonial communication by high rates, we inevitably limit Empire development and prevent wealth and revenue production.

Compulsory Arbitration in France.

Considerable irritation has been produced in Labour circles in France in consequence of the introduction in the Chamber by M. Jourdain, Minister for Labour, of a Bill which provides for the adoption of compulsory arbitration in order to settle disputes between workmen and their employers. The undertakings affected by the Bill are (1) railways, tramways, and other means of transport in common by land, sea or waterway; (2) gas and electricity works; (3) coal mines; and (4) undertakings for the distribution of water, light and power. Two preliminary stages are provided for under the Bill before reaching the state of compulsory arbitration. In the first place, a deputation of five workmen can wait upon the heads of the works to deal with the dispute; and, secondly, conciliation can be resorted to before a competent committee or before a magistrate. Should both these methods fail to bring about a settlement, compulsory arbitration will come into force, and strikes and lock-outs are suspended. The Bill proposes the imposition of penalties for contraventions of the law. These comprise (1) fines of from 16 to 10,000 fr., and imprisonment from six days to three months; and (2) the requisition by the Government of the buildings, plant, and *personnel* in case one of the parties infringes the regulations.

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EXTENSIONS IN THE CLYDE VALLEY POWER STATIONS.

The Clyde Valley Electrical Power Co. has just put on commercial load a large Metropolitan-Vickers turbo-generator set at its Yoker power station. This station is situated on the tidal portion of the River Clyde, and well placed for fuel, water, and distribution ; it is illustrated in fig. 3, p. 548.

The new set (fig. 2) is rated at 18,750 K.V.A., giving a normal output of 15,000 KW. at 0·8 power factor. The turbine has Rateau blading with 14 expansion wheels, the casing being of cast-steel for the high-pressure and cast-iron for the low-pressure end. The working steam pressure is 200 lb. per sq. in., with 160° F. superheat, and a special arrangement is provided at the low-pressure end of the turbine for drawing off steam for feed-heating under vacuum, which is estimated to give 5 per cent. additional economy by raising the temperature of the feed water to 155° F. The governor is of the oil relay type, the pump supplying oil at a pressure of 70 lb. per sq. in. The main bearings are lubricated under pressure from a second oil pump, also driven off the main shaft, both pumps drawing from a common tank in the turbine bedplate. The oil is cooled during use by Zimmermann oil coolers.

The alternator generates three-phase current at 11,000 volts, 25 cycles, at a speed of 1,500 R.P.M. The two-pole rotor is machined from a solid forging, and the end windings of the star-connected stator are specially braced to resist lateral stresses. Three air-cooled reactances, giving a reactance value of 5 per cent., are installed. Merz-Price balanced protective gear is fitted to protect the generator. The air for cooling the machine windings is circulated by fans carried on the main shaft and within the generator casing, the air being washed prior to use in a Davidson air washer. Excitation current can be supplied from the direct-coupled exciter on the turbine shaft, or separately from the station D.C. bars.

The cables from the generator to the switchgear gallery are 0·75 sq. in. single-core, lead-covered and armoured, six in all, two to each phase, and arrangements are made on the board for remote control of the main machine switch, as well as of the generator earth switch.

The condenser, situated immediately under the turbine, is of Messrs. Weir's land type, capable of dealing with 200,000 lb. of steam per hour, the normal vacuum carried being 29 in. with barometer at 30 in. The pumps are also by Messrs. Weir, being of their Dual make, electrically-driven through spur gearing from a 40-H.P. three-phase, 25-cycle, 480-R.P.M. induction motor.

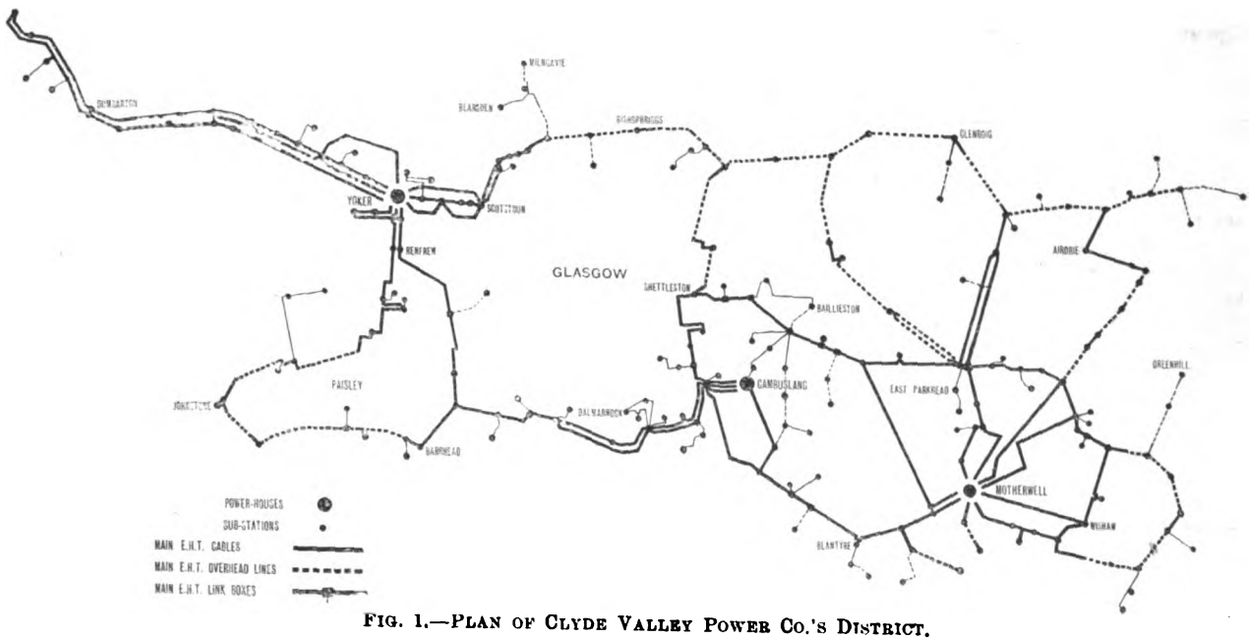

FIG. 1.—PLAN OF CLYDE VALLEY POWER CO.'S DISTRICT.

The pumping plant at the river intake in the Clyde is common to this set and to the other generators in the station, the whole circulating plant operating into a 42-in. main. Little trouble is experienced with the water screening at the station, the screens used being of the ordinary mesh pattern.

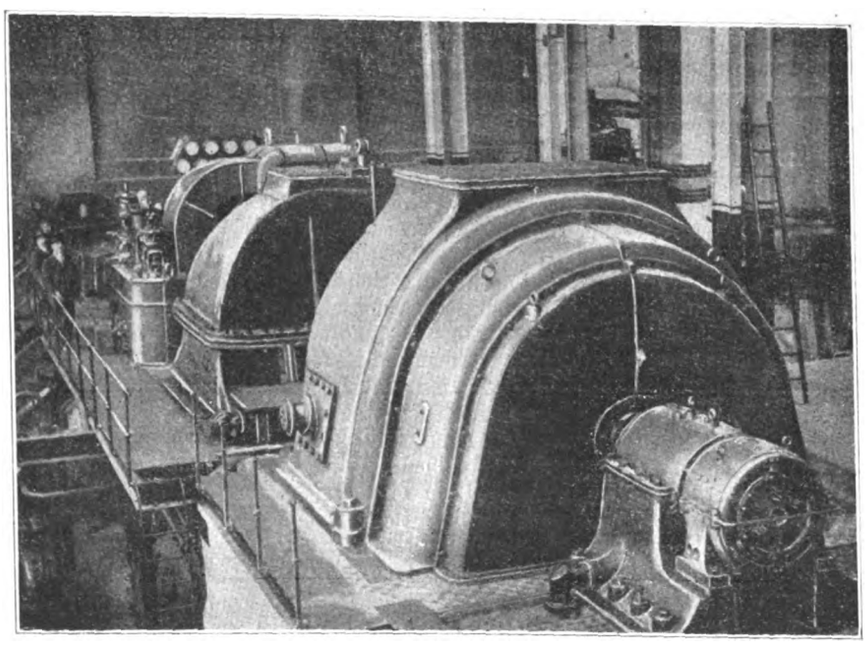

FIG. 2.—METROPOLITAN-VICKERS 18,750-K.V.A. TURBO-GENERATOR.

The set is supplied with steam from the station range of Babcock & Wilcox boilers ; the total steaming capacity of the power house is 285,000 lb. with four boilers on induced and eight on natural draught.

A similar turbo-alternator to that described is under construction at the company's Clyde Mill Power Station, Cambuslang, and the installation of a second 15,000-KW. set is under consideration for the Yoker power station.

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The company has now three large generating stations in commission, with 180 sub-stations and switch houses, as shown in fig. 1, and its power and lighting business is progressing very rapidly, the total contracts for supply at present amounting to 145,000 H.P. We are indebted to the company for the foregoing particulars and illustrations.

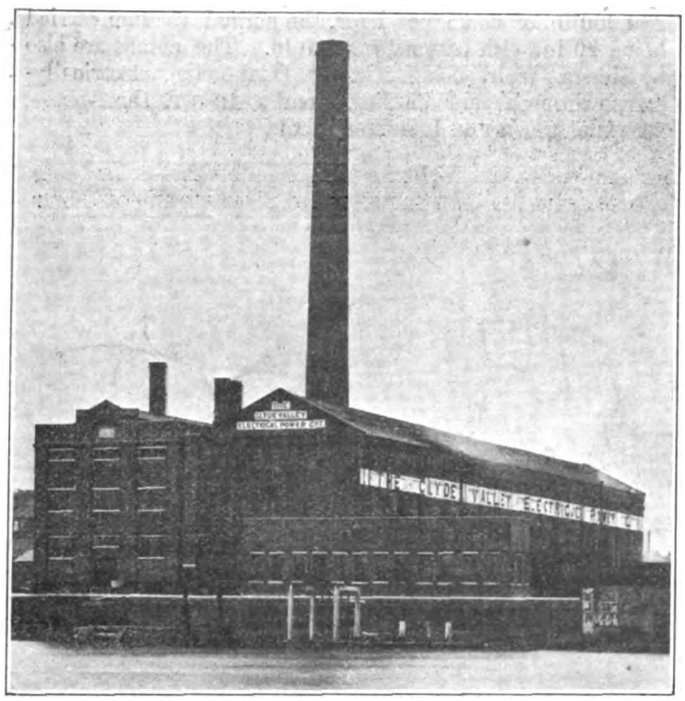


Fig. 3.—Yoker Power Station.

LOW-VOLTAGE LIGHTING OF ELECTRICALLY-EQUIPPED FACTORIES.

By C. T. WILKINSON.

It is to be regretted that the electric lighting of factories has not yet received the close attention and study in England which have been accorded it abroad. As a result, the English engineer planning the lighting of an electrically-equipped factory has not at his command the complete regulations and suggestions that are available elsewhere.

The recent report of Mr. Scott Ram on fatal accidents in electrically-equipped factories seems to point in the direction of low-voltage lighting, and, indeed, one such system is therein mentioned.

It is the object of this article to draw attention to a low-voltage lighting system of novel character, which claims to have appreciable advantages over other methods, and which it is thought might be worthy of the consideration of English illuminating engineers. By the adoption of this system low-voltage lighting was first applied to a factory at the time under the direction of the Admiralty. A pressure of 12 volts was selected, and this voltage was obtained by placing a small fine-wire 12-volt coil at the bottom of the slots of the standard induction motors operating the individual machine tools. The conditions governing the decision to use this system in the case of a modern factory were as follows :—

The shops were laid out according to latest practice, with plenty of space between the machines, and with steel tubes carrying the wires in the concrete floor up to each motor. Individual lighting points from above were impossible, as they would have prevented free movement of the overhead cranes, and if the lighting wires were kept entirely separate from the power circuit in the usual way, separate steel tubes for these lighting circuits would have been necessary. Further, the cost for individual lighting points for each machine would have worked out at more than £3 per point.

However, the men to be employed on the machine tools insisted on individual lights, and were backed up in this preference by the technical operating staff and foreman.

Examination of the best intensity allowances available for the different classes of factory work indicates that for this particular work if individual machine lights were used, the general overhead lighting of the shop would require only a fraction of the wattage otherwise necessary, and a great saving was made in this direction, not only in first cost of equipment, but in annual operating charges, this overhead lighting being only such as was necessary to provide sufficient illumination for the safe and speedy movement of overhead cranes carrying material, other shifting of material, and general supervision of work.

If, therefore, while reducing the cost and operating expenses of the overhead lighting, as previously mentioned, the individual lights for machine tools could be put in extraordinarily cheaply, at the same time consuming a negligible amount of power, it was obvious that a considerable step forward could be accomplished in this class of work.

For such individual lights, a low voltage is very valuable, enabling as it does the use of half-watt type 12-volt automobile headlight lamps. A number of these lamps could be supplied from one low-voltage transformer, or alternatively this small winding could be placed in each motor, so that every individual motor supplied the lights for its own machine tool.

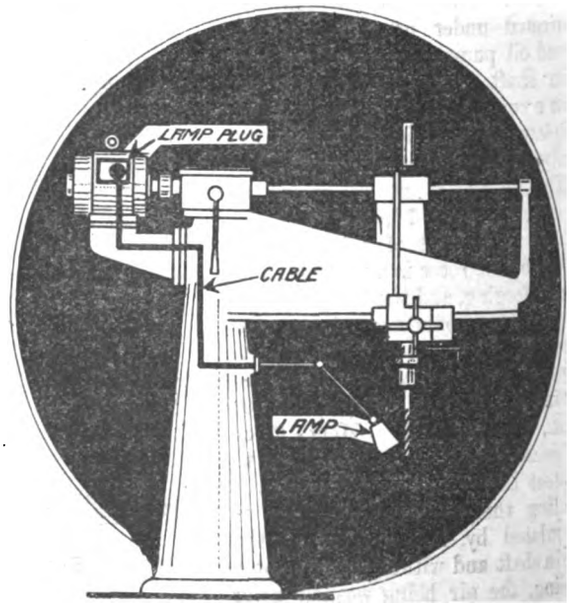
It was decided to adopt the latter method after consideration of the relative costs. The expense per point for the individual lights would not have been appreciably lessened by the adoption of the first method, whereas by utilising the new method it was greatly reduced, the actual cost of the small 12-volt coil being only a few shillings. The leads from this coil were carried through fuses to a small lighting plug-box situated adjoining the terminal-box for the power leads, but in future installations these two boxes would be made one, still further cheapening the device.

There then only remained a small plug, a few feet of flex, and the usual universal joint reflectors enabling the lamps to be held in any position convenient to the workman.

The total cost at the time was about half the price per point for lighting in the usual way, and if the suggestion for a common terminal-box just outlined were adopted, the figure would be appreciably less.

The efficiency of these half-watt lamps is, of course, comparatively high, and their use only becomes possible through the low voltage available.

The actual light required when thus brought right down to the work is so small, that the wattage consumed is almost negligible, as compared with the standard 100-volt or 200-volt system; moreover, these small 12-volt high-efficiency lamps are very substantial, and will stand far more vibration than high-voltage lamps, with consequent saving in replacements.



Low-Voltage Lighting of Radial Drill.

The saving obtained in power for a typical machine shop is, say, 40 per cent. or more, depending on the type of machine work and whether a large number of tools have

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to be supplied. This further means an appreciable saving in power-station equipment, and consequent reduction in initial cost.

By the adoption of the above-mentioned arrangement, it will be noticed that two sources of light are available, one overhead from the separate lighting circuit and the other individual from the main power circuit. This has the further advantage that trouble on either of these circuits does not leave the shop in total darkness.

It was at first considered that this system might have two disadvantages: (1) That the light might flicker, or that undue stress would perhaps be put on the lamp at starting—but these defects were never realised; and (2) that the light would not be available when the machine was shut down. The latter was, however, overcome by having two plug holes on each motor, so that in case of shutting down of the machine the workman could plug his light into his neighbour's motor. In practice it will be found that the need for this plugging into the neighbouring motor seldom arises.

The second difficulty is also overcome by careful consideration of the following determining factors:—

(*a*) Proportion of working time spent in "setting up" for each tool and class of tools.

(*b*) Tools provided with gear boxes for speed variation, in which case a clutch is provided, and the motor is run all the time.

(*c*) Tools which keep motor running continuously owing to very little time being absorbed in moving work.

(*d*) Tools for which group drive is used, and two, or three, or four lights are supplied from one motor.

(*e*) Tools in which the interval for adjustment is relatively long, and plugging into a neighbouring motor is not too frequent, and causes no inconvenience.

In further connection with Mr. Scott Ram's report on fatal accidents, it is claimed that with this 12-volt system no accident could possibly occur. Such immunity was ensured by placing the coil at the bottom of the induction motor slot, and entirely separate from the power winding, a full power insulation test being made between the lighting coil and the power coil, as well as between the lighting coil and the frame.

The above arrangement is fundamentally an appreciation of the fact that the stator of an induction motor is a transformer. Such a scheme, therefore, must essentially be much cheaper than any arrangement of separate low-voltage transformers. In fact, whereas it is greatly cheaper than the system of obtaining a number of lights from one low-voltage transformer, it is, of course, infinitely cheaper than the arrangement—also considered at the time—of supplying a small separate transformer for each light. It also greatly simplifies the lay-out, wiring, and operating of such a machine shop; and the conception of each machine shop having its own general lighting, and each tool getting its own special strong individual light straight from its own motor, is thought to be a distinct step forward in simplification, reduction of first cost, and economy of operation.

To sum up, the writer would suggest the use of this lighting coil as a standard for any modern factory, and believes that so few cases where it is not applicable will be found that they can be altogether neglected. The low cost of equipping the motors with the coil and the resulting economy in initial outlay, operating cost, and saving in power, would seem to be such that the system merits extended use.

Dock Congestion at Constantinople.—The Department of Overseas Trade is informed that, to relieve the congestion which exists at the port of Constantinople, a compulsory sale will take place very shortly of all goods which have been lying in the Custom House for more than one year and one day. A list of such goods has been prepared, and it is stated that the British Chamber of Commerce of Turkey and the Balkan States (Inc.), 34/35, Buyuk Tunnel, Han, Galata, Constantinople, is in possession of full information. United Kingdom firms who are interested in this matter are invited to communicate with that body without delay.

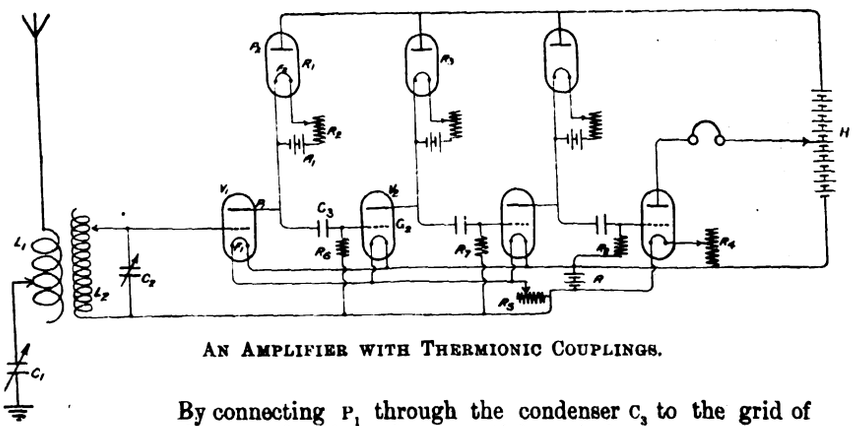
AN AMPLIFIER EMPLOYING THERMIONIC INTER-VALVE RESISTANCE COUPLINGS

By JOHN SCOTT-TAGGART.

The author has devised a large number of amplifying devices in which the coupling between the valves consists not in the usual form of resistances or transformers, but in thermionic couplings. In place of ordinary conductors of high impedance, it is proposed to use a conductive path between the cathode and anode of a vacuum tube such as the Fleming valve.

One form of the arrangement is shown in the accompanying figure, which shows the application of the arrangement to the reception of wireless signals.

An aerial circuit L_1 C_1 is coupled to a closed receiving circuit, L_2 C_2, which is connected across the grid and filament of the three-electrode vacuum tube V_1. The plate circuit of V_1 contains a two-electrode vacuum tube R_1 and the plate battery H. The valve R_1 may conveniently consist of an ordinary three-electrode valve in which the grid and anode are connected together. The filament, it will be noticed, is heated by means of an accumulator A_1, preferably through the five-ohm rheostat R_2. The electron current from the filament F_1 of the vacuum tube V_1 flows to the plate P_1, to the filament F_2 of the vacuum tube R_1, thence to the plate P_2, and so back to the filament F_1 *viâ* the battery H. The valve R_1 acts as a resistance of the order of 100,000 ohms, which value, however, may be conveniently varied by altering the emission from the filament F_2 by adjusting R_2. We thus conveniently obtain a non-inductive resistance whose value may be very readily varied, and whose normal value approximates to that of the valve V_1—a most desirable condition for effective amplification. By this means the voltage on the grid of V_1 will vary the resistance of V_1, and, consequently, vary the current in the circuit F_1, P_1, F_2, P_2, H, F_1. Since the current through R_1 is increased, the potential across P_2 and F_2 will also increase. If the grid of V_1 is positive, F_2 will become negative with respect to P_2.



An Amplifier with Thermionic Couplings.

By connecting P_1 through the condenser C_3 to the grid of the second valve, the potential variations across R_1 are impressed on the grid G_2, the condenser C_3 ensuring that grid G_2 is insulated from the high positive value which would otherwise be given to it by the battery H. The momentary negative potential on G_2 increases the resistance of the tube V_2, and so lessens the current in the circuit V_2, R_3, and H. Since the current through R_3 is decreased, the potential across R_3 decreases, and, consequently, the grid of the third three-electrode valve is given a positive pulse. The third three-electrode vacuum tube acts in a manner comparable to the first. The last vacuum tube is intended to act not as a high-frequency amplifier, but as a detector, and a pair of telephones is included in its plate circuit, a suitable tapping being taken from the battery H.

To assist us in arranging that the last valve shall act as a detector, we can conveniently make its filament current variable by the use of a separate rheostat, R_4. The current through the filament of the first three vacuum tubes may be varied by means of a rheostat, R_5. These three valves act as amplifiers of the high-frequency oscillations, and are not intended to act as detectors. Resistances R_6 and R_7,

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having a value of about 4 megohms, are connected as shown and are intended primarily to prevent the accumulation of electrons on the grids of the second and third vacuum tubes. It is to be noted that the grids of the first three valves are connected to the negative side of the filament-heating accumulator; moreover, the rheostat R_5 is so connected that the grids will always have a potential negative with respect to the negative end of the filament. This will tend to prevent the establishment of grid currents in the first three valves.

If desired, the same effect could be produced by using a fixed resistance of about 1·5 ohms in place of the rheostat, R_5, the filament currents being then regulated by means of a rheostat connected between the positive side of the filament and the positive terminal of the accumulator. This latter arrangement is probably preferable.

A high resistance R_3 of about 4 megohms is connected between the grid of the last valve, and either the positive or negative side of the filament accumulator, according to which connection gives the best results.

In addition to the advantages gained by being able to vary each of the plate circuit resistances, the valve resistances R_1, R_3, &c., may be arranged to act as a limiting device, in which case the strength of signals may be easily controlled, and exceedingly loud signals or atmospherics may be cut down by suitably adjusting the rheostats R_3, &c.

The writer hopes in the near future to present a paper on further applications of thermionic inter-valve resistances, including devices of practical importance and value.

ELECTRICITY SUPPLY TARIFFS.

At the meeting of the North-Western Centre of the Institution of Electrical Engineers, which was held on February 24th at Manchester, Mr. J. A. Robertson presiding, an informal discussion on electricity supply tariffs was opened by Mr. S. J. Watson. He summarised under five headings the total cost of supplying electrical energy: Power station; transmission; transformation or conversion; distribution; metering and accounting. The annual cost per consumer of the expenses included in metering and accounting was constant whether the number of units used was large or small. In most of the other items the expenditure per annum was entirely unaffected by the number of units, but was fixed by the rate at which the supply was used. Substantially the only costs incurred in connection with each actual unit delivered after the undertaking was placed in a position to afford a supply, were those for fuel and part of the losses in transmission, transformation (or conversion), and distribution. Therefore, the power station cost could be resolved into two parts, the standing costs (taken at £x per kw. per annum of maximum demand), and the running cost (taken at y pence per unit sent out). For convenience he took £5 per kw. as the standing cost and 0.4d. per unit as the running cost, based on fuel at 32s. 6d. per ton. If the whole of the output were utilised by one consumer in exactly the same form as generated and without any expenditure outside the power station, a charge on those lines would be sufficient. But suppose there were three consumers, taking the supply in rotation, between 12 midnight and 8 a.m., 8 a.m. and 4 p.m., 4 p.m. and midnight. Clearly the expenditure at the power station would remain the same, and would be covered by a charge of £1 13s. 4d. per kw., plus 0.4d. per unit. Diversity of usage vitally affected the problem. A 100 per cent. load factor at the station would be equally attained whether a number of consumers had a load factor of 1 per cent. with a diversity of 100 or a load factor of 100 per cent. with a diversity of 1. Therefore, the standing cost could be fully secured by a charge per kw. of maximum demand per annum varying from £5 in the case of consumers having a load factor of 100 per cent. and a diversity of 1 to 1s. in the case of consumers having a load factor of 1 per cent. and a diversity of 100, the cost per unit supplied remaining unaltered.

He assumed £3 per annum per kw. of the rated capacity to cover the equipment of the transmission, transformation (or conversion), and distribution systems, and the constant losses and the attendance and maintenance incurred in connection therewith. This must be the charge if the supply had to be available night and day for one consumer only, whether it was used to the maximum extent for one hour per day or for the whole 24. If three consumers were using the equipment in rotation the charge would be £1 to each. Therefore, the standing portion of the costs incurred in transmission, &c., could be met by a charge per kw. of maximum demand per annum varying from £3 in the case of consumers having a load factor of 100 per cent. with a diversity of 1, to 7.2d. in the case of consumers having a load factor of 1 per cent. and a diversity of 100. Some addition should be made to the original running cost of 0.4d. per unit to compensate for losses in transmission, &c., which varied with the units consumed. Really transmission, transformation (or conversion), and distribution should be considered as three separate items. For suppliers to large industrial concerns two types of tariffs were in general use: (1) A compound charge per kw. demand, plus a charge for each unit used. (2) A flat rate roughly equal to the average per unit which the compound charge was expected to yield assuming a certain load factor. In both cases provision was made for a variation in the charge per unit to cover any change in the price paid per ton for fuel. If the assumption in regard to the load factor was correct, either method would yield the same return in revenue, but it was very difficult, if not impossible, to ensure that any particular load factor would be reached and maintained, and a flat rate per unit was often found insufficient owing to strikes, reduced hours of working, &c. For this reason the compound charge was becoming the standard practice, but there were considerable differences in the methods of applying it. Some undertakings combined a comparatively low standing charge with a high running charge, others made a high standing charge and a low running charge. Assuming a load factor of 33⅓ per cent., a compound charge of £6 per kw., plus 0.41d. per unit would yield the same income as £3 per kw., plus 0.66d. per unit, or as a flat rate of 0.90d. per unit. He was strongly of opinion that the running charge should be based as closely as possible on the cost of fuel, subject to the additional cost of losses incurred by each unit, and all other items of expense should be treated as standing costs, subject to a reduction based on diversity usage. The charges would then approximate as nearly as could be ascertained to the actual costs incurred. With regard to large bulk or industrial supplies, the general adoption of a 47 or 48-hours' working week instead of 54 to 56 had reduced the load factor from about 31.5 per cent. to 27 per cent., and as the diversity of this particular class of load rarely exceeded 1.2, the resultant usage of the whole equipment had been reduced from 37.8 per cent. to 32.4 per cent. The late Dr. John Hopkinson first worked out the details of a compound tariff, and recommended its adoption by the Electricity Committee of Manchester. The principles adopted by him in dividing up the costs were, with slight variations, accepted to-day. Dr. Hopkinson divided the costs into two parts: (1) Those which were independent of the hours during which the supply was used. (2) Those which were directly proportional to the actual units supplied. In its original form the Hopkinson tariff had not been generally applied to the smaller consumers. Other forms of tariff were the following: (1) A sliding scale of charges based on the number of units used per h.p. (2) Flat rates based solely on the number of units used. (3) The maximum demand system (introduced by Mr. Arthur Wright at Brighton in 1893) in which a high price (say, 3d. to 4d. per unit) was charged for the use of the maximum demand during a certain number of hours per annum, plus a much lower price (say, ½d. to 1d. per unit) for all additional consumption. Sometimes an intermediate rate was charged for the units corresponding to the use of the maximum demand for a certain number of additional hours before the lowest rate was reached. (4) Flat rates per unit, depending on the purpose for which the supply was used. With the exception of the sliding scale based on quantity, all these tariffs gave results somewhat similar to those obtained by the Hopkinson method. There were few cases now where one flat rate per unit was adopted for power without any variation due to load factor or quantity. Such a rate would be extremely detrimental to the supply undertaking, as it would encourage short-hour users and discourage the long-hour users. For ordinary lighting purposes various tariffs, more or less akin to the Hopkinson, were in use. It was now generally recognised that in the case of a supply for domestic purposes the rates must vary from those applicable to ordinary lighting consumers. For lighting only the income derived from houses rated at £20 to £40 a year (which largely predominated in industrial areas) would not exceed an average of £3 to £6 per house per annum, an amount inadequate to cover the costs involved. Various special tariffs had been devised with a view to increasing the revenue by encouraging the use of the supply for purposes other than lighting. The requirements of such a tariff were that it should yield an income closely approximating to the costs incurred, it should be easily understood by the consumer, only one system of wiring should be needed with one meter, it should encourage consumers to use the supply for all purposes, and to wire for the maximum points of usage. A number of tariffs conformed broadly with those requirements by combining a fixed standing charge per annum with a low charge per unit. The standing charge could be arrived at in different ways: (1) By assuming a maximum demand based on the whole of the lamps and apparatus installed or on all average use of such appliances, and fixing the price per kw. for such assumed demand. (2) By assessing the standing charge as a percentage of the rateable value of the premises. (3) By fixing the standing charge at so much per room per annum, with or without allowances for each room in excess of a particular number. Each method had its disadvantages. The standing portion of the charge was obtained in a more or less arbitrary

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fashion without regard to the value of the services actually rendered. Despite these defects, some of those systems had been found very effective in practice, and had resulted in a large increase in the consumption, and consequently in the revenue. Much less care was shown in using the supply if a consumer realised that only ½d. or 1d. per unit had to be paid after the standing charge was met, and additional consumption was thereby assured. The strict application of the Hopkinson differential charge or of the maximum demand system was unworkable for domestic purposes, but he advocated a form of tariff which would ensure a standing charge per annum, plus a low running charge per unit. If any considerable progress was to be made in the extended use of heating and cooking appliances the running charge must be fixed as low as possible. One very important factor was the diversity demand of this class of load. No really definite information on this point was available. As applied to small cottages and workmen's dwellings the system of a fixed annual charge per lamp installed, without any charge per unit used, had the advantage of simplicity, but it was apt to lead to a wasteful use of the supply, and could not be conveniently adopted when heating or cooking appliances were installed. The fact should not be overlooked that the total quantity of coal consumed for domestic purposes, in a district like Manchester, was much the same as the total quantity used by the whole of the manufacturing concerns. Much good would result if an effort was made to standardise methods, and remove the anomalies in the charges of adjoining undertakings.

Mr. J. S. Corlett (Wigan), in a written communication, said it was highly desirable that agreements should be standardised, and the responsibility of the consumer defined on reasonable and equitable lines. Uniformity on such points as period of time-lag, method of calculating coal increment, and resetting meters to zero, would be highly beneficial to the industry.

Mr. J. Frith explained that on the system of the mixed charge two consumers might have to pay equally, although the cost of supply was very different, because their maximum demands came on at different times. It was very difficult to see how the supply authorities could deal with that. He agreed as to the importance of having a tariff which was easily understood. It was also important that the consumer should be able to foretell what he would have to pay. Agreements were not quite so black as they were painted, but almost everyone could be improved from the consumer's point of view, and he found the authorities amenable to argument. A very important point in considering these questions was the nature of the supplying authority. When it was a municipality the ratepayers were combining to supply themselves, and the concern ought to be thoroughly co-operative, the object being to extend the benefits of the service to as many as possible of the owners (*i.e.*, the ratepayers), and not so much to make a profit out of every consumer. From this point of view it was to the good of the community that cottage property should be lighted by electricity, and the householders, being ratepayers, were entitled to share the benefits of the concern in which they were joint owners. But a company was governed (and quite rightly so) by other considerations. Its responsibilities were to the shareholders, and its object to make a profit for them, the only limit to the profit being what could be reasonably got out of the consumer to the ultimate good of the shareholder. A profit which restricted the use of electricity would not be to the ultimate good of the shareholder. It might even be good business to take on certain consumers at a temporary loss in order to popularise the supply. But it was another thing to compel a company to run its mains to a lot of cottage property where it was very difficult to show any chance of making a profit. A domestic tariff should encourage the use of electricity all over the house.

Mr. W. J. H. Wood said it was essential for the good of the community that tariffs should be simplified, and a common basis of charge established, possibly by a division into several classes. The fairest method was to make a fixed charge, plus a charge per unit. After the consumer had reached a certain limit he would be charged purely on the running cost. That was a great inducement. Take the case of a lighting consumer. The way to make greater use of the capital expended on his service, and at the same time improve the load factor, was to induce him to take power for domestic purposes. Usually two meters were adopted, but it seemed to him that they should strive for the one-meter service. He sympathised with what had been said about agreements. It should be borne in mind, however, that regulations must be made to safeguard the interests of the supplying authority, which should get a certain return on its money over a period of years.

Mr. S. L. Pearce said at the present time a uniform charge, even for various classes, was quite unattainable. The most they could hope for was to standardise the method by which the charges were arrived at. All correct tariff systems must be based upon correct costing, and that raised the question how was the expenditure to be analysed. The division into fixed costs and running costs was easy, the difficulty came in the application to the particular supply concerned. He was surprised that Mr. Watson put the power factor as low as 1.2; in Manchester it was substantially higher, the analysis for the last financial year showing 2.2. That had the effect of bringing down the kw. demand charge very substantially. The Hopkinson method of an alternative charge for lighting was still maintained in Manchester. Two-thirds of the total lighting sales being on that principle. It was easily understood, no second meter reading was required for a purely lighting system, and there was very little diversity about it. The combined tariff for domestic purposes could not be supported on scientific grounds, but it was appreciated by consumers, and filled a useful place. Any power supply agreement must make provision for variables, such as changes in the cost of coal. When District Boards had been set up the charges for bulk supply might become more or less standardised and uniform in a district.

Mr. L. Romero thought the Hopkinson system in a modified form could be applied to lighting with advantage, the consumers being divided into classes, and a maximum provided for each according to the diversity factor. Electricity had a promising field in the heating of rooms where artificial heat was only occasionally required, and in places where other forms of heating could not be applied, but he did not think that at present continuous electric heating was a proposition they could look forward to.

The Chairman said he thought they were aiming at an ideal which he was sure they would never attain, in trying to make every consumer pay for the energy he took precisely what it cost to supply him with it. The difficulty about the Hopkinson system was that it took no account of the time at which the maximum demand was made. That was a very important point, especially in large towns which had a large lighting load. However correct the maximum demand system might be in principle variations had to be made to meet particular cases. Subject to such variations, he thought it could be applied to large bulk supplies. In the case of household lighting and household suppy, what did it matter if one consumer got a slight advantage over another. It might be sound policy for a Corporation to sell under cost to artisans' dwellings, because of the indirect benefits in the way of better health, reduction of smoke nuisance, and so on. He had recently had a case before him in which a supply was required for about 500 houses, and he suggested to the local authority concerned that it should, for a year or two at any rate, charge a fixed sum, 1s. 3d. to 1s. 6d. per week in proportion to the floor space of the houses, and collect it with the rental. The time had come for a wholesale scrapping of the conditions which were made in the early days to regulate the supply of electricity. Some might have been necessary originally, but were not needed now. Others were unfair. The power factor condition should be made very definite, and not bear too hardly upon the consumer.

Mr. Franks suggested that a great deterrent to the more extensive use of electrical power was the uncertainty whether a breakdown might not be followed by undue delay in repairing and necessitate a return to the steam engine with belting and shafting. There was also uncertainty as to voltages, and whether motors installed would continue to be suitable. If a manufacturer knew that by taking the supply at certain hours he would get it at a cheaper rate he might modify his working hours in order to secure that advantage.

In his reply, Mr. Watson said changes caused by the war had entirely altered the bases on which prices were formerly fixed, and he thought in future they would be subject automatically to alteration as the changes in the conditions affected the cost of production. It would still be necessary to enter into agreements to ensure an adequate return on the money expended on mains and other things. It was desirable to reduce these matters to a common basis, and if engineers would meet and discuss them there would be no difficulty in doing so. Of all the systems applicable to domestic users, the most satisfactory was that in which the rateable value was adopted as the basis. The householder could judge to within a small margin what the cost to him would be, and the supply authority was assured of an income whether the house was occupied or not. It encouraged the use of electricity for every possible purpose. But the charge must come down to something in the neighbourhood of 0.4d. with coal at present prices, or 0.25d. at the pre-war level. He was acquainted with men who had entirely electrified their houses, and the cost worked out at £120 per annum. But that was on the basis of 1½d. If there was a reduction to ½d., the price would not be really excessive, and it would be worth while to do it. He had recently calculated what the 10s. reduction on coal for domestic use meant in his own town, and he found that the domestic units supplied in the two winter quarters was 5 per cent. of the total coal consumption, and in the other two quarters 3 per cent. Those figures indicated how little had been done in connection with domestic use. Mr. Pearce's figure of 2.2 was not taken on the same lines as his 1.2. He was surprised to hear that the Hopkinson method was applied to two-thirds of the electric lighting in Manchester, and still more surprised that Mr. Pearce expressed satisfaction with it. The experience of others was that consumers did not understand it, and distrusted it. If a 40-hours' week was introduced the men would probably start at 9 and go on till 5 or 5.30. Therefore, the industrial demand would continue during the busy period from 4 to 5 in the winter months.

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DISK-DEPRESSION WELDING.

The disk-depression method of electric welding was developed primarily as a simple and effective means of forming a highly efficient joint or seam between heavy commercial plates. The following particulars relative to the method are taken from the *Southern Engineer*. After the preparation of the parts, by making depressions in the surface of one or both plates and introducing therein thin disks, the parts are brought into the proper juxtaposition and are then subjected to pressure and heating electric current between the terminals of an electric welding machine. The intermediate disks are welded to both plates, and are softened and forced into the depressions so as to permit the faces of the plates to come into immediate contact. The diameter of the disk is slightly less than that of the depression, but the thickness of the disk is greater than the depth of the depression, so as to hold the plates out of initial contact. The writer of the article in question usually employed flat disks in flat-bottom depressions, as he found that best results were obtained by making the area of initial contact substantially the same as the area of the desired weld, and applying the pressure normally to this surface. The surfaces of contact are thereby brought to a welding heat at all points at about the same instant, and a thorough fusion of the metals at all points is obtained by the time the intermediate metal is softened sufficiently to be forced into conformity with the depression. A plurality of such welds, properly staggered, makes an efficient joint.

Simple flat disks may be placed loose in flat-bottom depressions, as illustrated in fig. 1, which shows disks in depressions between two plates which are subjected to pressure and heating electric current between the terminals of an electric welding machine. Disks of varying thickness, flat on one side, and slightly conical on the other, give good results when placed in conical depressions. In order to hold the disks at the centres of the depressions during the progress of the work, small register projections on the disks fit snugly into register holes in the bottom of the depressions. Fig. 2 illustrates a drill for cutting the depressions and register holes. The cutting edge of the drill cuts the depressions while the small auxiliary drill cuts the register holes. The collar on the drill limits and determines the depth of the depressions. By means of multiple drills operating simultaneously, the depressions may be cut rapidly and economically. Movement of the disks may also be prevented by sticking them to the bottom of the depressions, which may be done by fusing them at one or more points of the contacting surfaces.

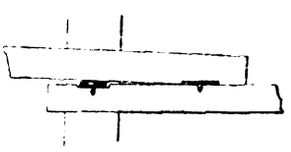

Fig. 1.

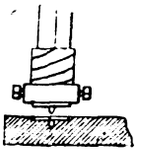

Fig. 2.

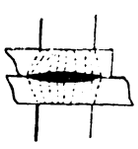

Fig. 3.

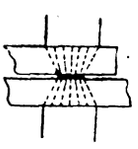

Fig. 4.

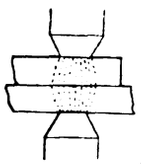

Fig. 5.

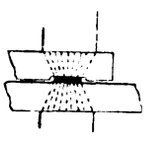

Fig. 6.

The depressions may be cut in the plates near their edges, and the plates are brought into juxtaposition with the depressions overlapping or falling beyond each other, so that, in a welded joint, the full strain can never come on a plate where it has been weakened in the least by such depressions.

Advantages of the disk-depression method of electric welding over riveting are claimed to be (1) a joint of greater strength and (2) greater economy in production. A joint of very high efficiency is obtained. The plates are not weakened by the cutting away of material in punching rivet-holes. The small amount of metal removed in making the depressions is negligible, and even this is restored by the disk-material which is fused into and completely fills the depressions. By cutting depressions in both plates near their edges, the full strain never comes on a plate where depressions have been cut. With proper means of bracing or mechanical framing, the seam can be completed for the present cost of rivets alone. The amount of heating current is relatively small, and the heating is limited to the immediate position of the weld. As the weld can be made rapidly, the conduction of heat by the plates causes very little heating of other parts.

The advantages of the disk-depression method over present methods of spot welding are claimed to be: (1) Greater thickness of plates, with (2) greater economy of welding current, (3) smaller capacity and less cost of welding machine, (4) portability of welding machine for very heavy work. As to the thickness of the material, there do not appear to be other drawbacks further than the matter of forcing through a very small distance into close contact.

The disks serve to confine the path of the welding current (fig. 3) and thus concentrate its heating effect. The advantage can be seen by contrasting with the plain spot-welding method (fig. 4), in which the welding current spreads out considerably and much heat is dissipated and causes distortion troubles. Similar trouble is experienced where it is attempted to use disks without depressions (fig. 5). As the disk is squeezed out (fig. 6) the heating current spreads considerably, practically no further welding occurs, and much difficulty is experienced in bringing the plates into close contact. But in the disk-depression method most of the heat is developed and concentrated at the disk surfaces (fig 3), and at once it becomes so intense as to fuse the thin disk and to weld it to both plates before the surrounding portions of the plate become heated to any great extent.

The depressions are very shallow, and do not have to be spaced accurately. The disks may be manufactured by being cut in large quantities, as are small washers, and at less cost.

THE ELECTRICAL TRADES BENEVOLENT INSTITUTION.

On Monday last the annual general meeting of the Institution was held at the offices of the Electrical Contractors' Association. Mr. J. Y. Fletcher presided over a very small attendance—it may be an indication of satisfaction with the conduct of the Institution's affairs, but it is greatly to be regretted that so few members feel it to be their duty to be present at the annual meeting.

After the minutes of the previous meeting had been read and approved, the secretary, Mr. F. B. O. Hawes, read the report of the Committee of Management for the year 1919. It stated that the income benefited by the special appeal of Mr. C. E. Hunter, chairman in 1918, and that of Mr. H. J. Cash, who last year presided at the first festival since 1914. The income from contributions was £2,925, which, added to receipts from dividends, &c., brought the total income to £3,502, compared with £1,168 in the previous year. The net income for the year was £3,187, out of which four grants had been made, and the balance of £3,143 had been placed to capital account. The total amount of the invested fund was £12,539. Assistance had been given to every qualified person who applied for it. The value of local advisory committees had been further manifested during the year; the Glasgow and Cardiff committees had brought in new members and additional funds, and an advisory committee was being formed at Newcastle-on-Tyne, where a committee had organised a reception and dance in December last in aid of the Institution, with excellent results. Besides bringing in funds, the local advisory committees would investigate cases requiring assistance. The committee appealed to individuals and firms to become or appoint collectors; in the present report only three appear, but their efforts have been very successful. Mr. H. J. Cash's appeal at the dinner, supported by Mr. Hugo Hirst and Mr. C. H. Wordingham, resulted in the collection of £1,146. The committee draws attention to the advantages of membership; as there is now more than £10,000 invested, a member (or his widow or dependents) is assured of the ability of the Institution to afford adequate assistance, and by becoming a member one assists in helping others. The subscription of a member is 10s. (or more, *ad lib.*) and carries with it voting powers, when a pension is applied for. The report concluded with thanks to the electrical Press for assistance.

Commenting on the report, the chairman said that the number of members had increased from 115 to 181, and the number of life members was now 81, compared with 61, the subscriptions from this source having increased by £391. While the number of applications for assistance had been very small, the time was not far distant when the condition of the labour market would be very much changed, and there would be heavy calls on the resources of the Institution. The amount carried forward to capital account was £3,143, compared with £962 in the previous year.

On the motion of the chairman, seconded by Mr. H. Bevis, the report and accounts were unanimously adopted. Messrs. W. B. Esson, E. Garcke, T. E. Gatehouse, C. E. Hunter, Sir Ernest Spencer, and Mr. G. Sutton, members of committee retiring by rotation, were unanimously re-elected, together with Mr. J. Y. Fletcher and Mr. R. B. Mitchell (nominated by the Glasgow Committee). The hon. auditors, Messrs. Price, Waterhouse & Co., and the hon. solicitors, Messrs. Sugden & Hextall, were re-elected, with votes of thanks for their services. The chairman proposed that rule 17 should be amended by raising the limits respectively from £6 to £12 and from £50 to £100, to enable the committee to give adequate grants to the children of deceased members. This was agreed to, and the necessary confirmatory meeting will be held on Monday, June 7th, at 2.30 p.m., at the secretary's office, 36-38, Kingsway, W.C.

The proceedings closed with a vote of thanks to the Electrical Contractors' Association for the use of the room, and to the chairman for presiding.

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NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

A New Electric Seam Welding Machine.

The electric seam welding machine which is being placed on the market by Messrs. Marryat & Place, 28, Hatton Garden, London, E.C.1, embodies several new features which lead to what are claimed to be improved results. Hitherto seam welding has been carried out on a continuous process, the work being held between rollers which move it steadily forward and, at the same time, carry the welding current. The metal between the electrodes at any moment is almost instantaneously fused, and therefore it leaves the electrodes in a plastic condition which renders the seam liable to open under any stress to which it may be subjected during welding. Another disadvantage of the continuous process is that it involves the preliminary cleaning of the metal by sand-blasting or pickling. As the scale on iron has a lower melting point than the iron itself, it becomes fused in advance of the metal, and introduces a plastic layer between the electrodes and the metal. The coefficient of friction being thus reduced, the electrodes are liable to slip and to feed the work slowly and spasmodically. Those portions of the metal which remain too long between the electrodes are burned, and the clinging of the burned metal to the rollers aggravates the trouble and causes more burning. Hence with the older method there is necessity for constant cleaning of the electrodes, which adds to the expense and the time occupied in the process.

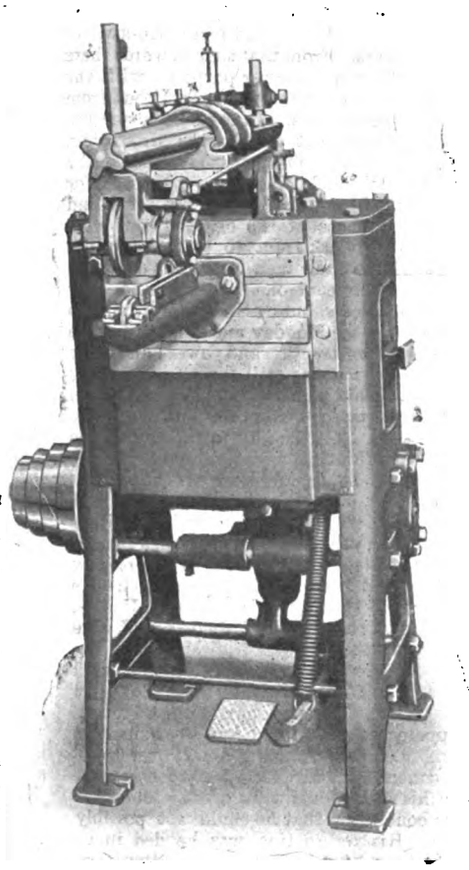

Fig. 1.—A New Seam-welding Machine.

These drawbacks are entirely eliminated, it is claimed, by the new machine, fig. 1, the essential feature of which is that the electrodes remain stationary during the brief welding period, and are revolved only to feed the work forward. As soon as the metal between the electrodes is fused the current is switched off, and a perfect weld is assured by a momentary additional pressure. Enough time is allowed to elapse to allow the weld to cool off and set, then the rollers revolve and feed the work forward for the next weld. By this arrangement the rollers invariably grip on relatively cold metal, giving a positive regular feed in spite of the scale on the surface.

The necessary series of operations is ensured by a simple and reliable cam action. In the first step the rollers are brought together in the usual way by means of a pedal operating through a spring. In the Marryat & Place machine, however, the pedal mechanism carries a toggle and a lever arm, and one end of the arm carries a roller which bears on a power-operated cam, while the other end is connected to the rod carrying the spring which controls the upper electrode, and which also actuates a trip switch to control the welding current. The cam and switch are so arranged that the current is switched on as soon as the electrodes are pressed on the work; then the cam raises the spring rod still further, simultaneously tripping the switch and giving the electrodes a further squeeze. After the interval for cooling the work is fed, either by hand or by power, until it is gripped again by the electrodes, and the same cycle of operations is repeated, giving a series of overlapping spot welds which form a watertight seam.

Application has been made for provisional protection for this machine.

A Selector Switch Box.

Messrs. Siemens Bros. & Co., Ltd., of Palace Place Mansions, Kensington Court, W.8, manufacture the 3-line selector switch box shown in fig. 3, for use on merchant ships.

This apparatus is employed when it is necessary to send instructions from one position to several outlying stations. The orders can be given to each station separately or to several stations simultaneously. The selector switch boxes are fitted with a 3-in. bell for calling and a flag indicator to denote which station is calling up.

A lamp, fitted inside the box, is lighted when a call signal is given by any of the outlying stations, the illumination being sufficiently bright to enable the flag indicator to be seen at night.

As the calling and speaking are carried out on distinct circuits, no interference or cross talk is possible if one station rings up while the home station and one of the outlying stations are already in communication.

For calling up from the home instrument, it is only necessary to turn the selector switch handle of the station required to the "on" position, and then to actuate the key or push of the instrument in the usual manner.

Calling from the outlying station is carried out in exactly the same manner as in the case of directly-connected instruments.

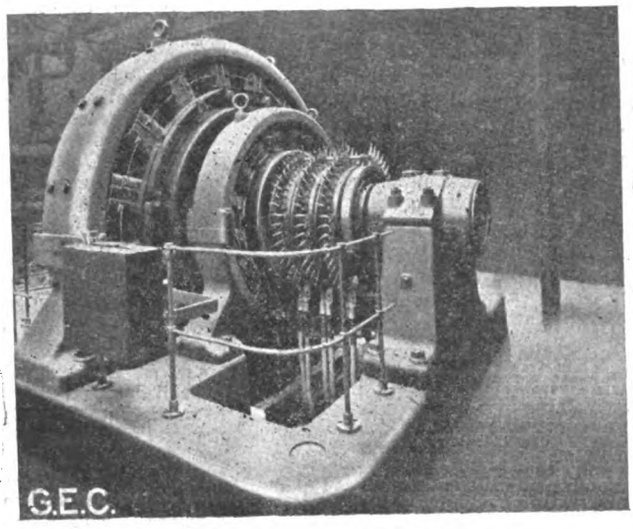

Fig. 2.—A.C. End of G.E.C. 1,500-kw. Rotary Converter.

Fig. 3.—Selector Switch Box.

A Large Rotary Converter.

A leaflet recently issued by the General Electric Co., Ltd., 67, Queen Victoria Street, E.C.4, gives particulars of a 1,500-kw. converter supplied to the Battersea Borough Council. It was required that the machine should convert either a.c. to d.c. or *vice versa* with a range of voltage of 6,000 to 6,600 on the h.t. side and 470 to 530 on the d.c. side, the power factor being maintained at unity at any voltage. In order to meet this wide range an alternating-current booster was fitted, having a potentiometer regulator in its field circuit. For inverted running the fields are excited from a direct coupled exciter so as to prevent the speed from rising unduly on account of lagging wattless currents.

When running a.c. to d.c. the converter is used as a shunt machine, but from d.c. to a.c. a compound field is put in circuit to steady the speed during fluctuations of the inductive.

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load. A change-over switch is mounted on the machine to cut the compound winding in and out. The converter is specified to start up from the D.C. side, but provision is made for fitting an A.C. starting motor at a later date. A three-pole switch is mounted on the machine to open the A.C. circuit during starting, and synchronising is effected on the H.T. side by means of an existing synchronising panel. Fig. 2 shows the A.C. end of the machine.

CORRESPONDENCE.

Letters received by us after 5 P.M. on TUESDAY cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Trading Restrictions.

With reference to the letter appearing in your issue of April 16th regarding trading restrictions on metal-filament lamps, this is rather a surprise to many of the people in the trade, and I think it would be of interest if Mr. Edgecombe would reply to the following questions:—

1. Can any contractor stock, advertise, or sell lamps which are not controlled by his Association?

2. Can any graded retailer stock, advertise, or sell metal-filament lamps of any other than Association makes?

I notice he mentions that only factors (who it is agreed are agents for Association lamps) are bound down by this agreement, but I have before me a *retailer's agreement on group 1 lamps*, and one of the conditions reads as follows:—

"We agree not to advertise, stock, or solicit orders for metal-filament lamps of any type or group of other than Association makes (as set out in previous page)."

It would be interesting to have Mr. Edgecombe's reply.

Interested.

Newcastle,
April 20th, 1920.

Electrolytic Iron.

I have read with interest an abstract from the series of articles in *Le Génie Civil*, by Jean Escard, which appeared in your issue of April 16th, and I should be much obliged if you would allow me to point out one or two facts in connection with the article of which Mr. Escard does not appear to be aware, namely, that the process being worked by the Société "Le Fer" is the process developed by myself, and a licence was granted to that company under my patents, which is the process it is using now. Mr. Jean Escard also points out that I made iron tubes about the year 1908 by a process analogous to the copper cylinders manufactured by the Elmore process, but this is not the case. The process I employed was not analogous to the Elmore copper process, as no burnisher was used to make the deposited iron smooth, but the mandrels were revolved at a critical speed to give the necessary skin friction between the deposited iron and the electrolyte, as is now being done at the works of Messrs. Bouchayer & Viallet, who hold a licence from "Le Fer."

S. Cowper-Coles.

Sunbury-on-Thames.
April 24th, 1920.

Cost of Living in Algeria.

I notice that the ELECTRICAL REVIEW frequently publishes information as to the cost of living in various parts of the world with a view to giving guidance to those who may be considering taking engagements abroad. I am sending you a list of approximate prices ruling at the present in Algeria:—

Rent (small flat suitable for two adults and two children), about 3,000 francs per annum; municipal tax on flat, 360 frs. per annum; coal (per ton), 600 frs.; general servant, 100 frs. per month; bread per kilo (2 lb. 2 oz.), 1 fr.; meat per kilo, 10 to 12 frs.; butter per kilo, 20 frs.; fish per kilo, from 4 to 8 frs.; tea per kilo, 25 frs.; coffee per kilo, 9 frs.; cheese per kilo, 15 frs.; sugar per kilo, 4 frs.; rice per kilo, 4 frs.; potatoes per kilo, 1 fr.; lard per kilo, 12 frs.; clothing (man's suit), about 450 frs., (woman's dress), about 350 frs.; boots (per pair), about 100 frs.

At the present time the rate of exchange is greatly in favour of anyone receiving payment in pounds sterling, but a study of these figures will show how high the prices of ordinary commodities are in Algeria at the present moment.

F. Dorrien Thoroton,
Sub-Commissioner, F.B.I.

Algiers.
April 22nd, 1920.

[We are very much indebted to our correspondent for these interesting and useful data.—EDS. ELEC. REV.]

THE SOUTHAMPTON STRIKE.

IN a statement which refers to the salient points of the above strike, particulars of which were given in our last two issues, Mr. Harry S. Ellis, borough electrical engineer, informs us that both the Mayor and himself declined to interfere between the two Unions concerned, and at 10 o'clock one morning the men intimated that they would shut down the undertaking at 5 o'clock that night. They had intimated the same thing every night for a week during the trouble in connection with Messrs. Pirelli, when the Corporation refused to cut off the firm's supply, and so helped it to break the strike. About 5.30 p.m. on the 13th inst., the shift engineer, junior shift engineer and switchboard attendant walked out of the works and left the plant in the hands of Mr. Ellis, his chief assistant, and the power station superintendent. At 10 p.m. the B.S.U. called out the whole of the rest of the shift staff and left the three mentioned above in charge of the whole of the running plant, with the full load of the station on. Shortly after this, Mr. Dobson, the tramway manager, went down with two of his men, and Mr. Bennett, consumers' engineer, went down and took charge of the canteen and telephone. This staff kept the whole plant running with the full supply on, until the following morning at 10.30; at which time Mr. Ellis sent two of those who had helped him home for a few hours' rest, in order to make sure of the lighting load for the following evening and night. This left Mr. Ellis and Mr. Hooper and a lad of 16 in charge of the whole station. One or two volunteers began to turn up, and they decided to make an attempt to raise steam. By 4 o'clock they had stoked up the boilers and raised the pressure to 90 lb., and had a 500-KW. set running on the general supply bars. From that time onwards there has been a full supply for lighting and power purposes, with the exception of one small area where the supply was furnished from a sub-station containing motor-generators. In order to ensure the lighting supply, the tramways were not run for the time being. The staff referred to, together with volunteers, maintained the whole supply as described, the peak load being about 2,000 KW., for four days, by which time skilled men had been appointed and taken over their duties. As only three of the original staff were left, it was necessary for them to work from 15 to 18 hours per day on the average, as although the new men were skilled, it was impossible for them to take complete control. The three not only trained all the new men and volunteers, but by Sunday were able to run the full traction supply, and by Monday morning the whole supply was normal, including lighting, traction and power; and every consumer in the town whose service was still intact was getting his supply in the ordinary way. This included the training of men for sub-stations—one containing motor-generators and the other two motor-generators and batteries. On the Monday afternoon the Town Council met at 2.30. The Chief Conciliation Officer of the Ministry of Labour went down to try and bring the parties together, as a general strike of all the workmen in the town had been threatened. The E.T.U. claimed that Mr. Hooper should either re-join the E.T.U. or be discharged; otherwise it would call a general strike. As a result of the Committee having decided to take on new men permanently, and to offer to old men only those jobs which were still vacant, the Trades Council, consisting of all the Unions, threatened a general strike unless the whole of the old staff were allowed to return to work, and the new staff discharged. The Council and the Conference sat from 2.30 p.m. on Monday until 5 a.m. on Tuesday, and as a result of the conference the Town Council decided finally that the whole of the old men should return to work, that the newly appointed men should have two months' pay, and that the question of Mr. Hooper should be left over to be settled by the two Unions concerned. Mr. Ellis felt so disgusted that responsible members of his staff should walk out at a moment's notice, that he came to the conclusion that he could not possibly continue to work with them. His resignation was handed in to the town clerk on the 22nd inst., and he stated that no matter what they offered him he would not remain any longer a paid official of the Corporation. He has, on the other hand, offered that if he can do anything to assist with extensions in the capacity of an independent consulting engineer, he is prepared to take over the work upon terms to be arranged, but it must be distinctly understood that whatever work he does is done from his own office, and that he is an absolutely free agent to take up any other consulting work that he can secure. The question at the moment is, what is going to happen in the case of the chief assistant; Mr. Hooper, power station superintendent; Mr. Bennett, consumers' engineer; and Mr. Brookes, meter test-room superintendent, who are all members of the E.P.E.A. Mr. Ellis is not interfering with them at all; but he understands it is the intention of the secretary of the E.P.E.A. to call upon all these men to hand in their resignations, and to black-ball the Southampton electricity undertaking so far as E.P.E.A. men are concerned.

All the other Trade Union men, such as the A.S.E., general workers, blacksmiths, carpenters, &c., remained at their posts, but they would not assist in any way whatever in operating the plant. The strike affected every member of the shift staff, and the whole of the mains and consumers' departments, with the exception of the general labourers.

Mr. Mills, who was chief assistant in Mr. Street's time, went down and took charge of the mains department; and in spite of the fact that he had no men to assist him, he single-handed attended to all consumers' service faults, and in addition, when a H.T. main cut off one large district, he was able to get practically the whole of that district going again, the only part of that section left out being that on the Portswood side of the H.T. fault. By the time he was ready to tackle this fault, arrangements had been made for

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the old staff to return to work again. Although Mr. Ellis asked the E.T.U. officials to send the whole of the men back to work immediately, the mains staff did not turn up until the following morning, with the result that part of the district referred to was without light for one night.

Mr. Ellis states that before the strike took place, he was on perfectly good terms with, so far as he knew, every member of his staff; and he believes that if it had been left with the staff to decide what to do, there would have been no strike at all. He also understands that the strike was not recognised officially by the principal officials of the E.T.U. in London.

During the six days of the strike it was practically impossible for Mr. Ellis or either of his assistants to leave the station for meals, and all meals taken were provided and served by Mrs. Ellis, with the assistance of two or three of her friends. According to the *Southern Daily Echo*, at the meeting of the Town Council on the 21st inst., a letter from the Mayor, Mr. S. G. Kimber, was considered, in which he tendered his resignation as chairman and member of the Electricity Committee. Mr. Kimber stated that the decision arrived at by the majority of the members of the Council not to honour the definite pledge of permanent employment given by himself on behalf of the Electricity (Emergency) Sub-Committee to those men who came forward to their assistance during the strike, and their further determination to reinstate the strikers, showed a want of appreciation of the successful efforts of his colleagues and himself to keep the station running. It showed a lack of confidence in his own administrative action, and made continuance in his office an impossibility. At the same meeting, Mr. Ellis's resignation of the post of borough electrical engineer from May 31st was also to be considered.

BUSINESS NOTES.

A Canadian Inquiry.—The Department of Overseas Trade has received a dispatch from H.M. Trade Commissioner at Toronto stating that a firm in that city wants quotations for quantities of 50 tons and upwards of electrical sheets for motor field magnets and armatures of 24 B.G. (0·025 in.). A small sample of the material in question was available for inspection on application to the Department of Overseas Trade, Room 50A, up to April 29th, when it was to be forwarded to firms in the provinces who may be unable to inspect it in London. The name and address of the inquirer can be ascertained at the Department.

Plant for Sale.—Clacton Urban District Council Electricity Department has for disposal two Davey-Paxman 150-B.H.P. double-cylinder Q type gas engines, direct-coupled to 100-KW. Thomas Parker D.C. generators; Whitby Urban District Council Electricity Department invites offers for one 100-KW. Parsons turbo-generator and one 28-H.P. vertical enclosed steam engine; Harrogate Corporation Electricity Department has for sale a 600-H.P. triple vertical steam engine, &c. For particulars, see our advertisement pages to-day.

A Swedish Transformer Competition.—It has long been considered in Sweden to be of national economic importance, from the point of view of standardisation, to obtain the most economical type, or series of types, of transformers which will meet the different requirements of consumption for average Swedish conditions. With the object of bringing about such a result, the Swedish Academy of Engineering Science (Ingenjors Vetenskap Akademien), of Stockholm, has opened a competition for proposals, which are to be submitted not later than October 31st, 1920, the sum of 2,500 kr. being offered in prizes. The problem put forward for solution is:—"Taking into consideration the costs of manufacture and working, what is the most appropriate construction for transformers, worked out on the basis of a systematic study of all the factors influencing the problem?"

A Dutch Company.—The report for 1919 of the Algemeine Nederlandsche Electriciteits Maatschappij (General Netherlands Electricity Co.), late Groeneveld, Ruempel & Co., of Amsterdam, states that the company's sphere of activity was extended during the year. The turnover, however, was less than in 1918, owing to the general fall in the prices of machines and of raw and other materials. It is intended to pay a dividend at the rate of 12 per cent. out of net profits of 208,000 fl., as compared with 26 per cent., and 535,000 fl., respectively, in 1918, the share capital having increased from 1,000,000 fl. in the latter year to 1,500,000 fl. in 1919.

National Federated Electrical Association.—At the annual meeting held on 20th inst., at the Chamber of Trade Rooms, Bradford, the following officers were elected for the ensuing 12 months:—Chairman of the Electrical Contractors' Association Incorporated, The National Electrical Contractors' Trading Association, Ltd., and the National Federated Electrical Association, Mr. A. Smith, of Messrs. Smith & Croft, Bradford; hon. secretary, Mr. H. Moss, 82, Leeds Road, Bradford; delegates to Chamber of Trade, Messrs. L. Jessop and H. Moss; delegates to the District Joint Industrial Council, Messrs. A. Smith, L. Jessop, F. Collinson, Casse and H. Moss.

Telephone Works at Coventry.—The industrial development of the Copsewood Estate, at Coventry, by the Peel-Conner Telephone Co., Ltd., is making considerable progress, and includes the erection of upwards of 80 dwelling houses on land adjoining the works. The works were designed by Mr. A. B. Strachan, architect, and the contractors are Sir Robert McAlpine & Sons, Ltd. The buildings are planned on lines which provide healthy conditions for the workers, and at the same time afford the maximum facilities for securing the best results as regards output. Provision is made for separate blocks of buildings set apart for the purpose of offices and administration, main factory, ebonite works, cabinet making, &c. The floor area of the factory buildings at present erected is about six acres in extent, but there is ample room for possible extension in the future. With the completion of the new works, this industry will be concentrated at Coventry, and existing works at Manchester will be closed down.

Belgium.—With the title of Fils et Cables Electrique, Société Anonyme, a company has been formed at Brussels, with a capital of 1,000,000 fr., for the manufacture and sale of electrical material, and, in particular, electric wire and cables.

A Bohemian Glow Lamp Factory.—It is reported from Prague that a glow lamp factory on a large scale is to be established in that city by a group to which the A.E.G. and the Osram Works belong, and in which English and American capital is said also to be interested. The factory is to serve the purpose of meeting the needs of Bohemia, the succession States, and the export trade.

Works in India.—In the report recently issued, Messrs. Fairbairn Lawson Combe Barbour, Ltd., state that a commencement has been made in the erection of works in India. For this purpose a separate company has been formed under Indian law, and a substantial issue of participating preferred shares of that company has been successfully made in Calcutta.

Liquidations and Dissolutions.—Quain Electrical Co., Ltd.—A petition for the winding up has been presented to the High Court by Messrs. R. & A. Main, Ltd., of Gothic Works, Angel Road, Edmonton, and will be heard on May 4th.

Chesterfield Tube Co., Ltd.—Winding up voluntarily for reconstruction purposes. Liquidator, Mr. J. G. Dixon, 6, Austin Friars, E.C.

Unelma, Ltd.—Winding up voluntarily; liquidator, Mr. F. T. Shearcroft, 36 and 37, Queen Street, E.C. 4. Meeting of creditors, May 4th, at Anderton's Hotel, Fleet Street, E.C. Claims to be sent to the liquidator by May 29th.

Alliance Electrical Co., Ltd.—Winding up voluntarily for reconstruction purposes. Liquidator, Miss E. McArthur. Meeting of creditors, May 3rd, at 32, King Street, Covent Garden, W.C.

Tooley, Emberton & Burrows, builders, contractors, and electrical engineers, 5, Lytton Grove, Seaforth, Lancs.—Messrs. T. A. Tooley, H. A. Burrows, and N. Emberton have dissolved partnership. Messrs. Tooley & Burrows will attend to debts.

French Electrical Companies.—The Société Electrique de la Sidérurgie Lorraine has been formed at Paris (63, Avenue Victor Emmanuel III), with a capital of 8,000,000 fr., for the erection and working of a motive power network knitting together the central stations of the ironworks and mines in the Lorraine district.

The Société Anonyme d'Appareillage Electrique Moderne (44 *bis*, Rue de Villejist), has been formed at Paris (previously erroneously described as the Société Anonyme Morse).

Under the style of the Electrique de Vendée, has been formed at Paris (Rue de Belzunce 11), a company for the production and utilisation of all forms of electric energy, especially in Vendée. Its capital is 1,000,000 fr.

The electric company styled Maison Bréguet has decided to raise its capital from 4 000,000 to 8,000,000 fr.

La Compagnie des Lignes Télégraphiques et Téléphoniques is the name of a new company which has just been formed in Paris (29, Rue de Londres), with a capital of 10,000,000 fr.

Wages in the Electricity Supply Industry.—The recent decision of the District Industrial Council for the West Midlands Area that, subject to the approval of the National Council, all electricity undertakings in the area should be recommended to apply Engineering and Foundry Trades Award No. 180 to all manual workers (except those workers whose wages are regulated by other Trade Union organisations), has now been approved by the National Joint Industrial Council for the Electricity Supply Industry. It will be remembered that the award gives an advance of 3s. per week from the beginning of April, and a further 3s. from the beginning of June.

All electricity supply undertakings in the West Midlands Area are, therefore, being notified to this effect, and are requested to apply the award to their employés forthwith.

The National Council adopts the view put forward by the District Council that in future any alterations in wages or working conditions are to be decided by the Industrial Council, without reference to any decision which may be come to by other industries. *Staffordshire Sentinel.*

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Book Notices.—"Commutators as Structures" (36 pp.), "The Critical Speed of Shafts" (43 pp.), "The Submarine" (32 pp.), "Design and Applications of High-Speed Gearing" (42 pp.), "Lubrication of Bearings" (36 pp.), "The Design of Flat Plates" (62 pp.), and "Steam-Raising from Waste Material" (27 pp.). Gateshead-on-Tyne: G. W. Mason & Co.—The Association of Engineering and Shipbuilding Draughtsmen has been well advised to publish these excellent papers by its members; the lecture on commutators by Mr. R. J. Roberts, A.M.I.E.E., includes valuable data regarding stresses and methods of dealing with them. Every paper is illustrated by lucid detailed drawings.

"Vickers News." Vol. II, No. 14. Pp. 36. London: Vickers, Ltd.—The present number of this journal contains many interesting and informative features, including a description of the "B.B.H." oil switch, and an account of the changing over of the Sheffield Armour Department from the production of war *matériel* to peace products.

"British Standard List of Rubber Tires for British Standard Rims." Pp. 22. London: Crosby Lockwood & Son. Price 1s. net.—This memorandum was urgently called for by the need for reducing the great number of sizes in present use. Prepared by the British Engineering Standards Association, these specifications have been accepted by the British Rubber Tyre Manufacturers' Association. Copies may be obtained from the offices of the former Association, price 1s. 2d. post free.

"*Journal* of the Institution of Electrical Engineers." Vol. LVIII. March, 1920. No. 289.—This issue contains the following papers: "Transformers for Electric Furnaces," by Mr. J. L. Thompson; "Direction and Position Finding," by Captain H. J. Round; and an address to the Students' Section, by Mr. R. T. Smith.

The Supplement to Vol. LVII (published April, 1920), Part 1, contains the following papers: "Electrical Methods of Measuring Body Temperature, and Some Notes on the Cardiograph," by Mr. R. S. Whipple; "The Fullerphone and Its Application to Military and Civil Telegraphy," by Major A. C. Fuller; "The Oscillatory Valve Relay: A Thermionic Trigger Device," by Captain L. B. Turner; and "Magnetomotive Force Calculations for Cylindrical-Field Alternators under Steady Short-Circuit Conditions," by Mr. A. E. Clayton. London: E. & F. N. Spon. Price 10s. 6d. each.

"On the Detecting Efficiency of the Thermionic Detector." By H. J. van der Bijl, M.A., Ph.D. Reprint from the *Proceedings* of the Institute of Radio Engineers, New York.—In this paper the author describes a method of determining the detecting efficiency of vacuum tubes by feeding them with radio-frequency current, modulated at audio-frequency, and gives the theory of the method. The use of a receiver shunt calibrated in terms of miles of standard cable is advocated. Details of the apparatus used are given, with experimental data; a method of comparing the efficiencies of tubes is described, and a method of measuring tube amplification is explained.

"The Book of the Ford Van" (120 pp.). By R. T. Nicholson. London: Temple Press, Ltd. Price 3s. net.—This volume will be invaluable to owners and drivers of Ford vans—an ever-increasing section of the public. The work deals in a complete manner with every aspect of the question, including costs, capacity, loading, driving, and care and maintenance. Although the information given is applied to the "Ford," its usefulness will be apparent to owners of other makes as well.

"Silvanus Thompson, His Life and Letters." By J. S. Thompson and H. G. Thompson. Pp. vi + 372. London: T. Fisher Unwin. Price 21s. net.

"Electric Welding and Welding Appliances." By H. Carpmael. Pp. xii + 128; figs. 84. London: Constable & Co., Ltd. Price 18s. net.

Three-Shift System.—A Special Committee of the National Federation of General Workers has agreed to recommend to the Central Conference that the question of hours and arrangement for a three-shift system be left to the districts. At a meeting of the Committee an agreement between the Manchester District Engineering Trades Employers' Association and the A.S.E., S.E.M., and the Electrical Trades Union for the introduction of three shifts for maintenance men employed at the Pearson & Knowles Coal and Iron Co., Ltd., and the Partington Steel and Iron Co., Ltd., was quoted. Under this the shifts are:—First shift, 6 a.m. to 2 p.m.; second shift, 2 p.m. to 10 p.m.; third shift, 10 p.m. to 6 a.m. The hours on the first shift, which is termed the day shift, are 48, for 47 hours of which the full week's wages are paid, the remaining hour being at time-and-a-quarter. The second and third shifts, termed night shifts, consist of 40 hours of five eight-hour shifts, for which 48 hours are paid.—*Manchester Daily Despatch.*

The Dutch East Indies.—A Rotterdam newspaper of the date of April 20th, published a statement issued by the Netherlands Indian Gas Co. (Ned. Ind. Gas Mij.). The latter stated that at an extraordinary general meeting held the previous day, Mr. O. S. Knottnerus, manager, announced that a concession had been granted to the company for 40 years for the operation of gas works at Medan, and in this connection the opportunity had been taken again to seek to conclude an agreement with the Electriciteits Maatschappij "Medan." The result of the negotiations was that it had been determined that the gas company should take over the shares of the electricity company on the basis of an exchange of 6,000 fl. shares in the latter for shares of 2,750 fl. in the former company. In this way 75 per cent. of the shares in the electricity company would immediately pass into the possession of the gas company, whilst the opportunity for acquiring the remainder in this manner would remain open for five years. All the directors of the electricity company were retiring, and the management had been taken over by the gas company, and Mr. J. P. Jager, manager of the Medan central station, had been appointed a director of the gas company. The transaction had taken place at a price which was not too high, as the Medan station required to be entirely renewed, which would naturally be at the cost of the gas company, which intended, notwithstanding its own gas concession, to bring the working of the electricity works up to date. The capital already issued by the gas company was 4,190,000 fl., and as shares for 800,000 fl. were in portfolio, the purchase price could be defrayed by the exchange of 44,000 fl. in shares out of the latter. After referring to the extension of certain gas concessions, and the acquisition of a concession for a gas works at Bandoeng, the statement mentioned that an electric lighting concession had also been obtained at Macassar, where preparatory work had already been begun. In conclusion, it is stated that all these proposals and transactions were approved by the extraordinary general meeting. The address of the gas company is Willemsplein 10, Rotterdam.

Conference of Manufacturers.—The National Union of Manufacturers (Inc.) has called a conference of manufacturers, which is to be held at the Guildhall, E.C., on Friday, May 7th, at 2.30 p.m., when resolutions will be proposed:—

1. Entering a vigorous protest against the continuance of the Excess Profits Duty.
2. Making a request to the Prime Minister to set up a Committee to examine and report as to whether Government Departments which were created during the war as Departments of control, should now in whole, or in part, be closed down.
3. Appointing a deputation to wait on the Prime Minister with the resolutions of the conference.

The chair will be taken by Mr. George Terrell, M.P., the President of the Union.

Australian Report on the British Trade Situation.—In the course of its report for 1919, the Australian Association of British Manufacturers and their Representatives says:—"Experience has proved that the optimistic views expressed as to the prospects of post-war trade in the last annual report were not warranted. The position of British trade during the past 12 months has been little better than during the war years, mainly owing to industrial troubles in the United Kingdom, the general feeling or unrest caused by the sudden release from the intense nervous and physical strain of war, increased and increasing costs of living and the difficulty in estimating costs of manufacture. British manufacturers are at the present time under a very great temptation to neglect their overseas connection, especially in such a remote Dominion as Australia, owing to the large orders which are placed in the home markets, and high prices ruling. The majority, however, are sparing no effort to keep their overseas connections together, and all should bear in mind the fact that there is a certain value attaching to the goodwill which they have individually built up in the overseas markets, and if they neglect to protect that goodwill, the result will be to make it a present to their foreign competitors. Later, when orders from home markets have been fulfilled, manufacturers will be compelled to look further afield to find outlets for their goods, and they may find foreigners well established in markets which before the war were theirs. It would then be an expensive and laborious task to regain their old ascendency, as those who have obtained a lucrative trade for the asking, will not be inclined to give it away on the same terms. British manufacturers are, therefore, studying their own interests in resisting the temptation of disposing of the whole of their output at their factory door and reserving a certain percentage for keeping together or regaining their overseas connection, even if this course may mean some present sacrifice. During the war America and Japan have made great strides in their trade with Australia, and there is a real danger that, unless British manufacturers are placed on the Australian markets in normal quantities, and at competitive prices, Australian merchants may become so used to dealing in foreign goods that they will continue to buy the goods they know, rather than 'experiment' with others."

British-made Electric Bulbs.—A private conference was held, on Tuesday, between the Electric Lamp Manufacturers' Association and manufacturers of glass bulbs. The conference marks a further stage in the wresting the glass industry from Germany and its rehabilitation in this country. It was called to discuss a proposal for the further standardisation of British-made glass bulbs.—*Financier.*

Auction Sales.—By direction of the Disposals Board Ministry of Munitions, MR. C. A. CHARLTON will sell by auction at the National Ordnance Factory (Cammell, Lairds), and the Radford Gas Works, Nottingham, on May 19th, a quantity of engineering plant and machinery, electric motors, centrifugal pumps, fans, &c. MESSRS. G. M. DIXON & Co. will sell by auction at Northwich on May 13th and 14th the chemical plant, tools, &c., of H.M. Factory, Gadbrook, and the works of Messrs. Brunner, Mond & Co., Ltd., at Winnington. Full particulars are given in our advertisement pages to-day.

Swiss Enterprise in Rumania.—The *Economic Review* quotes a French paper to the effect that a syndicate, consisting of several electrical undertakings, metal works and engineers, has been formed by Swiss manufacturers for the purpose of undertaking, primarily, the repair of electrical plant and works in Rumania. The necessary material will be supplied by four Swiss factories. Workers and experts are to leave for Rumania very shortly. The syndicate is also disposed to undertake the repair of the railways and roads. Rumanian workers are to be employed, and to be given technical training.

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Lead.—In their report, dated April 24th, Messrs. James Forster & Co. state :—

On Thursday, on publication of a cable from the Broken Hill district to the effect that the miners had refused to accept the terms offered them, there was a strong demand in all positions, July selling up to £42 11s. and closing at £41 10s. buyers.

The shipment of American lead round from Liverpool Stores has now practically ceased, and is not likely to be renewed. The lead was not at all liked, and much of the recent drop in values was undoubtedly due to it.

The scarcity of good brands is obvious, with premiums of 30s. to 40s. per ton being freely paid for Australian and even Spanish brands both by the trade and for export.

In the course of their report, Messrs. G. Cawson & Co. say :—

These purchases appear to have been based on the idea that the Broken Hill strike settlement has broken down. This does not appear to be a fact, as negotiations are still continuing and a settlement is expected next week.

The position generally has not changed, except that consumptive demand, if anything, is not quite so good. The stopping of all large building operations will tend to reduce consumption.

Supplies of lead are ample for all requirements, and are likely to continue so. The outlook would point to a declining market, but so long as speculators continue to pay heavy premiums to finance their operations the market may perhaps still be maintained at the present high level.

A Reuter's dispatch from Melbourne, dated April 23rd, stated that negotiations for the settlement of the Broken Hill strike were proceeding satisfactorily. It was hoped that a settlement would be reached.

Socials.—A concert was given, last week, in aid of the Huddersfield Corporation Tramways Social and Athletic Club.

Pope's Electric Lamp Co., Ltd., Social Club held another successful whist drive and dance on Wednesday, April 14th. About 500 were present, and the evening was successful in every way. The music was supplied by the Imperial Syncopated Orchestra, and Mr. Trevor Carman, chief engineer, was amongst those present. Mr. E A. Marx, sales manager, presented the prizes.

Catalogues and Lists.—The Lea Recorder Co., Ltd., 28, Deansgate, Manchester.—Leaflets No. N 2, showing a cooling-tower installation at one of the Birmingham Corporation's power stations where the flow is registered by "Lea" recorders; W 2, a photograph of "Lea" integrating apparatus supplied to the N.S.W. Government, and several lists of users of "Lea" recorders in a variety of industries.

London Electric Stores, Fulwood House, High Holborn, W.C. 2.—Illustrated and priced leaflet dealing with the "Holborn" fan regulator and the "Slidesie" fractional-H.P. motor regulator.

The Improved Solidite Co., Ltd., Advance Works, Jews Row, Wandsworth, S.W. 18.—Illustrated and priced list of "Solidite" insulating bushes, &c.

Enterprise Manufacturing Co., Ltd., Gun Street Electrical Works, Bishopgate, E. 1.—Price-list of direct-current starters for motors ranging from ¼ to 25 H.P.

The General Electric Co., Ltd., 67, Queen Victoria Street, E.C. 4.—Installation Leaflets Nos. E 10 and A 17. The first, including eight illustrations, describes the electrical equipment of the Berthlwyd Colliery, Gowerton, South Wales: and the second illustrates a 1,500-kw. rotary convertor supplied to the Battersea Borough Council.

The Semaphore Engineering Co., Ltd., Advance Works, Jews Row, Wandsworth, S.W. 18.—Leaflet dealing with dry cells, and one describing a cycle electric lighting outfit, priced and illustrated; also order card for cells.

Messrs. T. E. Slaughter & Co., 172, Church Road, Mitcham, S.W.—Leaflet illustrating and describing the "Lyto" dry cell.

Messrs. Siemens Bros. & Co., Ltd, Palace Place Mansions, Kensington Court, W. 8. — Pamphlet B 705, illustrating and describing an electric helm indicator.

Automatic and Electric Furnaces, Ltd., 281/283, Gray's Inn Road, W.C. 1.—Heat Treatment Bulletin No. 20, "Abnormal Steels." Giving results of tests on samples of eutechtoid and high carbon steels.

The Chloride Electrical Storage Co., Ltd., Clifton Junction, Manchester.—Illustrated folder dealing with "Nine Points of Special Excellence about the Exide Battery" for motor car starting, lighting, and ignition.

Surplus Aeronautical Material.—At the invitation of the Aircraft Disposal Co., Ltd., of which Mr. Godfrey Isaacs is chairman, and which has been incorporated for the disposal of all the surplus aircraft and accessories of the British Government, we had the privilege of seeing last week some small portion of the material which has been acquired under the contract. The sole managing and selling agents of the new concern are Messrs. Handley Page, Ltd., of Cricklewood, N.W. 2, and the purchase price, we understand, was £1,000,000, in addition to which 50 per cent. of any profits realised by the company from the sale or other use of the material taken over will accrue to the Government. After the inspection of part of the aircraft, material and equipment purchased under the contract, and now lying at Waddon aerodrome, in Surrey, a luncheon was given at the Savoy Hotel, at which a large number of guests from all parts of the world, besides representatives of the technical and daily Press, were present. The speakers were the Marquess of Londonderry, in the chair, General Sir Frederick Sykes, and Mr. Handley Page.

It is difficult to visualise the whole amount of material taken over when it is considered that the depôt which we saw at Waddon is but one of six which have been transferred, and that the contents of 130 more stations have to be sorted out and turned over to the new company. The material available for disposal includes 10,000 aeroplanes, 30,000 aero engines, £1,000,000 worth of instruments, and other accessories and materials in proportionate quantities, much of which is new and a large proportion in good condition. Mr. Page, in the course of his remarks, explained that the material and goods had been found to be readily adaptable to other than aeronautical purposes, and such things as the 1,000 tons of ball bearings, 350,000 sparking plugs, 100,000 magnetos, bolts, nuts and small accessories were finding a very ready sale with the present shortage of manufactured goods. Out of the large stock of instruments which they had, instrument sets for motor-cars were easily made up; revolution counters could be changed into speedometers; and aneroid barometers for registering height could be made into ordinary barometers for the more usual purpose of forecasting weather conditions. This did not, however, exhaust the list of possibilities; in engineering work large quantities of material were also being utilised. Engines designed for aircraft work ran satisfactorily on town gas; for instance, the Sunbeam "Arab" engine, which developed 200 H.P. as an aero engine, with its gearing removed, was being used at a lower speed as an efficient electric light and power plant, developing 50 H.P. Such a plant took but a small space, and could be purchased at a very low cost compared with the large low-speed gas engine which would otherwise be required. All these were, however, but side issues to the main problem of the disposal of aircraft, and it was to this that the company had directed its attention. To-day the prestige of British aircraft stood higher than any other in the world. It was early as yet for him to give the results of the sale of aircraft by the new company, but in the short period of its existence it had sold many more machines than the Aircraft Disposal Board had done during the whole period of its existence. It would be their endeavour still further to push the sale of British aircraft abroad, and for the good name already gained for British aircraft and, they hoped, for enterprise and energy, to remove the erroneous impression that sometimes existed that Britain lagged behind in selling efforts abroad.

Trade Announcements.—Messrs. Quead, Ltd., have removed their offices to 118-120, Victoria Street, S.W., to which address all communications should be sent. Telephone number: "3765, Victoria." The works are at Lewisham.

Messrs. Connollys (Blackley), Ltd., have opened offices and stores at Bradfield House, 27, Hunslet Road, Leeds, for the convenience of Yorkshire and Northern clients, and stocks of wire, &c., will be carried there.

Messrs. Drake & Gorham, Ltd., of London and Manchester, inform us that they are the sole concessionaires and manufacturers in the United Kingdom of the Ley-Allin electric time-checking system, described in the Electrical Review of September 7th, 1917, and since improved. The French rights are in the hands of Messrs. Burton, Fils, of Paris.

Messrs. W. E. Jones & Co., electrical engineers, have opened premises at 17, Queen Street, Deal (Kent).

The Sloan Electrical Co., Ltd., announce that their telephone number is altered to "2032 Clerkenwell" (4 lines).

Messrs. R. B. Hand & Co., Ltd., of High Holborn, W.C. 1, having secured an additional telephone, their amended number for all inward calls is "Museum 6286."

Automatic Telephone Developments.—It is announced by Mr. D. Sinclair, vice-chairman of the International Automatic Telephone Co., Ltd., of London, and managing director of its subsidiary company, the Automatic Telephone Manufacturing Co., Ltd., of Liverpool, that the new International Co. is vigorously prosecuting the introduction of automatic telephone equipment in foreign fields, and has received substantial overseas orders. Arrangements have been made by which the Western Electric Co., Ltd., of London, undertake under licence the distribution of Strowger automatic equipment as manufactured at Liverpool in certain territory outside of the United Kingdom and outside of the territory controlled by the International Telephone Sales and Engineering Corporation of New York and its subsidiary the Automatic Electric Co. of Chicago, U.S.A., and also outside of territory covered by the licences given by the Automatic Electric Co. of Chicago to Thomson-Houston of Paris. A substantial amount of new capital has been arranged for by the new International Co. for the extension of the plant of the Automatic Telephone Manufacturing Co., Ltd., of Liverpool, and it is expected that the manufacture of automatics on a large scale will be carried on there. The International Automatic Telephone Co., Ltd., is controlled by an International Syndicate composed of people who have been active in the management of the Automatic Telephone Manufacturing Co., Ltd., of Liverpool, and Theodore Gary and Company Syndicate of Kansas City, Missouri, U.S.A., who control the International Telephone Sales and Engineering Corporation of New York and the Automatic Electric Co. of Chicago. Among the International Syndicate members are Messrs. James Taylor and D. Sinclair, well known in connection with British manufacturing interests, and Messrs. Theodore Gary, A. F. Adams, and H. L Gary, who are, and have been for many years, prominently connected with large independent exchange and long-distance telephone properties in the United States. The Liverpool organisation remains unchanged, and the manufacture will proceed on the same lines as formerly, but the new arrangement will enable customers to benefit from quantity-production of automatic equipment. It will also make available for the benefit of Strowger business throughout the world the large staff of engineers controlled by the Automatic Electric Co. of Chicago, who were the inventors of the automatic telephone, and which company is the only organisation in the world to-day manufacturing automatic telephones exclusively and on the basis of quantity-production.

Electrical Factory in Jugo-Slavia.—An electrical repairing works, the only one in Jugo-Slavia, has been established at Agram under the name Première Usine pour l'Industrie Electrique Ivan Paspaet Fils. The section which makes electric torches can turn out from 6,000 to 8,000 a week.—*Economic Review.*

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Strike at Lever Brothers.—A few days ago our Liverpool correspondent reported that the strike of electricians at Lever Brothers' Port Sunlight Works continued. The Electrical Trades Union men were holding a mass meeting this week.

Bankruptcy Proceedings.—E. Cloney, tramway divisional traffic superintendent, 5, St. Albans Road, N.W. 5.—Last day for proofs for dividend, May 11th. Mr. W. P. Bowyer, Official Receiver, Carey Street, W.C.

H. H. Shave (H. H. Roberts), electrician, Portsmouth.—First meeting May 7th; public examination June 7th, both at Portsmouth.

Catalogues Wanted.—Messrs. Alfred Mumford and Co., Ltd., of 14-20, St. Mary Axe, London, E.C. 3, who are electrical shippers to India and East Africa, desire to receive catalogues and other publicity matter.

Neuhausen Aluminium Co.—The directors recommend a dividend at the rate of 18 per cent. for 1919, as contrasted with 20 per cent. in the preceding year, leaving 799,000 fr. to be carried forward.

Oerlikon Accumulator Co.—The dividend of the Akkumulatoren Fabrik Oerlikon, of Zurich, is announced at 20 per cent. for 1919, as in previous years. In addition, a bonus of 10 fr. per share is being distributed in connection with the celebration of the twenty-fifth year of the company's existence.

Copper and Lead Prices.—Messrs F. Smith & Co. and Messrs. James & Shakespeare report, April 28th: No change in copper prices. Messrs. James & Shakespeare report, April 28th: English pig lead, £43 10s.—an increase of £3 on the week.

LIGHTING AND POWER NOTES.

Aberdeen.—Wages.—After conference with the E.T.U., a Sub-Committee has recommended, and the Council has adopted, the following scale of increased wages:—Electricity Department: Plumber-jointer, £3 17s. 6d. to £4 per week of 48 hours; jointer (ex-Service men of nine months' training), £3 5s.; turbo-driver, £3 17s. 4d. to £3 19s. 8d.; stoker, £3 15s. 5d.; meter inspectors, £3 to £3 5s.; armature winder (as labourer), £3 12s. 6d.; motor inspector, £3 5s. to £4 5s. Lighting Department: One foreman, £4 9s. 10d.; two lamp trimmers, £3 1s. 10d. Tramway Department: One armature winder, 1s. 10d. per hour; one wireman, 1s. 10d. per hour. The meter inspectors, in addition to their pay, receive uniforms.

Bognor.—Price Increase.—The company supplying electricity to the town has decided to increase its charges as follows:—Power, first 100 units in each quarter 6d. per unit, from 100 to 200 4d., and beyond 3d. per unit. Heating, first 50 units 8d. per unit, from 50 to 100 6d., and beyond, 4d. per unit.

Brazil.—Water Power.—According to a statement recently made by the Brazilian Institute of Engineers, after a great deal of investigation, there are 148 waterfalls in Brazil, capable of developing about 30,000,000 H.P.

Burnley.—Increased Loan.—Owing to the increased cost of materials since his estimate for extensions was made, the electrical engineer states that £75,000 will be inadequate, and advises application for a total of £150,000.

Accident.—Owing to the recent bursting of a steam-pipe at the Byng Street power station of the L. & Y.R. Co., a dynamo attendant was severely scalded.

Blean.—Overhead Transmission.—The Rural District Council has granted permission to the Whitstable Electric Co., Ltd., to erect overhead lines in the parish of Herne for the transmission of electricity.

Bromyard.—Electric Lighting.—The Urban District Council has decided to adopt electric lighting for the town.

Continental.—France.—A considerable increase in supply prices is to come into operation on May 1st, as a result of a decision of the Paris Municipal Council last week. An attempt was made at the meeting to secure an adjournment of the question of advancing prices until the problem of raising charges had been more thoroughly investigated, but this was unsuccessful, and a similar result attended a proposal to render uniform the charges for the supply of power at high and low tension, and to introduce rates for lighting graduated according to the consumption. The final result is that the monopoly company and any others which may come into consideration have been authorised as from May 1st, to charge 1·10 fr. per KW.-hour for lighting, 0·75 fr. per KW.-hour for all other purposes for low-tension supply, and 0·55 fr. per KW.-hour for high-pressure supply.

The Energie Electrique du Nord de la France has decided to increase its share capital to 75,000,000 fr. by the issue of 260,000 250-fr. shares, and to augment its bond capital to the extent of 100,000,000 fr. The company is one of those which have suffered from the invasion, but its daily energy production now reaches 10 per cent. of that before the war, while its plant capacity will shortly be equal to that existing at the declaration of war. Present circumstances, however, have now created such a demand for energy that the company finds itself forced to contemplate the establishment of a large new station. This will be situated at Commines, and planned for an output of 60,000 KW., being equipped with big sets of the most modern type. This addition will suffice for the service of the existing network and its more immediate developments. Eventually the station's capacity will be raised to 120,000 KW.

The Commission nominated by the Conseil Général of the Bouches-du-Rhône to examine the scheme for a departmental station has decided to apply to the State for a concession of a fall on the Durance River, and the engineer of the Ponts et Chaussées has been asked to draw up a list of the requirements:—(1) For departmental railway lines existing, and likely to be built; (2) public lighting service in the department; and (3) lighting of public monuments.

Denmark.—The country is at present supplied from 497 central stations having a total output of 108,000,000 KW.-hours per annum. The net sale to 205,000 consumers is 30,800,000 units for light, and 54,700,000 units for power.

The average net cost per unit in 73 towns is 4½d., in 387 villages 7½d., and in 37 agricultural districts 3½d. The high cost in the villages is chiefly due to the load-factor, which seldom reaches 0·10, and in a smaller degree to the high cost of fuel.

The supply of electrical energy from Norwegian waterfalls is being carefully considered. The distance from the nearest suitable falls to Copenhagen is about 75 miles, and it is proposed to send 26,000 KW. at a pressure of 50,000 volts by an overhead transmission line running through Sweden to Malmö, and thence by submarine cable across the Sound to Copenhagen.

The engineering difficulties in connection with this proposal are easily overcome, but the economic question presents some difficulty, as a low load factor would require a very expensive transmission line, and necessitate high prices to consumers. The estimated requirements of the country, provided cheap energy can be supplied, are about 450 million KW.-hours per annum. No final decision has, however, been arrived at.—*Technical Review.*

Spain.—The *Technical Review* states that a report upon the possibility and desirability of installing an industrial electrical network has recently been published. By separating the generation of power, transmission and distribution, and by eliminating too many independent lines, a great saving would be effected both by reducing the initial expense and the working costs. Such a network would also solve for the State the question of the provision of its own power, either for electrifying the railways or for other purposes, as the provisions made in the Bill would reserve to it these rights. Low-calorific-power coal, unsuited for transport, could be utilised to raise power. The main source of supply would be the waterfalls of the country, especially those of high head: and the country is especially favoured in this direction because high-water prevails at different seasons in different parts of Spain: in the Pyrenees in spring and summer, and in other parts of the country in winter. A careful investigation of the water power resources available has shown that a total of 2,000,000 KW. could be generated (excluding from the calculation falls yielding less than 2,000 KW.).

The proposed network would, as far as convenient, join up the main centres of production and consumption. It would be a peripheral polygonal network, with Madrid as the centre of consumption. The total length of lines to be constructed would be 4,810 km.

As regards cost, three types of feeders are considered, according to the quantity of power to be transmitted. These are 3 × 50, 3 × 75, and 3 × 100 sq. mm. cross-section. With the largest of these cross-sections it would be possible to transmit 25,000 KW. over a distance of 330 km., with a permissible voltage drop of 12 per cent. This particular line would serve Oviedo-Duero-Madrid, Tremp-Madrid, Tremp-Bilbao, and Tremp-Barcelona. The remaining sections of the polygonal network would be of 45 sq. mm. cross-section, with the exception of the section Seville-Granada and Valencia-Tortosa, which would be 50 sq. mm. In order to provide a reserve for emergencies, the Commission recommends the construction of two parallel lines, suspended from the same towers, with stations for line-protection every 100 km., and change-over stations every 25 km. Provision is also made for an earthing cable of 10 mm. diameter. Taking as a basis a price of 1 peseta per kg. for towers erected, and a price of 2 pesetas per kg. for copper wire, the cost of the project is estimated to be 130 million pesetas.

The report recommends the preliminary construction of a network for 300,000 KW., which is about the power already available from other sources. The old systems would be joined up to the new one, thus giving initially an amount of 600,000 KW. available for consumption. As regards the unification of voltage, this will be an easy matter, since the frequency of 50 is practically universal in Spain and the current is three-phase. The voltage proposed at first is 150,000 volts.

Durham.—Lighting Scheme Abandoned.—The Board of Guardians has now definitely abandoned the scheme for electric lighting for the workhouse, which was to cost £500.

Dublin.—Loss of Revenue.—It is calculated that over £2,000 has been lost by the City Corporation's decision to cut off all lighting at night as a protest against the order forbidding inhabitants to be out in the city from midnight to 5 a.m.

Faversham.—Extensions.—The Town Council has decided to carry out extensions to the electricity works, at an estimated cost of £14,500.

Ireland.—Peat.—It is announced that Mr. Noel F. Harrison, who has had considerable engineering experience in hydro-electric work in the United States, expects to visit Ireland during the year to secure the co-operation of Town Councils and other bodies with a view to the development of the peat bogs of that country for the generation of electricity.

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Java.—Hydro-electric Station.—The Government has granted a concession to a Norwegian, states the *London and China Express*, allowing him to erect a hydro-electric power station on the River Moesi, above Bankollen. The primary object of the plant is to provide power for the manufacture of synthetic nitrogen compounds. It is stated that the total available head is between 500 and 550 metres, and the total development will be 150,000 H.P.

Lanark.—Electricity Supply.—The Town Council has under consideration proposals for the provision of an electricity supply for the town.

Leicester.—New Station.—The Electricity Commissioners have sanctioned the erection of a new 50,000-kw. power station on Freemen's Common, and as soon as permission to borrow the necessary funds is obtained, the first installation of 20,000 kw. will be proceeded with.

Londonderry.—Public Lighting.—The Lighting Committee has decided for the continuance of public lighting after midnight, on account of danger to citizens during recent riotous outbreaks.

Nelson.—Bulk Supply.—The Town Council is to be asked to authorise an application to the Electricity Commissioners for an order under the Electric Lighting Act, 1909, permitting the supply of electricity in bulk to the Colne Corporation.

Newport (I. of W.).—Public Lighting.—The Town Council has agreed to pay the Electric Light Co. a fixed sum of £38 per quarter for public lighting, plus 4½d. per unit.

Oakengates.—Electric Lighting.—Consequent upon the refusal of the local gas company to lay mains required by the Urban District Council, the latter has appointed a Committee to consider the question of the installation of electric lighting.

Southend.—Increased Loan.—The loan sanctioned in 1914 for the sub-stations at Leigh and Thorpe Bay has been found inadequate, owing to the enhanced cost of plant, and the Council is, therefore, applying for an additional sum of £13,591.

Spenborough.—Bulk Supply.—The Council has ceased to generate its own electricity, and now takes a bulk supply from the Yorkshire Electric Power Co.

Swansea.—Railway Siding.—The Borough Council has asked the Great Western Railway Co. to lay a siding to the rear of the electricity works, the cost to be borne by the Council and the company to pay a yearly acknowledgment of £10.

Coal Supply.—The engineer has been instructed to confer with the Coal Controller and endeavour to obtain an adequate supply of fuel for the power station.

Scunthorpe.—Electricity Supply.—Having had under consideration the cost of a scheme for electrical distribution, the Scunthorpe and Frodingham Urban District Council has decided to make a canvass of the district to ascertain what the demand is likely to be in each part of the area.

Walsall.—Cottage Lighting.—The Corporation proposes the following terms for electric lighting in the new municipal cottages:—(*a*) An additional rent will be payable for electricity supplied for lighting at the rate of 3d. per week per lamp installed. Such additional rent will be payable weekly with the rent for the house. The electricity supplied at this rate may only be used for lighting purposes; (*b*) The tenant will be responsible for all missing, damaged, or defective lamps or shades, and damage to the wiring or installation, glazing, replacement of loose fixtures, and damage to any other part of the premises; (*c*) All burned out, damaged or broken lamps or shades must be replaced by, and at the expense of, the tenant, and to the satisfaction of the Corporation, but the tenant will be allowed the free replacement of one lamp per annum; (*d*) The tenant has the option of being supplied with electricity by meter at the tariff charges for the time being in force and under the conditions of supply issued by the electricity supply department.

Warrington. — Price Increase. — The Town Council has increased the prices of electricity, as from April 1st, by 10 per cent. for lighting and traction purposes, and by 20 per cent. for power and heating.

Worcester.—Loan.—The City Council is seeking permission to borrow £15,000 for the provision of sub-stations, transformers, switchgear, and cables.

TRAMWAY AND RAILWAY NOTES.

Australia.—Railway Electrification. — The Chief Electrical Engineer for Tramways states that the Railway Commissioners have a large scheme of electrical extension in contemplation, not only including the metropolitan railways, but eventually all the principal railways in N.S.W. The power-houses at Sydney and Newcastle are being enlarged, and other power-houses are to be constructed in more remote districts near coal and water supplies. The plan is to give a cheap electric supply to all the municipalities in New South Wales, to enable not only electric lighting, but also power, to be supplied to private consumers.—*Australian Mining Standard.*

Bradford.—Improved Service.—It is stated that the Corporation Tramways Committee has at last got back to its full complement of cars for use on its system. The 26 new cars, and the 78 new motors for refitting to old cars, have been received. The pre-war number of cars, 200, were used on Saturday, and it is thought this number will soon be exceeded.

Continental.—Belgium.—The *Economic Review*, quoting the *Echo de la Bourse*, states that the Chemin de Fer Electrique d'Ostende-Blankenberghe et Extensions Cie. reports that during 1919 the various lines belonging to this combination have resumed service.

The line Ostende-Furnes reached the latter place on August 23rd. The line Ostende-Knocke, which was already in working order to Blankenberghe, reached Knocke-le-Zoute on January 29th. For the coming summer season the line Coxyde-Village-la Panne, and the electrified Ostende-Westende line are expected to be in running order. The recovery of war damages is in active progress, a very important sum being involved. The Central Electric Railway, which began to run in November, 1918, will be entirely restored by the end of 1920. The present financial year will presumably offer a great many difficulties owing to labour troubles, and the increase in the prices of raw material and fuel.

Norway.—The Norwegian Council of State has decided to place before the Storthing a proposal to enter into a supplementary agreement with the Swedish Kirunavara-Luossavara A.B. concerning the transport of iron ore on the Norwegian Ofoten Railway, and the electrification of the latter. It is estimated that the conversion of the railway to electric traction will involve an expenditure of 5,500,000 kr., including the cost of four locomotives. If the scheme is sanctioned, authority is to be sought to conclude an agreement with the competent Swedish authorities for the delivery of electrical energy from the hydro-electric works at Porjus, until it is possible to obtain power from a Norwegian generating station. A vote of 3,000,000 kr. is asked for so as to be able to begin the work in the financial year 1920-1921.

Spain.—It is announced from Saragossa that another general strike has commenced which embraces the tramway workers.

Cork.—Coal Shortage.—The Cork Electric Tramway and Lighting Co. having been informed by the Neath Abbey Colliery Co. that, under order of the District Supplies Committee, it must cease supplying coal to Cork until English electrical requirements have been met, announced that it might be necessary to close down the tramway service temporarily, in order to conserve the small available stock for absolutely essential industries, and that, in the circumstances, the supply of electricity to Queenstown must cease. The coal shortage in all parts of Ireland is very acute, and it is feared many electrical undertakings will have to close down.

London.—Electric Railway Extension.—The Central London Railway will shortly open to traffic an important extension, which will prolong its line from the present terminus at Wood Lane, opposite the main entrance to the White City, to Ealing Broadway. This extension will not only round off the system, which originally only ran from Shepherd's Bush to the Bank, and will now reach from Ealing to Liverpool Street, but by linking up at Ealing Broadway with the Great Western line, it will provide a new and much-wanted through route between the City and West End and the western suburbs.—*The Times.*

L.C.C. Tramway Scheme.—On April 22nd the House of Commons refused to suspend Standing Order No. 22 in favour of the L.C.C. tramway scheme. This rule provides that the sanction of local authorities whose districts are affected by such a scheme must be obtained before Parliamentary Bills regarding the matter can be proceeded with. Practically all the Metropolitan Boroughs have protested against the scheme.

New Zealand.—Tramway Purchase.—The *Auckland Weekly News* states that the amount paid by the City Council to the Auckland Electric Tramways Co. for the whole of the latter's undertaking was £1,229,463, paid in 5 and 5½ per cent. debentures maturing in 1940. The gross profit of the undertaking for 1917-18 and 1918-19 was £81,162 and £60,856. The Council assumed control on July 1st last.

Post-Office Railway.—Time Extension.—The Minister of Transport has extended the time of the Post-Office (London) Railway Act until August 15th, 1921, for the completion of the railway and works.

Preston.—Renewals.—The Tramways Committee proposes to carry out renewals of the permanent way at an estimated cost of £10,000.

Swansea.—Tramway Strike.—The Corporation tramway employés ceased work on April 23rd, refusing to accept an increase of 8s. per week offered by an official award.

TELEGRAPH AND TELEPHONE NOTES.

Canada. — Aurora Borealis. — How the Aurora Borealis recently provided power for transmitting telegraph messages, is told by a Canadian newspaper. For 30 minutes, says the account, a Canadian Pacific telegraph line carried messages from Vancouver to Calgary on power supplied in this way. The Northern lights had been playing havoc with the circuits when the experiment was made. At both ends of the circuit the line had become earthed; the batteries were finally disconnected, and for half an hour the system worked perfectly, the power to transmit the messages being induced from the air.

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Cable Operators' Grievance.—Trouble is brewing among the cable operators employed by the Western Union Cable Telegraph Co. in consequence of the dismissal of Messrs. A. D. Crisp and J. Doherty, two cable operators, who jointly edited the *Telegraph Cable Herald*, the official organ of the Telegraph Operators' Association. The dispute, according to the *Daily Express*, arose over a statement published in the *T.C.H.* relative to the death of Mr. R. Flexhel, an operator who, in the opinion of his colleagues, collapsed from overwork. Mr. Blenheim, traffic manager of the company at New York, telegraphed the dismissal of Messrs. Crisp and Doherty, stating: "It is a libellous statement, and such a charge is subversive of discipline." The Association considers the case to be one of victimisation, and in view of the fact that Mr. S. J. Goddard, the vice-president in London, has refused to hear either of the editors, it has threatened a general strike, in which the Electrical Trades Union may be involved. The Minister of Labour is conferring with the interested parties. According to the *Daily Herald*, reinstatement of the two men and recognition of the Association are demanded. The Association was formed in 1918, and has 600 members in London. Amalgamation with the E.T.U. is under discussion.

Dover.—New Channel Cable.—Two cable vessels left Dover on the 27th inst., says *The Times*, to lay a new submarine cable across the Channel to Ostend.

Ireland.—Wire Cutting.—At Midleton Quarter Sessions, last week, the Recorder of Cork awarded the Postmaster-General £27 compensation in respect of the malicious cutting of telephone and telegraph wires in the East Cork district.

London.—New Telephone Exchanges.—Sixty new telephone exchanges have been planned for London during the next 20 years, and an increase of over 250,000 subscribers is expected in that period. The exchanges to be enlarged number 17, and among the new exchanges on which work has been begun are those at Bishopsgate, Golders Green, the Tower, Stratford, and Hendon. Extensions are also being made at Barnet, East, Hampstead and Harrow.

High-Speed Wireless.—In a written reply to a question in the House of Commons regarding wireless telegraphic experiments at Woolwich, Mr. Churchill stated that wireless messages had been transmitted over considerable distances at the speed of 100 words per minute, and very much greater speeds had been obtained under laboratory conditions only. Funds at present available for experimental work were limited, owing to the urgent need for economy.

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the Electrical Review *in which the "Official Notice" appeared.)*

OPEN.

Algeria.—May 15th. Algerian Post and Telegraph Authorities at Algiers. Tenders for 25 tons of bronze wire, and 19 tons of copper wire.

Auckland (N.Z.).—September 1st. Harbour Board. For the supply of electric capstans and spares. Messrs. W. & A. McArthur, Ltd., 18-19, Silk Street, Cripplegate, London, E.C. 2.

Australia.—Perth.—May 3rd. Postmaster-General's Department. Insulators, bolts, brackets, &c. Schedule 673. (April 2nd.)

May 14th. Government of Western Australia. One 7,500-kw. turbo-alternator and condensing plant. (April 9th.)

Melbourne.—June 18th. City Council. Gas-filled metal-filament lamps. City Electrical Engineer's Office, Town Hall, Melbourne.

May 31st. Victorian Railways Department. Four 4,500-kw., 1,500-volt traction converter sets, and eight 1,000-kw., 1,500-volt ditto. (See this issue.)

Bacup.—Electricity Department. 30-ft. steel poles for street lighting purposes. (See this issue.)

Belgium.—Antwerp.—June 28th. Harbour Authorities (Town Hall). Two electric cranes of 30 tons and 10 tons respectively, for the new dry dock, and No. 61 of the Bassin Lefebvre. Copies of the specification in French, with tender form, price 4 fr., may be obtained on making application to: M. le Bourgmestre d'Anvers, Hotel de Ville, Anvers, Belgique, but a copy may also be consulted at the D.O.T. in London, on application to Mr. Shearer, Room 50, until May 8th, after which it will be available for loan to firms in the Provinces.

May 21st. Municipal authorities. Tenders for 10,690 metres of armoured cables, required in connection with the electrical equipment of the Nos. 2 and 3 docks. Particulars may be obtained for one franc from the Hotel de Ville, Antwerp.

Lincoln.—May 24th. Electricity Department. Coal-handling plant. (April 23rd.)

Leigh (Lancs.).—Electricity Department. One 2,500-kw. turbo-alternator; E.H.T. & L.T. switchgear; one 500-kw. rotary converter. (April 16th.)

Lochgelly (Fife).—May 5th. Town Council. Electric Lighting. Seventy-four new houses. Architect, Mr. A. D. Harton, 3, High Street, Leven.

London.—Lewisham.—May 3rd. Board of Guardians. Installation of an electric fire-alarm at the Hospital, High Street. (See this issue).

Hammersmith.—May 21st. Electricity Department. Two 10,000-kw. turbines and alternators, with condensing plant. (See this issue.)

Metropolitan Asylums Board. May 11th. Installation of automatic internal telephones at the head office. (See this issue.)

Manchester.—June 7th. Electricity Department. Main and auxiliary switchgear; Section A, 33,000-volt and 6,000-volt main switchgear; Section B, pressure-testing switchgear; Section C, 420-volt A.C. auxiliary switchgear; Section D, 240-volt D.C. auxiliary switchgear. (See this issue).

New Zealand.—Wellington. June 30th. Tender Board Public Works. Electrical equipment for the Arthur's Pass section of the Midland Railway. Particulars from the Department of Overseas Trade, 73, Basinghall Street, E.C.

Nuneaton.—May 5th. Electricity Department. 3-core and 4-core, L.T., paper-insulated cables. (April 23rd.)

Rochdale.—One 1,250-kw. (alternatively 1,500-kw.) rotary converter. Mr. F. H. Rudd, borough electrical engineer, Electricity Works, Dane Street.

Salford.—May 10th. Concrete foundations for a 5,000-turbo-alternator. Borough electrical engineer, Electricity Works, Frederick Road.

Sheffield.—Corporation Water Works. Electric haulage winch, pug mill. (April 23rd.)

South Africa.—Mossel Bay.—Electric lighting equipment. (See this column, April 23rd.)

Spain.—May 30th. Construction and working of an electric tramway between the Plaza de la Bonanova and the Monasterio de Pedralba, Barcelona. The Direccion General de Obras Publicas, Madrid.

Madrid.—May 18th. Concession for an electric railway from La Corogne to Sarda, 18,000 metres in length; estimated cost, 2,000,000 pesetas, guarantee, 11,785·79 pesetas. The Concessionnaire is to supply the whole of the material and rolling stock. General Direccion des Obras Publicas, Madrid.

Tasmania.—Launceston.—June 7th. City Council. One 1,000-k.v.a. hydro turbo-alternator, with switchgear. City Electrical Engineer, Town Hall, Launceston.

Uruguay.—August 7th. Department of Posts, Telegraphs and Telephones. Construction of a national telephone system for the Department of Montevideo. Particulars from the Uruguayan Legation in London, 3, Elvaston Place, South Kensington, S.W.

CLOSED.

Australia.—Sydney.—City Council. Recommended:—

H.T. Insulators (spec. No. 581).—Lawrence & Hanson (first alternative tender, £3,387).

Sub-station equipment (spec. No. 558).—Section 1, with feeder switches of 48,000 k.v.a. capacity, £17,890. Section 2.—Met.-Vickers, Ltd., £13,190. Section 3.—Standard Waygood Hercules, £1,000.

Transformers, 5,000/33,000 v. (spec. No. 574).—Noyes Bros., £11,472.—*Tenders.*

Belgium.—The Belgian Post and Telegraph Authorities in Brussels have just divided contracts for the supply of a large quantity of telegraph and telephone apparatus between the Antwerp Telephone and Electrical Works, of Berchem, Antwerp; the Bell Telephone Manufacturing Co., Antwerp; and the Société Electricité et Mecanique, Carels Frères, of Ghent.

Three tenders were received by the municipal authorities of Belgrade (Province of Namur), for the installation and equipment of a transformer cabin and distribution system in connection with the electric lighting of the town, and also for the high-tension feeder. The lowest was that of Messrs. N. Van Gastel & Mertens, of Brussels, whose price for the two contracts was respectively 97,000 fr. and 36,358 fr.

Municipal authorities of Haccourt (Province of Liége) recently invited tenders for the concession for the supply of electrical energy for the electric lighting of the town, but no offers were received.

Eastbourne.—Corporation. Electricity works. Cooling tower and tank:—

	Treatment of timber.	£
Clyne Eng. Co., Ltd. ..	Pressure	2,514*
C. Bradshaw & Co., Ltd. ..	Dipped	3,560
Premier Cooler & Eng. Co., Ltd.	**Vac. & Pres.** (recom.)	**3,805**
Premier Cooler & Eng. Co., Ltd.	Dipped	3,570
Film Cooling Towers, Ltd. ..	Dipped	4,010
Davenport Eng. Co., Ltd. ..	Vac. & Pres.	4,842
Davenport Eng. Co., Ltd. ..	Dipped	4,192
Hudson Econ. Co., Ltd. ..	Dipped	4,566
W. H. Roy & Co., Ltd... ..	Dipped	4,250*

*For tower only.

Glasgow.—Tramways Committee. Accepted:—

Rail welding plant.—Hitchcock, Lloyd & Co.
120 Too Cam brakes.—Dryers, Ltd.
Pneumatic hoist.—Consolidated Pneumatic Tool Co., Ltd.
Electric battery truck.—Hendry Bros., Ltd.
Two 2-ton motor lorries.—Bryson Bros.

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Government Contracts.—The following Government contracts have been placed during March, 1920.

ADMIRALTY (CONTRACT AND PURCHASE DEPARTMENT).

Electric lighting, heating and power wiring.—G. E. Taylor Co., Ltd.
Internal electric wiring.—T. Fairie & Co., Ltd.
Electrodes.—Quasi-Arc Co., Ltd.
Feed pump.—Rees Roturbo Manufacturing Co., Ltd.
Platinum wire and sheets.—Johnson, Matthey & Co., Ltd.
Steam superheaters for boilers.—Babcock & Wilcox, Ltd.
Torch batteries.—British Ever-Ready Co., Ltd.
Water-tube boilers.—Babcock & Wilcox, Ltd.

MINISTRY OF MUNITIONS.

Copper wire.—T. Bolton & Sons; India-Rubber G.P. & Telegraph Works Co., Ltd.; Siemens Bros. & Co., Ltd.
Electric batteries.—Accumulators of Woking, Ltd.; Tudor Accumulator Co., Ltd.
Electrical equipment.—Edison Swan Electric Co., Ltd.
Electric motors.—Bruce Peebles, Ltd.; General Electric Co., Ltd.; J. H. Holmes & Co., Ltd.; Metropolitan-Vickers Electrical Co., Ltd.
Insulators.—Bullers, Ltd.
Insulated wire.—G.E. Co., Ltd.
Electric lamps.—British Thomson-Houston Co., Ltd.
Pump installation.—Variable Pumps & Motors, Ltd.
Rotary transformers.—Newton Bros. (Derby), Ltd.

INDIA OFFICE: STORES DEPARTMENT.

Cells.—Chloride Electrical Storage Co., Ltd.
Gutta-percha core.—Siemens Bros. & Co., Ltd.
Crucibles.—Morgan Crucible Co.
Cutting compound.—Dussek Bros. & Co.
Dynamo.—J. Stone & Co., Ltd.
Fans.—J. Stone & Co., Ltd.
Generator.—Lancashire Dynamo & Motor Co., Ltd.
Switchboards.—Erskine Heap & Co.; Metropolitan-Vickers Electrical Co., Ltd.
Train lighting equipment.—J. Stone & Co., Ltd.

POST OFFICE.

Telegraph apparatus.—Automatic Telephone Manufacturing Co., Ltd.; British L.M. Ericsson Manufacturing Co., Ltd.; International Electric Co., Ltd.; Phœnix Telephone & Electric Works, Ltd.; Siemens Bros. & Co., Ltd.; T. E. Thompson & Co., Ltd.; Whitfield Aviation, Ltd.
Telephone apparatus.—Automatic Telephone Manufacturing Co., Ltd.; British L.M. Ericsson Manufacturing Co., Ltd.; Edison Swan Electric Co., Ltd.; General Electric Co., Ltd.; International Electric Co., Ltd.; C. Peacock & Co., Ltd.; Peel Conner Telephone Works, Ltd.; Phœnix Telephone & Electric Works, Ltd.; Siemens Bros & Co., Ltd.; Sterling Telephone & Electric Co., Ltd.; Western Electric Co., Ltd.
Telephone and telegraph cable.—British Insulated & Helsby Cables, Ltd.; Hackbridge Cable Co., Ltd.; W. T. Henley's Telegraph Works Co., Ltd.; Hooper's Telegraph & I.R. Works, Ltd.; New Gutta-Percha Co., Ltd.; Siemens Bros. & Co., Ltd.
Earth clips.—E. Showell & Sons.
Insulators.—J. Bourne & Son, Ltd.; Bullers, Ltd.; Doulton & Co., Ltd.; Litholite Insulators, Ltd.; Taylor, Tunnicliffe & Co., Ltd.
Terminal irons.—D. Willetts, Ltd.
Earth plates.—T. & W. Farmiloe, Ltd.
Distribution cable plugs.—Siemens Bros. & Co., Ltd.
Stay rods.—Bullers, Ltd.
Zinc rods.—Siemens Bros. & Co., Ltd.
Bronze wire.—T. Bolton & Sons, Ltd.; British Insulated & Helsby Cables, Ltd.
Enamelled and S.S.C. copper wire.—London Electric Wire Co. & Smiths, Ltd.
Flexible twin, &c., E.L. wire.—Macintosh Cable Co., Ltd.
G.I. strand wire.—Rylands Bros. & Co., Ltd.; Whitecross Co., Ltd.
V.I.R. wire.—Hooper's Telegraph & I.R. Works, Ltd.
Circulating pump: P.O. central power station.—Rees Roturbo Manufacturing Co., Ltd.
Laying conduits.—Spalding: Hodge Bros. (Contractors), Ltd. Hop-Victoria: J. Mowlem & Co., Ltd. Park-Ealing: J. Mowlem & Co., Ltd. Hop-Lee Green Junction: R. M. Parkinson. Greenwich-East Junction: W. H. Wheeler & Co., Ltd. Willesden (Walm Lane): O. C. Summers. London-Southampton (section I): Hardy & Co. London-Southampton (section II): R. Armistead. London-Bristol-Newport (South Midland, section 1): J. F. Hodge & Co. Southall: G. I. Anderson. Glasgow: R. & C. Murray.
Telephone Exchange equipment.—Malvern: Automatic Telephone Manufacturing Co., Ltd. Cardiff: Automatic Telephone Manufacturing Co., Ltd. Ilkley: Siemens Bros. & Co., Ltd. Birmingham (south): Peel Conner Telephone Works, Ltd. Willesden: Peel Conner Telephone Works, Ltd. Guildford: British L.M. Ericsson Manufacturing Co., Ltd.

H.M. OFFICE OF WORKS.

Engineering services, generating sets for Ministry of Pensions.—Saltash: Aster Engineering Co., Ltd.

CROWN AGENTS FOR THE COLONIES.

Telephone cables, &c.—Callender's Cable & Construction Co., Ltd. British Insulated & Helsby Cables, Ltd.
Spares for Diesel engines.—British Electric Co., Ltd.
Telephone switchboards.—British L.M. Ericsson Manufacturing Co., Ltd.
Telephone materials.—British L.M. Ericsson Manufacturing Co., Ltd.
Train lighting spares.—J. Stone & Co., Ltd.
Bronze wire, &c.—F. Smith & Co., Ltd.

PUBLIC WORKS, DUBLIN.

Dublin Electric Works and supplies.—Handley & Robinson, Ltd.

London. — HAMMERSMITH. — Electricity Committee. Annual contracts for stores and materials. In view of the few tenders and the conditions attached, the Committee considers it would not be advantageous to accept any for the time being, and recommends that it be authorised to obtain and accept quotations from various firms for the supplies of material required from time to time within the estimates during the current year.

MAINS EXTENSIONS.—8,000 yd. ·15 E.H.T. six-core cable :—

Western Electric Co., Ltd.	£9,935*
Enfield Ediswan Cable Works, Ltd.	10,066
W. T. Henley's Telegraph Works Co., Ltd.	10,100
B.I. & H. Cables, Ltd.	10,100
Siemens Bros. & Co., Ltd.	10,267
Union Cable Co., Ltd.	10,333
Callender's Cable and Construction Co., Ltd.	10,400
W. T. Glover & Co., Ltd.	10,400
Pirelli General Cable Works, Ltd.	10,442
Johnson & Phillips	10,500

* Recommended for the supply of 5,000 yd.

2,000 yd. ·15 L.T. three-core cable, £1,721; and 1,000 yd. ·05 L.T. concentric cable, £258—Western Electric Co., Ltd.

2,000 yd. ·1 E.H.T. concentric cable, £558; 1,000 yd. ·25 E.H.T. concentric cable, £804; 2,000 yd. ·1 L.T. three-core cable, £1,308; and 3,000 yd. 7/22 L.T. twin cable, £375—Enfield Ediswan Cable Works, Ltd.

CABLE DUCTS.

	4,000 yd. 4-way 4 in.	1,000 yd. 3-way 3½ in.	2,000 yd. 2-way 3½ in.	2000 yd. 1-way 3½ in.
Doulton ...	£2,069 (3½ in.)	£394	£560	£281 (3 in.) £380 (4 in.)
Sutton & Co. ...	£2,454	£371	£533	£380
Albion Clay Co., Ltd.	£2,584	£394	£560	£282 (3 in.)
Sankey & Co., Ltd.	£2,454	£371	£533	£629 (4 in.)
Key Engineering Co., Ltd.	Quote for fibre conduit. (not according to specification)			£321

The Committee recommends the acceptance of the tenders of Messrs. Doulton & Co. for 2,000 yd. 1-way 3 in. cube ducts at £281, and of Messrs. Sankey & Co. for 4,000 yd. 4-way 4 in. cable ducts at £2,454, 1,000 yd. 3-way 3½ in. cable ducts at £371, and 2,000 yd. 2-way 3½ in. cable ducts at £533.

The Committee reports that the electrical engineer has carefully considered the various tenders for switchgear, and upon his report has decided, having regard to the high prices quoted, and the unduly long periods stated for delivery, to amend the specification and to invite fresh offers thereon.

TRANSFORMERS.

Four 1,000-KW. single-phase transformers, £4,262; two 500-KW. single-phase transformers, £1,319; and three 500-KW. three-phase transformers (mesh star connected), £2,424. British Electric Transformer Co., Ltd.

BATTERSEA.—Electricity Committee. Recommended :—

Switchgear for the turbo-alternator and rotary converter.—Edison and Swan Co., Ltd.
Six lamp columns, £345.—Mackenzie & Moncur, Ltd.
Testing panel, £208.—Bertram Thomas.

Renewal of contracts for one year recommended :—

Electricity meters.—Chamberlain & Hookham, Ltd., Ferranti, Ltd.
Electrolytic meters.—Reason Manufacturing Co., Ltd.
Box compound and "Trindite" bitumen composition.—Dussek Compound Co., Ltd.
Coal.—Rose, Smith & Co.

STEPNEY.—Electricity Committee. Accepted. 5,000 pairs of yellow-flame arc carbons :—

Sloan Electrical Co., Ltd. (accepted)	**£112**
G.E. Co., Ltd.	127
W. White & Co., Ltd.	148

Six feeder boxes :—

W. Lucy & Co., Ltd (accepted)	**£198**
Universal Electrical Manufacturing Co.	207
Henley's Telegraph Works Co.	252
British Insulated & Henley's Cables, Ltd.	266

Turkey.—The *Journal of the British Chamber of Commerce* just to hand, states that an important contract for the electrical installation of the Haidar Pasha terminus station and its various dependencies, buildings, and factories, was put up to public adjudication, and the various electrical contractors of this city of all nationalities participated keenly. "We are pleased to learn that three British firms competed, and that one of them was successful in obtaining the contract."

FORTHCOMING EVENTS.

North East Coast Institution of Engineers and Shipbuilders.—Friday, April 30th. At the Literary and Philosophical Society, Newcastle-on-Tyne. At 6.15 p.m. Paper on "A Modern Power Station and its Development," by Mr. J. S. Watson.

Junior Institution of Engineers.—Friday, April 30th. At 39, Victoria Street, S.W. At 7.30 p.m. Social evening.

Friday, May 7th. At 7.30 p.m. Lecturette on "Pulverised Fuel," by Mr. J. O. McBryde.

London Association of Foremen Engineers. — Saturday, May 1st. At Cannon Street Hotel. At 6 p.m. 67th anniversary festival.

Institution of Electrical Engineers (Western Centre).—Monday, May 3rd. At the Public Library, Alexandra Road, Swansea. At 6.30 p.m. Kelvin lecture on "Modern Marine Problems," by Dr. C. V. Drysdale.

(Students' Meeting). — Friday, April 30th. At Faraday House, Southampton Row, W.C. At 7 p.m. Paper on "Tidal Power," by Mr. J. E. Holmstrom.

Society of Engineers.—Monday, May 3rd. At Burlington House, W. At 5.30 p.m. Paper on "The Assessment of Engineering Undertakings," by Mr. W. G. Cooke.

Roentgen Society.—Tuesday, May 4th. At 11, Chandos Street, W. At 8.15 p.m. Paper on "Some Problems in the Action of Radiation upon Tissues," by the President. Demonstrations: "The Transmission of Speech by Light," by Prof. A. V. Rankine, and "A New Portable Viewing Lantern," by Dr. H. A. Eccles.

Faraday House Old Students' Association.—Tuesday, May 4th. At the Holborn Restaurant. At 6.30 p.m. Annual dinner.

Chief Technical Assistants' Association. — Thursday, May 6th. At Anderton's Hotel, Fleet Street, E.C. At 7 p.m. Resumed discussion on "The Design and Equipment of Sub-stations."

Chemical Society.—Thursday, May 6th. At Burlington House, Piccadilly, W. At 8 p.m. Ordinary Scientific Meeting.

Iron and Steel Institute.—Thursday and Friday, May 6th and 7th. At the Institution of Civil Engineers, Gt. George Street, S.W. At 10 a.m. Annual meeting.

Association of Engineers-in-Charge.—Saturday, May 8th. At the Holborn Restaurant (Venetian Chamber). At 6 p.m. Annual dinner.

The Kinema in School.—Ealing elementary school children began to have lessons by film, this week, the Education Committee having rented a local kinema theatre for the purpose of showing educational pictures. It is hoped to develop the idea so that a fortnightly visit will fall to the lot of each child.

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NOTES.

London Electrical Engineers.—Smoking Concert.—The old members of this Corps are holding a re-union smoking concert at Cannon Street Hotel, E.C., on Wednesday, June 2nd, at 7 p.m. Tickets (price 2s. 6d.) may be obtained from the secretary, Mr. T. Franklin, 108, Heathwood Gardens, Charlton, S.E. 7. It is hoped to inaugurate an Old Comrades' Association at the concert.

Electric Vehicles in South America.—A correspondent, writing to the *Times Trade Supplement*, says:—"For town work, especially for heavy haulage, there is great scope for a sound electrical vehicle, as commercial electricity is generally pretty cheap in South America, and electrical vehicles do not demand the skilled handling that petrol or steam vehicles do; further, the running costs, upkeep, &c., must be very low. It is unfortunate so many millions have been sunk in internal combustion machines, as if half the sum had been expended on electrical vehicles, we should probably have no other by now. However, it is now stated that Edison's battery has proved itself a success upon the streets of London and elsewhere, so that there should be a good future for the electrical vehicle in South America, where the use of electricity is extending rapidly."

Faraday House O.S.A. Dinner.—The annual dinner of the Faraday House Old Students' Association is to be held at the Holborn Restaurant, London, W.C. 1, on Tuesday, May 4th, at 6.30 for 7 p.m. Mr. G. Scott Ram, M.I.E.E., H.M. Electrical Inspector of Factories, the President, will be in the chair, and the dinner will be followed by an excellent musical programme. Old students desirous of attending should communicate at once with the Hon. Secretary.

Fatalities.—An employé of the Cork Electric Tramway and Lighting Co., Patrick Noonan, 40, met with a tragic death on the 22nd inst., whilst working in a coal elevator, in which he was caught when the machinery was in motion, and was imprisoned, after the machinery was stopped, for some two hours. Every effort was made to get the unfortunate man out of his terrible position in the elevator, but it became necessary to remove the steel plates before this could be done, and then Noonan was dead.

At an inquest held at South Bank, near Middlesbrough, on Tuesday, respecting the death of A. E. Richardson, aged 29, an electric wireman employed at Messrs. Bolckow, Vaughan & Co.'s steelworks, it was stated that deceased had been laying fresh cable. He apparently began to disconnect a switch running on to which were live wires. Mr. J. Hodges said the cause of the accident was at first a mystery. On the covering of one of the wires, however, two small cuts had been discovered. From marks on the pliers which deceased was using it appeared as though Richardson had been killed by that means. It was remarkable that he should be attempting to disconnect live wires. The most probable explanation was that, in a moment of forgetfulness, he had mistaken the incoming and the outgoing wires. The Factory Inspector raised the question whether deceased was competent to do such work, but employés agreed that it was only ordinary routine work, and not at all technical. The medical evidence was that the burns on Richardson's hand were compatible with electric effects. The Coroner found that the man was competent to do the work, and that death was due to accidental electric shock.

Aero-Engine Efficiency.—An average speed of 109·89 miles per hour was maintained by Lieut. Holthouse and Lieut. Debeer in the 1,000 miles flight between Cape Town and Pretoria, which was accomplished in 9 hours 6 minutes. This speaks well for the efficiency of the British engine and British magnetos which form the propelling unit of the South African aeroplane "Vortreker" which was used for the flight.

Dublin Electricity Official Released from Jail.—Mr. Fred. Allen, secretary, Dublin Corporation Electric Supply Committee, was last week released from Mountjoy Jail, Dublin, on completion of three months' imprisonment, in default of giving bail, for having in his possession Sinn Fein literature, which was found in an election committee-room at Kingstown, with which he was associated. On leaving the prison, Mr. Allen, who was in good health and spirits, was greeted by members of the Corporation and of the electrical department staff.

Water Power.—Committee's Report.—A scheme for the utilisation of the water power of the United Kingdom is contained in the report of the Government Water-Power Resources Committee, which will shortly be published. The Committee's chief recommendation is the creation of a new authority, to be known as the Water Commissioners, as a Department of the Board of Trade, with general powers and functions similar to those of the Electricity Commissioners already appointed. The Committee has divided England and Wales into districts, and calls for the creation of Local Committees in counties, or groups of counties, to arrange for the best use of the water supply in those districts. The Committee concludes that there are large reserves of power in British rivers which have not been utilised.

Appointments Vacant.—Cable jointer (87s. 2d.), mains superintendent (£228, rising to £270), for the City of York Electricity Department; meter mechanician (92s.), for the Borough of Wolverhampton Electrical Engineer's Department; meter tester (94s.), for the Edinburgh Corporation Electricity Supply Department; mechanical maintenance engineer (£300), for the Leigh Corporation. See our advertisement pages to-day.

Seed Electrification.—In order to be in a position to express an opinion from direct personal observation, Messrs. Sutton & Sons, the well-known seedsmen, carried out some experiments at Reading in 1919 with seeds electrified by the Wolfryn process, of which particulars have been given from time to time in our pages. In a report upon the experiments, Mr. Martin H. F. Sutton, F.L.S., states that the following series of trials was carried out:—Seeds of mangold, swede, cattle cabbage, and carrot, were sent for treatment to Mr. H. E. Fry, of Godmanstone, one of the patentees of the Wolfryn process, who returned them in due course. The Wolfryn treatment consists in immersing the seeds in a solution of common salt and water (4 oz. to the gallon), or calcium chloride and water (8 oz. to the gallon), to which an electric current is then applied. The seeds are afterwards dried at a temperature of 100° F., and they are then ready for sowing.

The series of experiments made at Reading included two controls of seeds untreated in any way; seeds treated by the Wolfryn process; seeds unelectrified, but soaked for four hours in a solution of salt and water (4 oz. per gallon), and afterwards dried at a temperature of 100° F.; and seeds unelectrified, but soaked for four hours in a solution of sulphate of ammonia and water (4 oz. per gallon), and subsequently dried at a temperature of 100° F. In each case all the samples of seeds of one subject were drawn from the same bag. Two distinct series of experiments were made:—(1) A germination test under glass; and (2) a field test.

The conclusions come to were with regard to (1) that, notwithstanding the one or two points which seemed to be slightly in favour of the electrified seed, the results obtained by this series of tests, as a whole, could only be regarded as inconclusive; (2) reviewing the outdoor tests as a whole, the results would appear to be no more conclusive than were the tests for germination, the returns from the electrified seed showing no advantage over the other sections, except to a small extent in the case of the mangold crop.

Summer Time in Canada.—Daylight saving is to be generally adopted throughout the Province of Quebec, but according to *The Times* the Canadian and American railways will continue to run to standard time, and probably most Canadian towns and cities will follow the same time as the railways.

The Pasadena Convention.—The American electrical Press is, and has been for some time, full of details of the National Electric Light Association Convention to be held at Pasadena, California, from May 18th to 22nd next. The latest received copy of the Association's *Bulletin* gives a complete programme of events, and the names of the members of the many Committees. The enormous amount of work (and pleasure) to be got through in the short time at the disposal of the Convention will, judging by the programme, tax the American characteristic of "hustle" to the utmost. Every branch of the industry is being dealt with from the generation and distribution of power to the smallest details of salesmanship and finance. Electric vehicles and hydro-electric development are in charge of two special sections. The reader of such a formidable scheme may well wonder where the "auto" rides, golf, and dances, are to come in.

Earthing.—An article in the *Revue Générale de l'Electricité* refers to the lack of precision in official regulations on the earthing of electrical machines and installations, and gives a few practical rules justified by experience. The French rules only deal with the earthing of non-current-carrying parts. The question of earthing windings and live parts is a controversial one, particularly with regard to the earthing of the neutral points of three-phase alternators and transformers. On the other hand, instruments and instrument transformers must have their cores and windings earthed, also arresters, &c. The earthing should be done by means of a copper conductor containing as few bends as possible, of section calculated at 1 sq. mm. per 10 amperes of the normal load current of the apparatus or installation to be protected, with a minimum of 10 sq. mm. This refers only to the earthing of machine frames and parts liable to be traversed by the full short-circuit current. The earth contact should be a sheet of galvanised iron at least 5 mm. thick, or a copper sheet at least 2 mm. thick, placed in a bed of coke breeze 50 cm. thick. If a sheet of water is available, the earth contact may be a metal cable or pipe immersed therein. In either case, the surfaces and lengths must be such that the resistance of the contact shall not exceed $R = 50/I$, I being the maximum short-circuit current, equal in A.C. to $E\sqrt{C/L}$. Therefore, $R < (50/E)\sqrt{L/C}$, L and C being the machine constants. In practice $\sqrt{L/C}$ generally averages 70. We may thus take $R < 3{,}500/E$, with a minimum of about 5 ohms. For direct current, R can be taken as between 5 and 10 ohms. For earthing arresters, the earth wire should be of 50 to 100 sq. mm., and the earth resistance not over 10 ohms.

Electrical Work in Sydney.—Asked at the Municipal Council whether there was any shortness of work for skilled men, such as those engaged in working overtime at the power-house, the Lord Mayor of Sydney, N.S.W., replied:—"I am not aware of any such shortage, and I am advised by the city electrical engineer that there is no shortage of work in Sydney at present for skilled workmen. On the contrary, the city electrical engineer informs me that any employer of skilled labour, if asked, will say that he is short of the number of skilled men which he could usefully employ. Moreover, if the office of a Trade Union of skilled workers is applied to for men, the general answer is that there are no men on the books of the Union out of employment. The city electrical engineer has further reported that in one trade, for instance—that of electrical installation work—several hundred electrical mechanics could be employed immediately if they were available; but every electrical mechanic is already employed."

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INSTITUTION NOTES.

Institution of Electrical Engineers.—Arrangements for May, 1920:—*Ordinary Meetings.*—13th: "Permanent Magnets in Theory and Practice," by Mr. S. Evershed. 20th: Annual general meeting.

Territorial Centres.—11th.—Leeds: Annual general meeting.

Students' Section.—14th: Annual general meeting: paper by Mr. E. G. Humfress on "Electrical Motor Control Devices."

The March *Journal* announces that in place of one premium of £10 and several of £5 hitherto awarded each session for papers read before the Students' Sections, the Council has decided to award, in future, three premiums of £15 each. The Council has also accepted an offer from the B.E.A.M.A. of prizes of £10 each (up to a total value of £100 for the first year), for the best papers by students of the Institution on electrical subjects suitable for publication in the B.E.A.M.A. *Journal*.

North-Western Centre.—The eleventh Kelvin lecture on "Modern Marine Problems in Peace and War," was delivered at the Manchester College of Technology by Dr. C. V. Drysdale on April 20th. There was a large attendance.

Mr. J. A. Robertson presided, and in introducing the lecturer, said that in view of the great work which Lord Kelvin did for marine purposes, it was fitting that the subject of this lecture should be associated with his name. No one could question the importance of what was done by Lord Kelvin and by the men who successfully tackled vital problems during the recent war.

North-Eastern Centre.—The annual meeting of the North-Eastern Centre was held on April 19th at Armstrong College, Newcastle-on-Tyne. Mr. W. Cross was in the chair. The annual report of the Committee was submitted. It stated that the membership of the Centre had increased from 291 to 389. The attendance at the meetings had averaged 58. In addition to the ordinary programme of meetings, a special course of lectures upon "The Foundations of the Theory of Electrical Power Transmission" had been given by Prof. Thornton, D.Sc., D.Eng., to the members of the Centre. The first annual dinner held since the war took place on January 30th, at Newcastle, at which 78 members and guests were present. The Students' Section had held eight meetings during the session, in addition to several visits to works, &c.

The question of rules for the Centre had been given considerable attention by the Committee, and at a special general meeting on February 23rd last the following resolutions were passed relative to the election of future committees:—(1) That the number of ordinary members of committee be limited to 15; (2) that in addition to the retiring committee's nominations, any four persons entitled to vote (members, associate members and associates) may nominate any other duly qualified person to fill any vacancy by delivering such nomination in writing to the Hon. Secretary. The Committee had prepared a full set of rules for the election of officers, and for carrying out the business of the Centre. The draft had been submitted to the Council, which was considering it with a view to issuing a set of regulations, unifying the procedure of the different Territorial Centres.

In order to give adequate attention to the large and varied business which came before the Committee, a number of standing sub-Committees had been appointed, the result of whose work came before the full Committee for confirmation before any action was taken. The sub-Committees at present set up were:—(1) Finance; (2) sessional arrangements; (3) rules; (4) engineers' club; (5) Territorial Centre's improvement; (6) Electricity Supply Bill; (7) Students' Advisory; (8) metric and decimal; (9) wiring rules.

The election of officers resulted as follows:—Chairman, Mr. J. R. Beard, M.Sc.; vice-chairmen, Prof. W. M. Thornton, D.Sc., Messrs. E. Fawsett, T. Carter, and F. G. C. Baldwin; Ordinary Members of Committee—Power Supply Undertakings:—Messrs. R. M. Longman, W. F. T. Pinkney, G. L. Porter, C. Vernier. Manufacturers and Contractors:—Messrs. H. W. Clothier, N. W. Prangnell, T. Carter, A. Collins, J. Rosen. Municipal Engineers:—Mr. E. Moxon. Consulting Engineers:—Mr. C. H. Davison; Mr. R. W. Gregory. Civil Service and Railways:—Mr. G. L. Drury; H. Kitchen. Miscellaneous Sections:—Dr. A. C. Mitchie, D.Sc. Hon. Treasurer:—Mr. W. T. MacCall. Hon. Secretary:—Mr. H. B. Poynder.

The report of the Tees-side Sub-Centre also was read; it stated that they had had nine meetings, and in addition to these, the Committee had arranged for Dr. Thornton to give three lectures. It was suggested that next session an earlier start should be made with the meetings, and, if the necessary support was forthcoming, they should, if possible, be held fortnightly.

Major T. Rich, O.B.E., then delivered a lecture upon "Electricity on the Western Front," which was highly appreciated.

Liverpool Sub-Centre.—The first annual general meeting was held at Liverpool on April 26th, at which the new committee for the session 1920-21 was elected, and the annual report presented. The meeting was followed by a smoking concert. The report states that five general meetings have been held with an average attendance of 106. It is recommended that the Liverpool area should be defined by straight lines between the following towns:—Southport, Prestatyn, Wrexham, Warrington, Wigan, and back to Southport. Southport and Wigan are at present included in the Preston area, but the members are to be invited to decide which sub-Centre they wish to become attached. The total number of members (including students) has increased from 220 in November, 1919, to 294 up to April, 1920.

Birmingham Metallurgical Society.—The subject of "Refractories and the Electric Furnace," was discussed by Mr. P. S. Devereux, before the Society on April 15th. Dealing with the higher refractories, he pointed out that the rapid development and rate of adoption of the electric furnace had been phenomenal, but urged that it was greatly retarded by want of suitable refractories. Only such materials as pure silicon carbide (SiC), fused alumina ($A_1 2O_3$), sintered magnesia (MgO), fused spinel (MgO $A_1 2O_3$), crystalline sillimainte ($A_1 2O_3$ SiO_2), and calcined zirconia (ZrO_2), would meet the excessively high temperatures required, and have at the same time the many other desired heat, strength, and dielectric properties. Which of these refractory materials would be most suitable for a given case would be much more dependent on physical than on chemical conditions, and the desired physical properties could be obtained with greater certainty with such refractories than with such materials as clay, bauxite, or calcined magnesite, in which the physico-chemical reactions were only partially completed in the finished refractory product. Fused alumina was also an electric furnace product being manufactured from bauxite and carbon. The great advantage of bricks made from this material over those made of unfused alumina was the absence of shrinkage combined with high resistance to abrasion and slags. Magnesia spinel (MgO $A_1 2O_3$) did not soften until a temperature of 2,135° C. was attained, its entectics with MgO and $A_1 2O_3$ melting at 2,030 and 1,925° C. respectively. Pure magnesia did not liquefy until a temperature of 2,800° C. was attained. If any quantities of alumina, no matter how small and not exceeding 70 per cent., be mixed with the magnesia, the liquefaction temperature dropped from 2,800 to 2,030° C. By mixing together magnesia and alumina in the proportion of 72 of $A_1 2O_3$ to 28 of magnesia, the compound magnesium aluminate would form even at temperatures considerably below its melting point. Refractories might, added Mr. Devereux, help in the conservation of fuel. In a high temperature furnace or kiln where the internal temperature required was higher than the refractory lining would withstand, it was customary to protect this lining by artificial cooling, either by means of air or water. Such artificial cooling resulted in a great waste of heat, and a corresponding greater consumption of fuel. The ideal arrangement would be to cover the outside of the furnace with a good thermal insulator so as to retain the heat in the furnace. The development of refractory materials which would permit the thermal insulation of industrial furnaces would result in an enormous fuel saving.

Warrington Electrical Society.—The inaugural meeting will be held on Friday, 30th inst., at the Pelican Hotel, Warrington. A comprehensive programme of lectures of an educational nature is being arranged.

Iron and Steel Institute.—Responding to the toast of "Kindred Associations," at the annual dinner of the Staffordshire Iron and Steel Institute, at Dudley, on Saturday, Dr. C. C. Garrard, chairman of the South Midland Centre of the I.E.E., said the electrical engineering trade was indispensable to the iron and steel manufacturer. That was shown during the war, and he believed he was correct in saying that there were installed during the war more electrical rolling mills than the total number that existed before the war. The electrical manufacturer was not getting the number of steel forgings and the like that he wanted, and the future of electrical engineering depended upon his ability to get an adequate supply of these materials. The industry at the present time stood in great danger owing to the scarcity of these essentials, and to the high prices. He had no doubt there were good reasons for the increased prices, but steel plates had gone up four times and forgings for electrical machinery three times. They were being invited by everybody in authority to increase exports, in which direction the question of prices was a very important one. Before the war there was considerable competition from Germany in exports, and now the war was over it was still a very difficult proposition, but the competition had passed from the old world to the new. There was no doubt in his mind that the cost of electrical machinery in America was less than in this country at the present time. The future, he was afraid, was dark. They had the workman continually asking for increased wages in his endeavour to keep up with the increased cost of living, and perhaps they could hardly blame him for that. On the other hand, they had the manufacturer content to go on increasing his prices, not only for iron and steel, inflating his capital to the increased level of prices, and hoping that something would turn up to avert the Nemesis that was in front of them. They had got to increase their exports. Some people thought the Government would provide the solution, but he had little faith in that. He thought it was up the manufacturers themselves. They represented the knowledge, the intelligence, and the experience, and they had got to provide the solution. He thought such Institutes should discuss the commercial as well as the technical side of the matter. They were continually told they must increase production, but they must come forward with concrete proposals. It seemed to him that if manufacturers, engineers, and ironmasters, could get together and appoint Commissions it would be the best way out. The Commissions should consist of the best brains in industry, to suggest how production costs could be decreased. The key of the solution was co-operation, and he was certain it would be best for the country and for themselves. If they did not do this it would be forced upon them either by fast-declining trade or the advent of a Socialist Government, neither of which alternatives they wanted.

Society of Chemical Industry.—On Friday last at a conference of the Chemical Engineering Group of this society at Birmingham University, Mr. H. Blyth read a paper on "Modern High-Speed Electric Telpherage and its Applications in Chemical Works," giving details as to the invention, early application, and development of electrical telpherage in the United Kingdom, with notes on contemporary progress abroad. Mr. H. J. H. King spoke on "Pneumatic Conveying of Coal and Similar Substances"; Captain C. J. Goodwin on "Portable Conveyors and Transporting Trucks"; Mr. Gordon S.

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Layton on "Pneumatic Conveying of Granular Substances"; Mr. A. E. Marshall on "The Development and Use of Labour-Saving Devices in the American Chemical Industry"; Mr. H. Varndall on "The Importance of the Mechanical Handling of Material in its Relation to Production Costs." "Automatic Weighing and Filling Machines for Liquids" was the subject of a paper by Mr. H. F. Broadhurst.

Edinburgh Electrical Society.—On April 21st, Mr. J. McEwan Brown, of the Post Office Telephone Service, lectured to the above society on "Telephones." The paper was illustrated by diagrams and apparatus, and dealt chiefly with the development of the telephone. The theory of phantom circuits was explained in an interesting manner, and discussed by the members.

On Saturday, April 24th, the society visited the works of Messrs. Bruce Peebles & Co., Ltd., at East Pilton, and was much impressed with the variety, size, and quantity of the machines in process of building for home and export use.

The annual meeting of the society, which is the last of this session, will be held at the Philosophical Institute on Wednesday, May 12th, when the council will be elected and prizes distributed.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Stepney B.C. Finance and Parliamentary Committee, on the recommendation of the General Purposes, Staff and Education Committee, recommends that in lieu of the inclusive salary now being paid to the borough electrical engineer and manager, Mr. W. C. P. TAPPER, he be paid an inclusive flat rate salary of £1,700 per annum as from April 1st, that the salary be in full discharge of all existing or future bonuses unless and until the cost of living further increases to at least 160 per cent. over pre-war figures as shown by the B.O.T. returns. The salary, according to the scale of the A.E.E. of Great Britain would be £1,705; the present salary of the electrical engineer is £1,200.

Dover Corporation has granted the following increases of salary to officials at the electricity works: Chief engineer, to £520, including £220 bonus; chief assistant engineer, to £400; mains engineer, to £300; all from April 1st last.

The following appointments have been made in connection with the Tasmanian State hydroelectric department. Mr. BUTTERS, the chief engineer and general manager was leaving on a business visit to America and England, and Mr. F. M. Nicholl (who for some years was in charge of electricity stations in England, and afterwards was chief of the Kolar Goldfields) was appointed deputy chief engineer and general manager. Mr. R. Morse was appointed engineer for electrical designs; Mr. F. W. Echlin is supply and transport superintendent; Mr. E. F. Du Rieu was appointed engineer for electrical construction; Mr. C. C. Halkyard will, at an early date, take up the duties of engineer-in-charge of hydraulic designs in addition to present hydraulic designing, estimating, and survey work, so as to free Mr. A. H. Bastow from everything but construction in the field. Mr. Bastow, civil engineer, will relinquish the design side of hydraulic work and concentrate upon construction work.

Captain J. HUNTINGTON has been appointed district manager for Bristol and the South-West of England by Messrs. Simplex Conduits, Ltd. He joined the firm 18 years ago. In the early days of the war he took a commission, saw much active service, was mentioned in despatches, and gazetted captain. He rejoined his old firm in 1919.

Rochdale Corporation Electricity Committee proposes that the salary of the electrical engineer, Mr. F. H. RUDD, be increased from £500 to £700 per annum, with further increases of £50 next year and £50 in 1922. The Tramways Committee recommends that the salary of the general manager, Mr. G. WEBSTER, be increased from £600 to £800 per year.

Mr. J. R. LILLEKER and Mr. C. H. JESSOP, members of the Rotherham Corporation electricity staff, who are leaving, have been presented by their colleagues with a gold watch and a case of Treasury notes respectively.

Mr. C. H. BARRETT, of Wendover, has been appointed mains assistant at the Aylesbury Corporation electricity works.

Mr. T. TURNER has been appointed by the Board of Trade secretary to the Water Power Resources Committee in the place of Mr. R. T. G. French, who will continue to assist in the work of the Committee so far as his new duties as secretary to the Electricity Commission will permit. Mr. Turner's address is: Board of Trade Offices, Great George Street, S.W.1.

Mr. O. T. WILKINSON, London manager of the Milliken Manufacturing Syndicate, has been appointed by President Townley, of the American I.E.E., on the recommendation of Mr. E. B. Meyer, Chairman of the Transmission and Distribution Committee, to membership of that committee, an honour which we believe has not been conferred on any other engineer outside the United States.

Mr. G. M. CHAPMAN has left the War Department employ at Aldershot, where he was a shift engineer, to take up an appointment with a large industrial concern in Kent. Mr. F. PHILP, also until recently employed on the staff at the central electric power station, Aldershot, has entered the service of Winchester Corporation electricity department.

Mr. W. C. CAMERON is leaving the staff of the central electric power station, Aldershot Command, where he has been a shift engineer for the past 14 months, in order to take up a position with the Newcastle-on-Tyne Electric Supply Co.

Mr. A. MARKS has been appointed representative for Messrs. Albert Lee & Co., Ltd., in the Southern and Eastern Counties in the place of Mr. W. P. Kerr, who has been transferred as representative for the North of England.

Will.—The late Mr. R. N. JACKSON, chairman of P. R. Jackson & Co., Ltd., of Salford, left £128,330 gross and £93,178 net personalty.

NEW COMPANIES REGISTERED.

Locomobile Engineering Co., Ltd. (166,717).—Private company. Registered April 21st. Capital, £500 in £1 shares. To carry on the business of general, motor and electrical engineers, blacksmiths, copper and tin smiths, manufacturers of and dealers in motors, &c. The first directors are: G. W. Capewell, 56, Rawcliffe Road, Walton, Liverpool; Fred. Ambler; Frank Ambler, 136, Carisbrooke Road, Walton, Liverpool, motor haulage contractor. Registered office: 444, Eastbourne Street, Aintree, Liverpool.

Wm. Anderton & Co., Ltd. (166,308).—Private company. Registered April 12th. Capital, £5,000 in £1 shares. To take over the business of electrical engineers, &c., carried on by W., C., and T. Anderton at 16 and 18, Fenney Street and 2, Cornett Street, Higher Broughton, Manchester, and the Promenade, Rhos-on-Sea, North Wales, as "William Anderton & Co." The first directors are: W. Anderton, King's Mount, Rhos Road, Rhos-on-Sea, Colwyn Bay; C. Anderton, Hazel Bank, Singleton Road, Kersal; T. Anderton, Hill Crescent, Singleton Road, Kersal. Solicitor: F. Wills, 22, Booth Street, Manchester.

Spanish and General Corporation, Ltd. (166,682).—Registered April 19th. Capital, £500,000 in £1 shares. To take over the business of the Spanish and General Wireless Trust, Ltd. (in liquidation), to acquire, hold, sell and turn to account shares and securities of any company established in the U.K., the British Colonies or dependencies, Spain or any other foreign country, &c. The first directors are: Godfrey C. Isaacs, Lyne Grove, Virginia Water; Alfonso Marconi, 75, Harley House, Regent's Park, N.W.; Capt. M. H. P. R. Sankey, 57, Castlebar Road, Ealing; S. F. St. Jermain Steadman, 4, Clever Road, N.W.6. Qualification, £100. Remuneration, £200 each per annum, with an additional £200, divided between them, for every 1 per cent. above 5 per cent. distributed as dividend on the ordinary shares. Secretary: H. W. Corby. Solicitors: Coward and Hawksley, Sons and Chance, 30, Mincing Lane, E.C. Registered office: Marconi House, Strand, W.C.

A. Spooner & Co., Ltd. (166,602).—Private company. Registered April 19th. Capital, £1,000 in £1 shares. To carry on the business of electricians, electrical, motor, mechanical, telephone, heating, ventilating, consulting and general engineers, &c. The first directors are: A. Peel, 239, Manchester Road, Nelson; W. Ramsbottom, 34, Rock Mount, Whalley Road, Accrington; J. Ramsbottom, 19, Owen Street, Accrington; A. Spooner, 49, Aitken Street, Accrington. Secretary: W. Ramsbottom. Registered office: 96, Whalley Road, Accrington.

Amalgamated Firms, Ltd. (166,503).—Registered April 16th. Capital, £200,000 in £1 shares. To carry on the business of electricians, accumulator manufacturers, manufacturers of electrical appliances, engineers, suppliers of electricity and electrical machinery, &c. The subscribers (each with one share) are: W. L. Hodges, The Twining, Grove Park, S.E., solicitor; A. Warren, 45, Morley Road, Lewisham, S.E., clerk; and five clerks. Minimum cash subscription, £7. The subscribers are to appoint the first directors. Solicitor: E. C. Simmons, 12, Finch Lane, E.C.

Magstarlite, Ltd. (166,588).—Private company. Registered April 17th. Capital, £2,500 in £1 shares. To take over, as from April 12th, 1920, the undertaking of P. G. Broom and T. Cartledge, trading as the "Magstarlite," and to carry on the business of mechanical and electrical engineers, manufacturers and patentees of magnetos, car lighting sets, dynamos, insulators, accumulators, &c. The first directors are: P. G. Broom, 18, Avonwick Road, Heston, Hounslow; T. Cartledge, 284, Bath Road, Hounslow; H. R. Harris (secretary), 48, Agamemnon Road, West Hampstead. Registered office: 22, Western Broadway, King Street, W.6.

Bennett & Rutherford, Ltd. (11,134).—Private company. Registered in Edinburgh April 14th. Capital, £10,000 in £1 shares. To take over the business of mechanical and electrical engineers, merchants, agents and manufacturers and suppliers of electric current carried on by W. Bennett and R. Simple at 254, West George Street, Glasgow, as "Bennett and Rutherford." The subscribers (each with one share) are: W. Bennett, 254, West George Street, Glasgow, electrical engineer; R. Simple, 179, West George Street, Glasgow, engineer; A. S. Paterson, 254, West George Street, Glasgow, electrical engineer. The first directors are: W. Bennett, R. Simple and A. S. Paterson. Registered office: 254, West George Street, Glasgow.

Kendall & Gent, Ltd. (166,527).—Registered April 16th. Capital, £150,000 in £1 shares. To take over the business of machine tool makers carried on by Kendall & Gent, Ltd., at Victoria Works, Gorton, Manchester. The first directors are: A. H. Baldwin, Southernhay, West Didsbury, Manchester; E. Harper, 12, Sandeleigh Avenue, Withington, Manchester; J. Westall, Cedar Villa, Highfield, Gorton, Manchester; A. Tongue, Da Vince House, Eccles; F. C. Mosley, Crumpsall Grove, Crumpsall, Manchester; C. E. H. Baldwin, Southernhay, West Didsbury, Manchester. Secretary: J. Maguire. Registered office: Victoria Works, Williams Road, Gorton, Manchester.

Telephos, Ltd. (166,495).—Registered April 15th. Capital £30,000 in 35,652 ordinary and 40,000 "A" preference and 44,348 "B" preference shares of 5s. each. To adopt an agreement with the Telephos Domestic and Street Lighting Co., Ltd., and H. H. Foster, the liquidator for the acquisition of certain rights and property referred to therein, to light, extinguish and control at a distance all kinds of gas, to light with gas, electricity or other illuminating means or appliances, roads, streets, houses, shops, buildings, railways and wharves, &c. The first directors are: A. St. J. Cooke, 40a, Hyde Park Gate, S.W.7 (director, Gas and Coke Ovens, Ltd., &c.); Sir James Heath, Bt., Oxenden Hall, Market Harborough (director, English Oilfields, Ltd.); F. W. Wright, 6, Vale Avenue, Chelsea, S.W. (director, Cowie Harbour Coal Co., Ltd.); A. E. Broadberry, Ellerslie, Buckhurst Hill, Essex; J. H. Swinson, 44, Oxford Mansions, W. Minimum cash subscription, 7 shares. Secretaries: C. L. Anderson & Co. Registered office: 805-6-9, Salisbury House, E.C.

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Turner Brothers Asbestos Co., Ltd. (166,685).—Private company. Registered April 19th. Capital, £100 in £1 shares. To acquire the business of a company of similar name, incorporated in 1899 and now in liquidation, and to carry on the same and any other business for the time being acquired or carried on by this company for the benefit and under the control of Turner & Newall, Ltd., who are the permanent managers. The first directors are: Sir Sam Turner, Chaseley, Rochdale; R. Turner, Denehurst, Rochdale; C. H. Turner, Falinge Corner, Rochdale; S. Turner, jun., Spring Bank, Bamford, Rochdale; R. H. Turner, Thrum Hall, Rochdale (all directors of Turner, Newall & Co., Ltd., Samuel Turner & Co., Ltd., and Asbestos and Electrical Fittings Co., Ltd.). Solicitors: Jackson & Co., Rochdale. Secretary: H. S. Howorth. Registered office: Woodland Road, Spotland, Rochdale.

Newall's Insulation Co., Ltd. (166,700).—Private company. Registered April 19th. Capital, £100 in £1 shares. To acquire the business of a company of same name, incorporated in 1908 and now in liquidation, and to carry on the same and any other business for the time being acquired or carried on by this company for the benefit and under the control of Turner & Newall, Ltd., who are the permanent managers. The first directors are: F. S. Newall, Castle Hill, Wylam, Northumberland; G. S. Newall, Sunniside, Hexham, Northumberland; N. D. Newall, Low Warden, Hexham, Northumberland; M. Robson, The Cedars, Lyndhurst Road, Benton, Northumberland. The two first named are directors of the Washington Chemical Co., Ltd., and Turner & Newall, Ltd., and F. S. Newall is also a director of various electrical and other companies. Registered office: Woodland Road, Spotland, Rochdale.

Coventry Automatic Telephones, Ltd. (166,752).—Private company. Registered April 23rd. Capital, £60,000 in £1 shares. To acquire the benefit of certain inventions relating to automatic telephone systems, exchanges or apparatus, to adopt agreements (1) with the North Electric Manufacturing Co., of Galion, Ohio, U.S.A., F. R. McBerty and K. B. Miller, and (2) with the General Electric Co., Ltd., Peel-Conner Telephone Works, Ltd., and M. S. Conner; to carry on (with due regard in the U.K. to any exclusive or other rights for the time being vested in H.M. Postmaster-General) the business of a telephone, telegraph and electric light, heat and power supply company, controllers of telephone exchanges, &c. Nominated directors: M. S. Conner, Copsewood, Grange Stoke, Coventry; J. Fraser, 31, Copthall Avenue, E.C.; H. P. Wells, 67, Queen Victoria Street, E.C.; F. R. McBerty, Galion, Ohio, U.S.A.; K. B. Miller, Galion, Ohio, U.S.A. M. S. Conner, J. Fraser and H. P. Wells and any directors appointed in their places by the General Electric Co., Ltd., are permanent. F. R. McBerty and K. B. Miller and any directors appointed in their places by the North Electric Manufacturing Co. may hold office so long as that company retains £7,500 ordinary shares. Secretary: P. P. Kipping. Registered office: 71a, Queen Victoria Street, E.C.

F. W. Bland & Co., Ltd. (166,755).—Private company. Registered April 23rd. Capital, £5,000 in £1 shares. To take over the business of an electrical and mechanical engineer carried on by F. W. Bland at 68, Crosby Street, Maryport, Cumberland, as "F. W. Bland." The first directors are: F. W. Bland (permanent managing director), 27, Coronation Street, Maryport; R. B. Ritson, Kirkby House, Maryport; R. Ferguson, 14, Church Street, Maryport; E. Prior, 13, Curzon Street, Maryport. Qualification, £30. Secretary: E. Prior. Registered office: 68, Crosby Street, Maryport.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Woodbridge and District Electric Light Co., Ltd.—Particulars of £7,500 debentures created February 9th, 1920. Present issue £50. Property charged: the company's undertaking and property, present and future, including uncalled capital. No trustees.

Trafford Power and Light Supply (1902), Ltd.—Satisfaction in full of debentures dated June 28th, 1915, and June 10th, 1918, securing £15,000 and £50,000 respectively.

Herne Bay Gas and Electricity Co., Ltd.—Mortgage or charge, by way of resolution, dated August 10th, 1911, to secure £9,500 debenture stock charged on company's undertaking. No trustees. (Registered April 16th, 1920, pursuant to Order of Court.)

New Trafford Engineering Co., Ltd.—First mortgage debenture dated April 8th, 1920, to secure £15,000, charged on the company's undertaking and property, present and future, including uncalled capital. Holders: D. A. Prosser and C. M. Jeram, 190-2, Portland Street, W.

Premier Electric Welding Co. (Swansea), Ltd. (166,422).—Private company. Registered April 14th. Capital, £20,000 in £1 shares. To carry on the business indicated by the title. The subscribers (each with one share) are: J. G. de C. Coke, Bank Buildings, St. James Street, S.W.; A. L. Haggerty, Bank Buildings, St. James Street, S.W. The subscribers are to appoint the first directors. Solicitors: Bircham & Co., 46, Parliament Street, S.W.

James Scott, Ltd.—Equitable mortgage charged on certain freehold land and premises at Knowsley Road, Bootle, Lancs., dated March 22nd, 1920, to secure all moneys due or to become due from company to Bank of Liverpool and Martins, Ltd., not exceeding £12,000.

Electrical Apparatus Co., Ltd.—Mortgage dated March 31st, 1920, to secure all moneys due or to become due from company to London Joint City and Midland Bank, Ltd., charged on Vauxhall Works, South Lambeth Road, S.W.

Staffordshire Electrical Accessories Co., Ltd.—Debenture dated April 8th, 1920, to secure £1,735 charged on company's undertaking and property, including uncalled capital. Holders: H. F. Howells, 40, Lichfield Street, Hanley.

Fredk. R. Butt & Co., Ltd.—Charge on 10, Devonshire Grove, Old Kent Road, S.E., dated April 8th, 1920, to secure all moneys due or to become due from company to London Joint City and Midland Bank, Ltd.

CITY NOTES.

Brush Electrical Engineering Co., Ltd.

Mr. E. Garcke presided at the annual meeting on Monday. He said that the balance sheet showed a further substantial improvement in the position of the company. The gross profit amounted to £227,466, compared with £159,254 in the preceding year. The general charges had increased from £22,829 to £25,852. The net profits were £148,685, an increase of £57,687. He wished to repeat a statement that he made at the last meeting when he said that if in future they were able to declare dividends at what might be regarded as high rates, it should be borne in mind that the capital was small in relation to the size of the undertaking, and the volume of business now done. It was a small capital because it was written down drastically at a time when it was impossible to earn profits in this country by the manufacture of electrical apparatus because of the legislative and fiscal conditions then obtaining. The sum of £85,000 which they were carrying forward might appear large, but they had to provide for excess profits duty. The output from the works during the year under review had been large in both the rolling stock and the engineering departments, and the amount of work in hand and the number of orders flowing in were considerable. The improvement in the business was due mainly to the development of their standard lines of manufacture, and only to a small extent to residual war orders. Immediately on the signing of the armistice in November, 1918, they took in hand the change over from the production of war material on which they were then exclusively engaged, to industrial work, with the result that they were quickly in a position to resume their normal manufactures. Such extensions as they were able to carry out during the war had been adapted as far as possible for the purposes of their normal business, but they had proved to be quite insufficient to meet the increasing demands made upon them. During 1919 they had increased their capacity for building railway, tramway, and other rolling stock, and they were still improving and adding to their facilities in that department. On the engineering side there had been great development in the orders for Brush-Ljungstrom turbo alternators and auxiliaries, and the demand for that plant was now only limited by their capacity to supply. The orders received this year exceeded by more than 75 per cent. those for the corresponding period of 1919, and already they amounted to more than half the total for the whole of that year, which was in itself a record year. After careful consideration of the whole situation, the directors had authorised the erection of a large additional factory to be devoted to the economical production of Brush-Ljungstrom electrical power sets. The transformer branch of the business had also grown very much, and they had put up a large new shop to help their production of transformers, which they hoped would be in full operation in the course of the next three or four months. Additional buildings and plant were of little use if they were not able to command sufficient labour and they were experiencing great difficulty in attracting workmen and their families because of the lack of housing facilities. That was a very real difficulty at Loughborough, and it was clear that they must help themselves if they were to derive early benefit from the extensions they had in hand. To that end they had acquired a suitable site of six acres near the works on which they proposed to erect a substantial number of houses to meet their more pressing requirements. They had been much handicapped by labour unrest, and the continual advance in wages and materials. The uncertainties as to labour conditions and as to cost affected their contracts seriously. They, of course, covered themselves as far as they could against those contingencies, but it was not satisfactory either to themselves or their customers not to be able to carry out their contracts at firm prices, and it was to be hoped that more settled conditions would soon be established in order to permit of the resumption of normal terms of contract. The moulders' strike had been far-reaching in its effects on production, which had also suffered by the general shortage of labour and by the stand taken by the trade unions against overtime being worked except in cases of special urgency. All their various extensions to factory and other buildings, plant, and tools obviously called for more capital, and the increase in the volume of business also required a larger working capital. They had, therefore, decided to increase the authorised capital of the company from £253,000 to £600,000. That would take the form of ordinary shares, and arrangements for the issue were now under consideration. In making the issue, the interests of the existing shareholders, both ordinary and debenture stockholders, would be protected, in the sense that applications from them would receive preferential consideration in the allotment of the new shares. In view, however, of the fact that some of the company's profits had from time to time been carried to a general reserve fund and spent on extensions, or otherwise employed in the business, and more especially in view of the heavy writing down of the capital in former years, the directors thought it only right before making any new capital issue and admitting new shareholders into a participation in the profits, that the bulk of the general reserve fund should be capitalised and distributed on a cent. per cent. basis to the holders of the existing ordinary stock. As to the future, it was full of hope for them. Some years ago when the company was in dire distress, the board took off their coats and put their shoulders to the wheel with a determination to get the cart out of the mire. It was a heavy task, and took a long time, but it had been accomplished, and they felt satisfied that they were now on the high road to prosperity, and that with the recollection of past adversity deeply rooted in their minds, they had good guarantee that in the future they would keep to the centre of the road.

Subsequently an extraordinary general meeting was held, at which a resolution was agreed to empowering the board to capitalise part of the undivided profits of the company.

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Bromley (Kent) Electric Light and Power Co., Ltd.

Mr. F. E. Gripper presided at the recent annual meeting. He referred to the substantial improvement over the previous year. Costs had risen, but there had been a decided increase in output and consumption. There was a considerable number of new consumers, and the wiring department had been busy during the whole of the period. The result of removal of rationing would be shown more fully during 1920. They obtained authority for the maximum rate to be increased from 8d. to 9d., but the additional charge was only in force for three months of the year. During the past few years they had been unable to make substantial provision for the reserve fund. On coming to renew the plant, &c., the cost would be double what was on the books at the present time. Bulk supply was to be taken from the West Kent Power Co. to supplement their own. A supplementary supply would be an advantage, and would save additional expenditure that they would otherwise have to deal with before long.

Vickers, Ltd.

Mr. Douglas Vickers, M.P., presided at the annual meeting, held at Sheffield on 22nd inst. He referred to the acquisition since the last meeting of the Metropolitan Wagon & Carriage Co., Taylor Bros. & Co., and W. T. Glover & Co. He briefly mentioned the new industries that they had taken up to replace the production of armaments, and to the purchase jointly with the Metropolitan Co. of the controlling interest in the British Westinghouse Co., with its connections in France and Italy. The name was subsequently changed to the Metropolitan-Vickers Electrical Co. Relations with the American Westinghouse Co., however, still continued on the most intimate and friendly lines, and further connections had been made with Brown, Boveri & Co., the well-known Swiss electrical firm. With this combination they would have the benefit of a world-wide experience in the design of a large range of materials which had been proved to suit both European practice and that of other countries. The electrical works of the company were very full of work, and the present prospects were excellent. Sheffield works would share, as certain sections of the material will be made there. As far as Vickers' other interests were concerned, the Barrow works had been extremely busy with shipbuilding, and they had every reason to suppose that they would continue to be so for some time to come. Contracts for a term of years had been made with the Cunard and other companies. The first of the Cunarders had been launched, and another one had been laid down. The Barrow works was also building a large number of oil tankers, fitted with internal combustion engines of their own type. On the engineering side of these works also they were repairing and reboilering a large number of locomotive engines, and were making several different types of machinery, so that this section also was well provided with work. The company's Crayford works were increasing their output of sewing machines satisfactorily, and were also helping the Wolseley Co. by manufacturing certain standard motor-car elements for them. The firm's works at Ipswich had been transferred to a subsidiary company, formed jointly with Petters, Ltd., for the manufacture of medium-sized internal combustion engines. These works were very busy. The number of workmen employed by the firm had decreased very much from that employed during the war, which, at one time, rose to 107,000 in the company's factories, including the Wolseley Co. It had now got down to about 44,000, of which 3,600 were women. These figures did not include the Metropolitan Co., Taylor Bros., Glovers, or Metropolitan-Vickers' interests. Taking the year as a whole, it had been one of extreme difficulty, due to changes in trade, shortage of materials, reduction in working hours, and repeated increases in wages. For a long time customers held off, thinking that prices would go down, and they were late in realising that there was no prospect of this for some time to come. Manufacturers also were unable to quote firm prices for work of any magnitude, owing to the continued rises of wages and materials. In addition to this, there was an almost universal restless spirit, and in many branches the output was at first very low. The year ended unfortunately with the moulders' strike, which lasted many weeks, and, in the end, was throwing many of the firm's engineers out of employment through want of machining material. Happily, this strike ended early this year, and the general opinion was that there was a marked improvement in the spirit of the workers among all classes, and it appeared as if 1920 was proceeding, and likely to continue, under very much more satisfactory conditions. The speaker alluded in some detail to their continued inability to publish the accounts. Some negotiations with the Government were outstanding even for 1916. The negotiations were proceeding amicably, and they had no reason to suppose that they would not be fairly treated.

Bath Electric Tramways, Ltd.

Mr. J. B. Hamilton presided at the annual meeting, in London, last week. He said that like all statutory undertakings they had had a difficult year. They had been helped by the fine weather. Owing to this fact and to their being able in April last year to obtain powers to increase fares the total revenue had been increased by £37,344 to £100,000. The expenses increased by £34,035, leaving an excess surplus over the previous year of £3,300, but they were bound to deduct the cost of some renewals. Their increase in fares was made under a temporary Act. After referring to the wage and hours of labour demands, and to meetings that were taking place last week in regard to such demands, the speaker said that a further Act to keep alive the previous increase in charges and extend its powers had passed second reading in the House of Commons, and if passed the directors hoped to place the position before the Ministry so that their petition would be granted. The undertaking had been in operation for 16 to 17 years, and within the next two or three years—perhaps earlier—they would have to spend upon the track sums equal to 2½ times what it cost to lay the original track. On this account he would not be satisfied until they had doubled the amount of £45,000 standing to the contingencies and renewals account. Another reason for not paying the dividend on the preferred ordinary shares was to be found in the terms of their Act regarding higher fares. The directors contemplated the formation of a subsidiary company to take over the motor omnibus and char-à-banc business. If they did so the shares would be offered in the first instance to the shareholders of Bath Tramways, Ltd. The motor company would pay a considerable portion of the capital in cash to the tramway which would have the necessary funds to carry out the necessary renewals.

British Electric Transformer Co., Ltd.

Mr. A. F. Berry presided at the annual meeting on April 20th. He said that they had carried out large extensions to the buildings at Hayes, and purchased freehold land for future developments. The gross profit on trading had increased by nearly £28,000. The profit was over 70 per cent. more than that of the previous year—the issued capital had been increased by over 60 per cent.—and the position disclosed in the accounts was highly satisfactory. Referring to the dividend of 10 per cent., and bonus of 2½ per cent. on the ordinary shares, he said he hoped it might be possible, when the company got well into its post-war stride, to do something still better for the ordinary shareholders, who had so willingly agreed to improve the fixed preference dividend. In regard to the new issue of capital, he said that shareholders sometimes felt that they alone should be given an opportunity of taking further shares, and those holding shares in this company would undoubtedly feel that the present opportunity was even better than that which the directors were able to afford for investment last year, but the directors desired as large a body of shareholders as possible, and were particularly interested to receive the applications of those who were in any way connected with the electrical, engineering, or allied industries, as such shareholders, particularly the small active ones, could and did help them in their business, to which they lent considerable strength. So far as could be seen, it would not be necessary to issue any further shares for some time to come. Replying to a question by a shareholder, the chairman said that in connection with the transformer business they were inundated with orders from all over the world. They had orders booked to the absolute limit of their present producing power, and saw no limit to the demand for their product. They had practically completed the building operations which they determined upon and started as soon as possible after the armistice. The issue they were making was a large one, namely, £325,000, and the directors considered it was a wise policy, particularly in these times, to have it underwritten, especially as the issuing house were very nearly presenting the company with their services.

English Electric Co., Ltd.

The first annual report (1919) states that the balance to the credit of profit and loss account (including certain undistributed profits on subsidiary companies at January 1st, 1919) is £410,835. Debenture interest and trustees' fees absorb £23,943; expenses of debenture issue, £115,660; preliminary expenses, £17,385; transfer to capital reserve, £100,000; preference dividend 6 per cent., less tax, £79,842; balance to carry forward £45,302. The company is, for the time being, a holding one, deriving its profits in the main from dividends on shares from its subsidiary companies. It has always been, and still is, the intention of the directors to consolidate the different constituents into one manufacturing entity, but the process is slow, especially at the present time. During the greater part of the year under review the several works were occupied in the conversion of the plant from war conditions to those suitable for commercial requirements. As this company owns the whole of the shares of the Coventry Ordnance Works, Ltd., and the Phœnix Dynamo Manufacturing Co., Ltd., the directors have been able to transfer from these companies sufficient of their undivided profits at January 1st, 1919, to permit of the writing-off of the whole of the discount on, and expenses of, the debenture issue, and of the preliminary expenses of the company, as well as the setting aside of £100,000 to capital reserve account. During the year, negotiations for the purchase of the Siemens Dynamo Works at Stafford were brought to a satisfactory conclusion, but as possession was obtained only at the beginning of December, no profits have been taken in from that source. Since the beginning of 1920, an opportunity has occurred for the disposal of the Scotstoun works belonging to the Coventry Ordnance Co. on terms which the directors consider satisfactory. The works, therefore, now controlled and operated by the English Electric Co.

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are as follows: Dick, Kerr Works, Preston; Ordnance Works, Coventry; Phœnix Works, Bradford; Siemens Works, Stafford, and Willans Works, Rugby, and the products cover all classes of electrical and allied machinery. The moulders' strike has materially reduced output, and its effects are still hampering production. The position of the company's order book is good, and the directors hope that, given the absence of further labour disorganisation, satisfactory results will be realised. During the year Sir John A. F. Aspinall and Lord Meston joined the board.

French Companies.

The Société des Cables Electriques has declared a dividend at the rate of 64.70 frs. per ordinary share for 1919, founder shares receiving 284 frs. each.

The Société Anonyme pour la Fabrication des Appareils de Chauffage par l'Electricité, whose general meeting was held recently at Lyons, decided to pay a dividend of 70 frs. net per share.

The Société Centrale pour Industrie Electrique reports net profits of 1,049,000 frs. in 1919, as contrasted with 888,000 frs. in the previous year. A dividend at the rate of 25 frs. per share has been sanctioned, being the same as in 1918.

The Société Francaise des Electrodes reports gross profits, excluding the balance forward, of 1,530,000 frs. for 1919, as compared with 1,033,000 frs. in the previous year. It is proposed to pay a dividend of 40 frs. per share, or at the rate of 8 per cent.

German Companies.

The accounts of *Julius Pintsch A.G., of* Berlin, after making provision for depreciation, show net profits of 2,952,000 marks for 1919, as compared with 1,889,000 marks in the previous year. The directors recommend a dividend at the rate of 15 per cent., this contrasting with 10 per cent., and a bonus of 47 marks per share in 1918.

The Treuhand Bank fur Elektrische Industrie, of Berlin, which belongs to the group of the A.E.G., and the Felten and Guilleaume Co., reports net profits of 948,000 marks for 1919, after having written off 1,139,000 marks for losses through depreciation of securities. It is proposed to pay a dividend of 6 per cent., as compared with no distribution in 1918, on a paid-up capital of 13,750,000 marks.

The directors of the *Hamburg Hochbahn A.G.* recommend for 1919 a dividend at the rate of 1½ per cent. on the "A" shares, and ½ per cent. on the "B" shares, these contrasting with 6 and 5 per cent. respectively in 1918. The guarantee of the State of Hamburg, however, raises the rate on the "A"" shares to 5 per cent. The net profits are returned at 764,000 marks, as compared with 2,289,000 marks in 1918.

The report of the *Land und Seekabelwerke A.G., of Cologne-Nippes*, states that the degree of activity in 1919 was favourable and the working results satisfactory. After setting aside 95,000 marks for depreciation as against 562,000 marks in 1918, the accounts show net profits of 1,038,000 marks, as compared with 824,00 marks, and a dividend of 15 per cent. is proposed, this contrasting with 12 per cent. in 1918. The stock of orders brought over into 1920 is said to be good, and to have since been maintained on a favourable level.

The report of the *Robert Bosch A.G., of Stuttgart*, dealing with the third financial year, ended on September 30th, 1919, states that the transition from war work to ordinary manufactures was completed, but despite the increase in sale prices the value of the turnover was not inconsiderably less than in the preceding year. A considerable loss was incurred by the sale offices in Frankfort, Vienna, and Buda Pesth, but only that of the first mentioned affected the balance sheet, as the losses in the other two cases concerned the independent balance sheet of the Vienna company. The sale offices at Geneva and Milan had been reopened, but it had not yet been possible to resume direct relations with England, France, and Belgium. The directors recommend the issue of a loan for 12,000,000 marks, and an increase of 8,000,000 marks in the share capital to 20,000,000 marks. It is, however, suggested that the augmentations in the latter should proceed gradually, and shares for 2,000,000 marks be issued as a first instalment. The net profits in 1918-19 amount to 2,919,000 marks, as against 3,799,000 marks in the preceding year, and it is recommended that instead of paying a dividend the sum of 1,200,000 marks should be credited to the shareholders, corresponding to a dividend of 10 per cent., as part payment for the first instalment of new shares for 2,000,000 marks, leaving the shareholders to pay 800,000 marks to complete the transaction. No dividend was paid for 1917-18, as three-fourths of the net profits were transferred to the taxation reserve fund.

Stock Exchange Notices.—The Committee has ordered the undermentioned to be officially quoted:—

Underground Electric Railways Co. of London, Ltd.—267 "A" ordinary shares of 1s. each, fully paid (Nos. 1,198,711 to 1,198,977).

Oriental Telephone and Electric Co., Ltd.—Final dividends of 3 per cent., less income tax, on the preference shares, making 6 per cent. for 1919, and of 6 per cent. on the ordinary (free of income tax), making 10 per cent. for the year; also a bonus of 2 per cent. on the ordinary, free of tax.

Erinoid, Ltd.—Interim dividend of 15 per cent. per annum for the half-year.

Folkestone Electricity Supply Co., Ltd.—The report for 1919 states that the equivalent of 13,330 8-c.p. lamps were connected during the year (the largest increase in any year since 1913), making the total 181,827. Price of current advanced to 8d. from beginning of 1919; receipts show substantial increase, but cost of fuel, &c., has continued to increase. The higher charges were authorised under the provisions of the Statutory Undertakings Act, and one of the provisions was that the company might pay a dividend of not more than 4¾ per cent. per annum on the ordinary capital. The profit on revenue accounts from the three undertakings was £14,302, plus £965 brought forward. Interest on debenture stock and preference dividend are provided for, £7,703 is carried to depreciation, 4¾ per cent. (less income tax) is recommended on the ordinary shares, leaving £939 to carry forward. A note is attached to the report stating: "The payment of the dividend recommended is subject to the consent of the Electricity Commissioners, which has not been obtained at the time of issue of this report."

River Plate Electricity Co.—The *Times* states that the board consider that a part of the general reserve may properly be capitalised and divided among ordinary stockholders, and they will submit the necessary resolution at the general meeting to enable them forthwith to allot and issue seven fully-paid ordinary shares of £1 each for each £10 of ordinary stock held. In their report for 1919 (according to the *Financial Times*) the directors say that the improvement in revenue has been materially helped by an exceptional profit on exchange account, due to the large premium on cash remittances from the Argentine to this country. The net revenue for the year, after providing for administration expenses, bad debts, and depreciations, amounts to £57,791, which, with £17,612 brought forward, makes £75,403. The board recommends a dividend of 7 per cent. for the year on the ordinary stock, placing to general reserve £40,000, and carrying forward £4,152.

Bristol Tramways & Carriage Co., Ltd.—Revenue for 1919 £848,050; working and general expenses and renewals £772,430; net revenue (including balance brought forward) £90,319. Debenture and other interest £22,575; interest (carried to reserve) on uninvested portion of reserve fund £6,486; 4 per cent. preference dividend (subject to tax) £14,000; dividend on ordinary shares 7 per cent. for the year, £35,000; carried forward £12,258. The receipts of the tramways department showed an increase of £56,992, and those of the carriage department an increase of £36,142. Passengers carried 72,838,076, an increase of 11,024,952. The Minister of Transport declined to accede to the Corporation's application for a further extension of time for the exercise of its option to purchase. Mr. C. Challenger, after 40 years' service, and for reasons of ill-health, resigned the managership. He will join the board. Lieut.-Col. S. E. Smith has been appointed manager.

Johnson & Phillips, Ltd.—The profit for 1919 on trading accounts, &c., after providing for bad and doubtful debts and charging to revenue upwards of £27,000 for maintenance of buildings, plant, &c., is £89,965, plus £38,832 brought forward, less the dividend paid in May, 1919, £17,500, and 1 per cent. debenture bonus £822. There are deducted: Directors', &c., remuneration, £1,521; debenture stock interest, £4,109; debenture sinking fund reserve, £8,781; interest on second debentures, £2,500; depreciation on machinery and plant, £12,198; interest on loans, £1,195; income tax and excess profits duty, £16,376; leaving £63,795. A dividend of 12½ per cent. per annum, less tax, on the 350,000 ordinary shares requires £30,625, leaving to carry forward, subject to excess profits duty for 1919, £33,170.

Prospectus.—Low Temperature Carbonisation, Ltd.—An issue of 200,000 ordinary shares of £1 each at par is being offered to the shareholders. A contract has been made with the Yorkshire Electric Power Co. at Barnsley for the supply of power gas, and with the Rotherham firm of Steel, Peech and Tozer, Ltd., for the supply of gas for use in steel making, boiler firing, and other purposes. It is proposed to form a subsidiary company to acquire the benefit of these contracts and to obtain from the parent company the sole licence to use its patented processes in the County of Yorkshire.

Eastern Telegraph Co., Ltd.—The report cannot be issued during May owing to unavoidable delays in obtaining returns from stations abroad. Final dividend on the ordinary shares for 1919, 5½ per cent., free of tax, making a total of 10 per cent. for the year. The usual distribution at the rate of 3½ per cent. per annum, less tax, on the preference stock for the first quarter of 1920, is announced.

Montreal Companies.—Montreal Light, Heat & Power Consolidated has declared a dividend of 1¾ per cent. for the quarter ended April. On the stock of the Montreal Light, Heat & Power Co. the dividend for the same quarter is 2 per cent.

Lima Light, Power & Tramways Co.—Dividend of 2 per cent.

Kaministiquia Power Co.—Dividend 2 per cent., less tax, for the quarter.

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Hydro-Electric Power and Metallurgical Co.—A cable received from the company at Melbourne states that the works started full capacity on March 27th.

Eastern Extension, Australasia & China Telegraph Co., Ltd.—Final dividend for 1919 5½ per cent., making 10 per cent., free of tax, as against 8 per cent. for 1918.

Merthyr Electric Traction & Lighting Co., Ltd.—After putting £1,200 to reserve, and paying 6 per cent. on the ordinary shares, £581 is carried forward.

STOCKS AND SHARES.

TUESDAY EVENING.

STOCK EXCHANGE markets in the main continue dull to heavy. There is not much to make them otherwise. Taxation lies like a blanket over companies and individuals alike. New enterprise is likely to be hard hit by the Budget proposals. Shares in manufacturing companies of all classes are no longer the eagerly-sought investments by all classes. It is the day once more of gilt-edged stocks, which are being absorbed by the same people who, a couple of months ago, were ardently pursuing the industrial boom checked, now, by Bank Rate, Budget, labour, foreign politics, *et hos genus omne*.

Severe shrinkages are shown in the prices of the Underground Railways group. Underground £10 shares are 12s. 6d. lower at 40s., the A shares have dropped a florin to 5s., and the income bonds shed 6½ points to 61½. There has been a good deal of pressure to sell, and the market in the Stock Exchange, reluctant to take stock forced upon it, put down the prices heavily. Until the company is granted Parliamentary powers to raise fares, it is feared that even the 4 per cent. dividend on the income bonds may be further reduced. Metropolitans are down 1 to 19½, and Districts dropped to 17½.

Would-be sellers complain, with some show of reason, of the difficulties attendant upon present-day realisations. As one instance Indo-Europeans may be cited. The middle price is 40, but shares changed hands the other day at 35. Anglo-American Telegraph preferred is another case in point. Although the nominal price is about 77½, a seller had to take 75½ a few days back. In many other stocks and shares it is not always easy to find a buyer at all, and dealings relapse into that uncomfortable state known as a "matter of negociation."

What has happened in the financial world is the unexpected interference of dear money and increased taxation with the speculative spirit that certainly overleapt the bounds of prudence and of national advantage. The new issues that rushed out ahead of the Budget were subscribed to some appreciable extent by people whose object in applying was simply to scalp a profit; permanent investment in the shares was far from their intentions. Having to take up the shares and pay the calls, financial assistance has to be obtained if there are no buyers in the market, and this all helps to aggravate the monetary stringency. While the profound disappointment in connection with the Excess Profits Duty is having a direct effect upon such shares as many of those comprised in our own lists.

British Aluminium ordinary at 21s. 3d. are about 2s. lower, and so are Electric Constructions at the same price. Edison Swan's lost their gain of a week ago, reverting to 22s. 6d. General Electrics keep their quotations with firmness. The company can claim to be in the van of the many which, nowadays, are raising the rates of dividend on their preference shares. Callenders, it may be recalled, acted similarly, and at the present time hardly a day passes without furnishing fresh examples of this latest development of financial fashion. The suggestions are usually passed with an amount of agreement that seems a little surprising.

The River Plate Electricity Company is taking steps to increase its capital, and proposes to issue, as a bonus, 70 per cent. new shares for £100 ordinary stock now held. The price of the latter has accordingly risen 20 points to 170. Para Electric Railways and Lighting shares are being dealt in this week for the first time in their £1 shape, and the ordinary are quoted 13s., the preference 17s. The Bombay Electric Supply and Tramways Company offers new ordinary shares to its proprietors, and although the old shares stand at 115 ex rights, a premium, that is, of 100 guineas, the premium on the new is called about £40. The preference shares are now 15 ex rights.

City Lights have receded to 12½ and County of London ordinary to 9. Westminsters are lower at 5½. Metropolitans have receded to 3⅜. City preference rallied to 9, at which they appear fully-valued as compared with many other investments now offering. Proprietors of preference shares in various companies will doubtless be on the look-out for additions to be made to their dividends on lines carried into effect by others. The electric supply share market suffers with the rest in the disappointment felt at the Government's decision in regard to the Excess Profits Duty; besides which there is the threatened big rise in the price of coal that renders people nervous of entrusting their money to any industry likely to be sharply affected by the state of the coal outlook.

Subscription lists were due to be closed on Wednesday in this week for the sale of 137,500 seven per cent. cumulative preference shares of £1 each at 17s. 6d. and of 162,500 ordinary shares of £1 each at 24s. in the British Electric Transformer Co., Ltd. The prospectus stated that preferential treatment in allotment would be accorded to applications for an equal number of both classes of shares, and from shareholders in the company. Profits for the nine years 1911-1919 inclusive were set out in the "offer for sale," but no independent statement of assets and liabilities was given, although the auditors certify that according to the balance sheet dated December 31st last there was a surplus of assets over liabilities, excluding patents and goodwill, of £351,680, subject to payment of the final dividend for 1919.

Foreign issues are weaker again. Mexican, Argentine and Brazilian shares and bonds have fallen. British Columbia Electrics are better. In the cable list, Indo Europeans have lost 90s., Anglo-American preferred a couple of points, West India and Panama fell back to 16s. 3d., Marconis firmed up a little. Certificates of some of the new Radio Corporation shares (the old American Marconis) are beginning to arrive in this country, and dealings may start again towards the end of the week. Brush ordinary has gained 10 at 130. English Electrics are somewhat heavy at 22s. 6d.; the 8 per cent. dividend is not up to all expectations. India-Rubber shares fell back to 13½. Rubber shares weakened on E.P.D. apprehensions, but the produce is a rather better market than of late.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1918.	Dividend 1919.	Price April 27, 1920.	Rise or fall.	Yield p.c.
HOME ELECTRICITY COMPANIES.					
Brompton Ordinary	8	12	6½	—	£9 4 8
Charing Cross Ordinary	6	7	8½	—	9 0 8
do. do. do 4½ Pref.	4½	4½	5⅞	—	8 8 8
Chelsea	3	4	5	—	6 8 4
City of London	8	10	12⅜	— ⅛	8 5 0
do. do. 6 per cent. Pref.	6	6	9	+ ½	6 13 4
County of London	7	8	9	— ⅛	8 17 10
do do. 6 per cent. Pref.	6	6	8⅛	—	6 17 2
Kensington Ordinary	5	7	5	—	7 0 0
London Electric	Nil	2½	1⅜	—	5 2 6
do. do. 6 per cent. Pref.	6	6	8⅞	—	9 4 8
Metropolitan	5	6	8⅞	— ⅛	8 17 10
do. 4½ per cent. Pref.	4½	4½	2½	—	8 0 0
St. James' and Pall Mall	10	12	6½	—	8 16 10
South London	5	6	2⅜	—	7 12 8
South Metropolitan Pref.	7	7	18/9	—	7 0 0
Westminster Ordinary	8	10	5½	— ⅛	9 10 6
TELEGRAPHS AND TELEPHONES.					
Anglo-Am. Tel. Pref.	6	6	77⅛	—2	7 14 10
do. Def.	55/6	1½	18⅜	—	8 0 0
Chile Telephone	6	6	6½	—	£4 18 3
Cuba Sub. Ord.	7	7	10	—	£7 0 0
Eastern Extension	8	10	15½	—	£6 9 1
Eastern Tel. Ord.	8	10	160	—4	£6 5 0
Globe Tel. and T. Ord.	8	10	15⅜	—	£6 7 0
do. do. Pref.	6	6	9	—	6 13 4
Great Northern Tel.	22	—	23½	—	9 15 6
Indo-European	15	10	40	—4½	6 5 0
Marconi	25	—	8⅜	— ⅛	6 18 4
Oriental Telephone Ord.	10	—	2⅛	—	8 11 0
United R. Plate Tel.	8	—	7⅜	—	£6 1 7
West India and Panama	1/2	—	⅛	— ⅛	7 18 10
Western Telegraph	6	10	15⅜	—	£6 7 0
HOME RAILS.					
Central London Ord. Assented	4	4	47½	—	8 8 6
Metropolitan	1	1½	19½	—1	8 8 2
do. District	Nil	Nil	17½	— ½	Nil
Underground Electric Ordinary	Nil	Nil	2	— ½	Nil
do. do. "A"	Nil	Nil	5/-	—2/-	Nil
do. do. Income	5	4	61½	—6½	6 10 1
FOREIGN TRAMS.					
Anglo-Arg. Trams. First Pref.	Nil	Nil	8⅜	—	—
do. do. 2nd Pref.	—	—	3	— ½	—
do. do. 5 Deb.	5	5	59½	—1	8 8 0
Brazil Tractions	—	—	19	—3	—
Bombay Electric Pref.	6	6	15	—2½	4 0 0
British Columbia Elec. Ry. Pfce.	5	5	56½	—	8 17 0
do. do. Preferrred	2½	5	59½	+1	9 18 0
do. do. Deferred	Nil	3	44½	+2	6 14 10
do. do. Deb.	4½	4½	56½	—	7 19 2
Mexico Trams 5 per cent. Bonds	Nil	Nil	9½	—4	Nil
do. 6 per cent. Bonds	Nil	Nil	20	—2½	Nil
Mexican Light Common	Nil	Nil	12½	—	Nil
do. Pref.	Nil	Nil	17⅜	—5	Nil
do. 1st Bonds	Nil	Nil	86	—8	—
MANUFACTURING COMPANIES.					
Babcock & Wilcox	15	—	8	—	£5 0 0
British Aluminium Ord.	10	10	1⅛	— ⅛	9 8 2
British Insulated Ord.	12½	15	1⅛	—	7 14 8
Callenders	25	—	8½	—	7 11 6
,, 6½ Pref.	6½	6½	4⅜	—	8 16 10
Castner-Kellner	20	—	4	—	—
Crompton Ord.	10	—	22/-	—	9 1 10
Edison-Swan, "A"	10	—	1⅜	— ⅛	8 17 10
do. do. 5 per cent. Deb.	5	5	79½	—	£6 5 9
Electric Construction	10	—	1⅛	—1/9	9 8 2
Gen. Elec. Pref.	6½	6½	18/6	—	7 0 6
do. Ord.	10	—	1⅜	—	£5 14 4
Henley	25	15	2⅜	—	7 1 2
do. 4½ Pref.	4½	4½	3⅜	— ½	6 8 7
India-Rubber	10	—	13½	— ½	£9 11 0
Met.-Vickers Pref.	—	8	2⅛	—	6 11 2
Siemens Ord.	10	10	27/6	—	£7 5 6
Telegraph Con.	20	20	24½	—	£4 13 6

* Dividends paid free of Income Tax.

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TECHNICAL BOOKS.

By A. C. PURDAY.

The lack of response to a recent letter of mine on the above subject would appear to confirm one of the editorial comments thereon, viz., that many English engineers and students do not appreciate the value of good technical books.

However, a great many of the readers of this journal must find it necessary to purchase books from time to time, and anything that would help them to obtain reliable and useful books at a reasonable outlay should be of interest to them.

The general body of readers of engineering books could probably be classified under three headings, viz. :—

1. Engineering students.
2. Engineering draughtsmen and designers.
3. Installation and maintenance engineers.

For these three classes quite different types of books are needed.

For the first, text-books dealing mainly with the scientific principles underlying the particular branch of engineering dealt with, though not neglecting some indication as to how these principles are practically applied, are required ; for the second class, books in which the principles already understood are put into actual practice in designing machines ; and for the last class, manuals of a practical nature dealing with the problems which arise in the installation, running, and repair of engineering plant.

While it may not be impossible to get books which keep within one of these limits, I think that a great many try to deal with two or all, and in consequence some sections are scrappy and of little practical use.

Again, their titles generally do not adequately disclose the nature of their contents nor the class for which they are written.

This may not be a matter of great importance in London and the larger cities, where a man may go into many book shops, publishers' book rooms, technical Press offices, &c., and look through many books without being compelled to purchase ; but in the smaller towns this is not possible.

Some publishers' catalogues give a synopsis of contents or headings of the chapters, which is a good custom : but many do not even do this.

There would appear to be still some room for very practical manuals suitable for the third class.

Possibly engineers who are still in practice do not always wish to give their hard-won experience away ; but it appears to the writer that there is a scarcity of British literature (not so much of American) on the practical points which arise in the daily life of the installation and maintenance engineer.

Of course, this is to a large extent supplied by the engineering Press, and the papers read before the engineering institutions and recorded in their journals. The value of the former cannot be too highly rated.

Any engineer who wishes to take an intelligent interest in his profession and to keep abreast of the times, must read the engineering periodicals regularly and thoroughly.

To read only one paper or one branch is not sufficient, I think, and a good plan where there are several engineers or draughtsmen in a works or office is to form a book club, each member subscribing the same amount into a fund, from which the papers are purchased.

It will be found that more interest is taken in the club if there is one periodical per member, and if each member is (as far as possible) allowed to keep the paper he prefers after it has circulated to the other members.

With regard to the papers read before institutions, these, of course, are often most valuable sources of information, the discussions after the reading of the paper forming sometimes the most valuable part.

Where these are not obtained through membership of the particular institution, they can be referred to at the Patent Office Library, London, and at some of the larger public libraries. Good abstracts of most of them also appear in the technical Press.

However, giving all due credit to the Press and institutions, books of a very practical nature, written by men of standing, would, I think, be very welcome in greater numbers than at present, provided always that they were not too dear.

Possibly some saving of cost could be brought about by publishing them in a somewhat similar style to Government publications, *i.e.*, in stiff paper or board covers, and printed on paper not quite so good as that usually used for technical publications.

Perhaps I may be allowed to digress here to remark that there are a number of interesting Government publications dealing with factory plant, &c., which may be obtained for a few pence or a shilling or so from the sales offices of H.M. Stationery Office, or the printers, which are well worth the money expended.

This reminds me that a number of engineering books are issued with fairly full extracts from these Government pamphlets, which seems quite unnecessary. A reference to them should be quite sufficient, as one can obtain the full pamphlet for much less cost than the number of pages it occupies in the book.

To return to the argument, I think it must be the experience of many that every-day factory work lags a good deal behind the state of knowledge and the materials available at the time, and this may be partly due to the want of such practical literature.

There is a very big temptation to put in the *safe* plant, the operation of which the engineer has known for many years, rather than the more efficient, but lesser known, machine that is available.

If, however, it were known, through, say, the medium of recent practical books, that such machines were thoroughly reliable, the careful ones might take heart and gain increased economy (and dividends !) thereby.

I should like to recapitulate the other points mentioned in the letter referred to at the beginning of this article, viz. :—

1. The provision of the date of writing in every edition of the book, so that the purchaser can know whether he is getting an up-to-date book or not. This should also be stated in all catalogues of technical books.

2. The discontinuance of issue (or otherwise complete revision) of books which have become quite out of date.

3. The undesirability (in many cases) of the common practice of beginning a book with the elementary theory, however advanced the main body of the book may be.

4. The possibility of a committee representative of technical institutions, colleges, Press, publishers, and writers, preparing a suitable graded series of standard books on the various branches of engineering, one book of a series leading to another more advanced.

Any remarks on the latter proposal would be welcomed by the writer.

THE EARTHING OF PORTABLE APPARATUS.

By P. R. FRIEDLAENDER.

The fact that cases of more or less serious electric shock in connection with the use of portable apparatus like drills, electric irons, &c., are still occasionally reported, shows that the question of earthing has not yet been completely solved.

The use of three-pin connectors, with the third pin connecting the frame of the apparatus to an earth wire specially run throughout the installation, is a fairly reliable solution if carefully carried out, but is expensive and clumsy, and is, in fact, seldom used.

Since most supply systems to-day are already earthed intentionally at some point (the neutral wire of three-wire supplies, or one main of the ordinary two-wire supply, or the neutral of four-wire three-phase supplies), it seems absurd that an additional special earthing wire should have to be run before a small piece of portable domestic or industrial apparatus can be made entirely shock-proof.

All that should be necessary is to connect the frame of the apparatus directly to the earthed main. This could be effected by modifying the ordinary lampholder (from which so much portable apparatus is still run) in such a way as to give it a unidirectional character, *e.g.*, by making one of the bayonet-cap slots a wide one, and providing the adaptor with a corresponding wide pin on one side.

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If then the earthed pole of the installation is always connected to a particular (marked) terminal in the lampholder, and the frame of the portable apparatus is permanently connected to the wire leading to a particular (marked) terminal in the adapter, the apparatus will always be automatically and efficiently earthed when in use. Such a modification of the lampholder need in no way interfere with the use of standard bayonet-cap lamps in it. If screw-cap lamps and adapters are installed, the required unidirectional character is, of course, already present without any modification. In the same way, if the portable apparatus were supplied from a wall plug, it would only be necessary to adopt one of the various forms of non-reversible plugs on the market to attain the same result.

The advantages of such a system would include the important one of making the earthing reliable, as it would practically be under the control of the supply authority, instead of being the haphazard earthing of the individual consumer.

The chief objection seems to be that the neutral wire would be practically converted into an uninsulated return, instead of being earthed only at one point in accordance with the existing Board of Trade regulations, but this rule should not prove an insuperable obstacle, and is, in fact, seldom strictly complied with. Also the difficulty of testing for earth faults on the live mains might be somewhat increased.

NEW AUSTRALIAN TARIFF.

The complete schedule is now available in this country of the new Australian Customs Tariff which was recently introduced into the Commonwealth Parliament. It was published as a supplement to the April 22nd issue of the *Board of Trade Journal*.

It has been known for some time that the revision of the Australian import duties was to be directed mainly towards the protection of existing Australian industries and the encouragement of new ones. The schedule is not final, being under discussion in the Commonwealth Legislature, but it is not likely that any alterations will be passed which do not conform to the underlying principle of the tariff policy, viz., protection.

The items of chief interest to the electrical and allied trades are given below. The new rates under the British preferential tariff are there compared with the old rates. The revised tariff provides also for a general tariff and an intermediate tariff.

	Tariff at Sept. 25, 1918. Per cent.	New tariff. Per cent.
Electrical machines and appliances, electric heating and cooking appliances. Ad. val.	10	30
Electrical fittings consisting wholly or partly of metal, viz., switches, fuses, and lightning arresters. Ad. val.	20	30
Regulating, starting, and controlling apparatus for all electrical purposes, including distributing boards and switchboards, except telephone switchboards and telephone distributing boards Ad. val.	20	30
Dynamo electrical machines, static transformers, and induction coils for all purposes, electrical fans. Ad. val.	25	30
Telephones, telephone switchboards, telephone distributing boards and appliances. Ad. val.	Free	Free
Electroliers, gasoliers, chandeliers, pendants, brackets, zinc tubing, gas stoves, and gas rings.	25	35
Metal filament lamps	20	1s. per lb.
Electrical articles and materials. Arc lamps, covered cable and wire, except cotton covered, electrical vacuum tubes, measuring and recording instruments. Ad. val.	Free	Free
Cable and wire, cotton covered. Ad. val.	Free	25
Carbon manufactures of all kinds, including carbon blocks. Ad. val.	Free	30
Electrical fittings not containing metal to be dutiable according to material not elsewhere indicated, and therefore presumably including batteries and accumulators (other than telephone). Ad. val.	Free	27½
High speed reciprocating steam engines for direct coupling or directly coupled to electrical generators or to pumps, subject to departmental by-laws. Ad. val.	25	27½

On most of the items mentioned the general tariff is 10 per cent. above the British preferential tariff.

It will be noticed that in the case of electric lamps the duty is now placed at 1s. per lb. instead of 20 per cent. Under the general tariff it would be 3s. per lb. This should go some way towards removing the difficulties lately experienced by British lamp manufacturers in competing with the Dutch lamp. It will be remembered that when the import duty was on an "ad valorum" basis, the low cost of the foreign lamp nullified the British preferential rate.

The most ardent protectionist in the Commonwealth is realising that new developments in its manufacturing industries do not depend solely upon the magnitude of the import duty payable upon competing imported manufactures. Additional forms of encouragement will have to be offered to capitalists and manufacturers if they are to be induced to launch out in any big ventures. Some guarantee of more settled labour conditions is essential. Restriction of output and strikes are too prevalent at present. It is true that in spite of such drawbacks, not a little progress has been made in iron and steel production and in the manufacture of numbers of metal products of the simpler forms. There is a fair output, too, of machinery, and quite a lot of assembling plants where locally-made parts are brought together with more complicated imported parts. But what is generally required in any highly-protected industry is a broad and growing home market. And there is room for doubt whether the potential demand in Australia alone for all the manufactured goods which it desires to make within its tariff barrier really justifies any lavish investment of capital in the establishment of artificially protected industries. About the present demand there is no doubt. It would seem preferable, however, in the interests of all, to satisfy it, especially as regards electrical material, by importing United Kingdom goods. This would at any rate make the new tariff a success from the point of view of revenue.

We have received this week the annual report (1919) of the Australian Association of British Manufacturers, and their Representatives. It contains the following reference to the new tariff:—

"It is anticipated that the new Tariff Bill will be introduced to Parliament almost as soon as it reassembles. It is the avowed intention of the Government to grant substantial preference to Australian manufacturers, and with this policy the Association has no fault to find so long as it is carried out in an impartial manner, and without placing prohibitive duties on British manufacturers or irksome duties on goods which cannot be manufactured in the Commonwealth. The Association is, however, not a free-trade organisation, but recognises the wisdom of the protectionist policy of the people of Australia, so long as that policy is not abused. Having granted reasonable and adequate protection to local manufacturers, the Association then looks for reasonable and adequate protection for British goods as against foreign. It must be recognised that the old preferential rates of 5 per cent., or 10 per cent., are no longer sufficient, owing to the enormous increase in the costs of manufacture in the United Kingdom, while the increase of costs in America and Japan are not so high. These countries also have less distance to transport their goods, and consequently lower freights. Therefore, to be of any assistance to the United Kingdom, preferential rates ranging from 20 per cent. to 30 per cent. must be granted to goods of British origin."

Later the report refers to the prohibition of imports thus:—

"Owing to representations received from local manufacturers, the Government issued a proclamation towards the end of last year prohibiting the importation into Australia of certain goods except under licence. Your Association immediately approached the Chief Prices Commissioner, in whose hands the administration of this proclamation was placed, and he assured us that licences would be granted for the importation of reasonable quantities of the prohibited goods. The administration of this office has, however, proved most irksome to traders, as applicants for licences have been required to satisfy the Commissioner with regard to numbers of matters about which it is most difficult for a private trader to obtain information. It is, however, hoped that the Government will see the folly of placing such irksome hindrances in the way of legitimate trade, and will in the near future permit merchants to carry on their business in a normal manner."

"Following on the passing of legislation by the Victorian Government as to the marking of specified goods with the name of the country of origin, the Association has collected a quantity of information from British manufacturers and British associations as to the goods which it is considered should be so marked, and this information has been passed on to the Government. The Governments of the other States have also been approached and urged to pass similar legislation, but up to the present they have not fallen into line."

The Council of the Association reports a considerable increase in membership—the total being 761, as against 623 a year ago; 466 are British manufacturers and 295 are representatives of British manufacturers.

New Irish Industry.—The Electrolytic Copper Co. is negotiating for the purchase of a large part of the ground of what was until recently Kynoch's factory at Arklow, Co. Wicklow, for the purpose of starting a new mineral industry.

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THE METROPOLITAN-VICKERS RATEAU PRESSURE-REDUCING STEAM TURBINE.

Where central heating is employed for large buildings the amount of steam required for this purpose might be utilised to great advantage for the generation of electric power.

By generating heating steam at 150 to 250 lb. per sq. in. and passing it through a back-pressure or pressure-reducing turbine before it is exhausted to the heating main, a considerable amount of power may be generated for a small additional expenditure of coal.

Where the whole of the exhaust from the turbine can be utilised irrespective of the load on the generator, a back-pressure turbine is generally installed; but the instances in which this type of turbine can be employed are limited, since it generally happens that the demand for heating steam is irregular and does not coincide with the demand for power. In other words, whereas with a back-pressure turbine there is a direct connection between the amount of steam available for heating purposes and the work which can be done by the turbine, there are other and more numerous schemes of power plant in regard to which the amount of power required and the demand for heating steam bear no relation to each other. A turbine is therefore required which will give either heating steam or electric power independently, and as the demand for either varies. These requirements are met by the pressure-reducing turbine, which consists of a back-pressure turbine and a low-pressure turbine arranged within one casing and having one shaft. The chief merit of this combination is that it possesses the advantages of an ordinary high-pressure turbine, in that low-pressure stages are provided, through which can be economically expanded to condenser pressure, all surplus steam which has not been discharged into the heating mains.

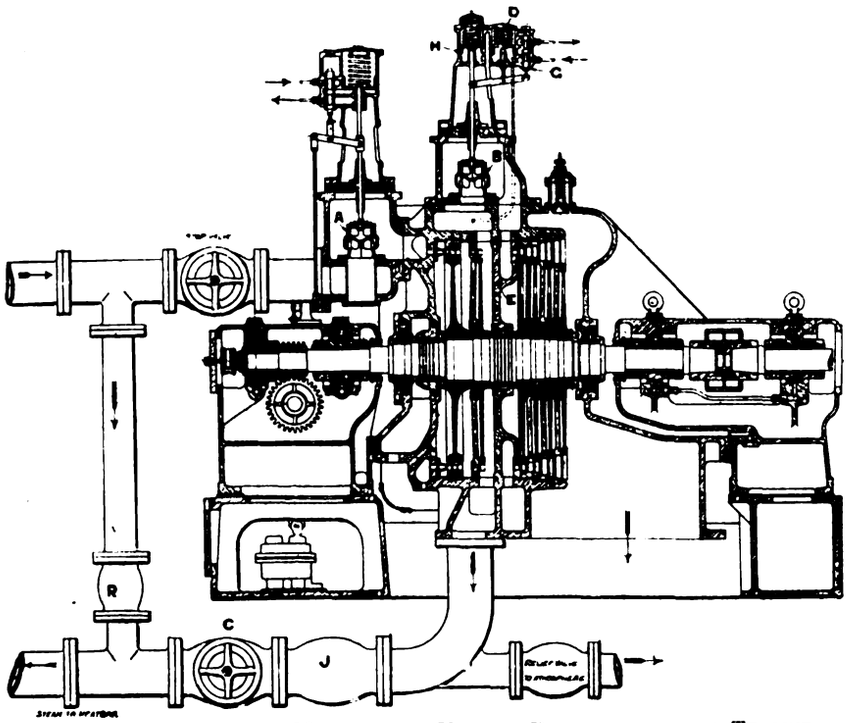

Fig. 1.—Section of Metropolitan-Vickers Pressure-reducing Turbine.

It is of vital importance in some heating processes that there should be no trace of oil in the steam used for heating. This applies particularly to those cases in which the heating steam comes into direct contact with the liquid to be heated. But even if a surface heater is employed, the presence of oil is a serious disadvantage, since it leads to fouling of pipes and heating surface, thereby considerably reducing the efficiency of the heating apparatus.

With a back-pressure engine the difficulties of separating the oil carried over with the exhaust steam are very great, especially where superheated steam is employed.

The best result which can be expected from an oil separator is that the steam leaving the separator will not contain more than 0.35 grain of oil per gallon of condensed steam. Assuming that this result is obtained on an installation where 40,000 lb. of heating steam per hour is required for 3,000 hours per annum, this would mean that in a year some 550 lb. of oil would be carried over to the heating plant.

The steam discharged from a pressure-reducing turbine is entirely free from oil, consequently there are many instances in which a decision must be made in favour of the turbine on this point only, especially as in many cases a pure water supply is of considerable importance for boiler feed purposes.

A typical Metropolitan-Vickers pressure-reducing turbine is shown in diagrammatic form in fig. 1. In this illustration the steam chest and valve gear are shown attached to the top half of the cylinder. This is merely for the sake of facilitating an inspection of their functions. In practice the steam chest and valve gear are placed at the side of the turbine. This arrangement has been found satisfactory for many reasons, for instance:—

1. The mechanism of the governor gear and valve is accessible and convenient from the point of view of operation.
2. The pipe connections are simple and do not form a source of obstruction.
3. With the steam chest and valve mechanism attached to the lower half of the cylinder, there is nothing to interfere with the removal of the top half of the cylinder. It is not necessary to break any pipe joints or dismantle any valve mechanism in order to open up the turbine for inspection.

Considering fig. 1, steam from the high-pressure main, at some pressure usually between 150 and 220 lb. per sq. in. by gauge with a superheat varying from zero to 300 deg., passes through the stop valve and high-pressure governor valve A into a steam belt which feeds the nozzles of the first stage. It then passes through a velocity wheel and a Rateau stage before being discharged at some pressure between 60 lb. per sq. in. by gauge and atmospheric, into the heating main via the non-return valve J and the stop valve C.

When the load on the generator is such as to require more steam than is demanded for heating purposes, a certain quantity of steam is automatically by-passed by valve B to the L.P. portion of the turbine in which it is expanded down to vacuum in the condenser.

The automatic valve B depends for its operation upon variation of steam pressure behind the first Rateau wheel, this variation in steam pressure in turn depending upon variation of load on the generator and adjustment, if any, in the quantity of steam passed to the heating mains. This automatic by-pass valve should maintain the heating steam pressure sensibly constant.

If at any time the amount of steam required for heating exceeds that which corresponds to the load on the generator, the deficit is supplied from the high pressure steam supply through the reducing valve R.

In order to prevent steam from the reducing valve R, or from another set, passing through the heating main into

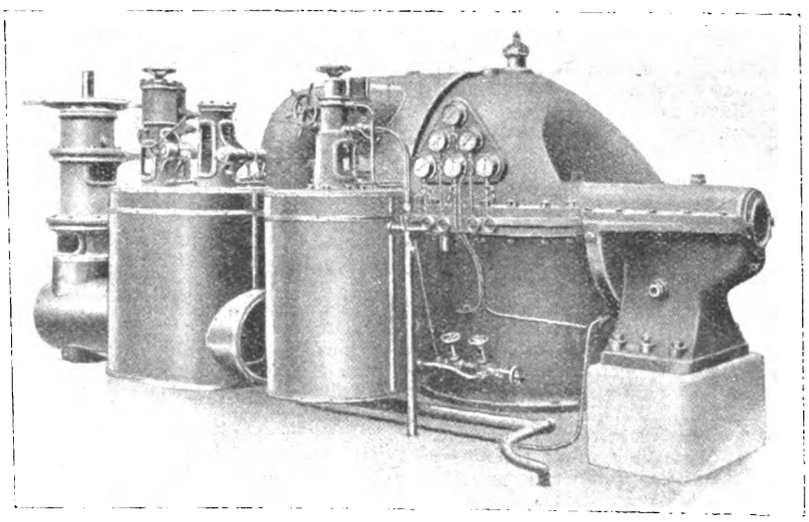

Fig. 2.—2,000-kw. Metropolitan-Vickers Rateau Pressure-reducing Turbine.

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the low-pressure end of the turbine and causing the machine to race, a non-return valve J is provided.

As a precaution against any undue increase of pressure being produced in the high-pressure end of the turbine by the automatic by-pass valve sticking in the event of stop valve C being closed, an automatic relief valve is provided on the heating steam outlet from the turbine.

When, with a given electrical load, the demand for heating steam decreases and the supply is throttled at valve C, the pressure behind the first Rateau stage at once increases. This increase in pressure is communicated to the underside of piston D, which is lifted, thereby admitting oil by means of relay G to the underside of piston H, which in turn lifts valve B, thus by-passing surplus steam to the low-pressure stages.

When no heating steam is required, the whole of the steam entering the turbine passes through all the stages into the condenser, and under these conditions the machine operates as an ordinary high-pressure turbine.

PROTECTION OF A.C. SYSTEMS WITHOUT USE OF SPECIAL CONDUCTORS.

At Manchester, on March 23rd, Major K. Edgcumbe's paper on the above subject, an abstract of which appeared in our issue of February 20th, was read and discussed before the North-Western Centre of the Institution of Electrical Engineers.

Mr. H. R. Ratcliffe thought that the various ingenious devices described did not constitute the final solution of this problem; in gear of that description the essential thing was absolute simplicity. The author dealt with feeders and distributors indiscriminately; the line of demarcation between H.T. feeders and distributors was rapidly disappearing, which he thought was unfortunate. From it arose half the necessity for this protective apparatus, half the troubles on systems. At the present time by H.T. systems they meant something between 5,000 and 10,000 volts, but in the majority of cases the actual economic conditions would soon require that those should be regarded as quite moderate pressures. That, again, would be a very good thing, because he thought it would simplify the problem to some extent when pressures were raised, as they would be, to anything between 20,000 and 60,000 volts. New H.T. mains would be laid which they would be able to recognise as feeders pure and simple, and the present H.T. network would distribute only. That would facilitate the separation and isolation of the various compartments of the system and the use of some such devices as the author had described, though in a very modified form. He agreed that pilot leads did not provide the general solution of the problem, but at the present time they provided the simplest and most definite solution—at any rate with regard to such apparatus as was available. Continuity of supply became of very much greater importance with reduced working hours; to be shut down for half an hour was a very big item, therefore continuity of supply must not be sacrificed even for some slight gain in efficiency; it was the more important consideration of the two. With regard to the "simplicity of the apparatus involved," he could not altogether agree that the apparatus the author had described fell within that category. He had quite as much faith in the cable as he had in the protective gear. He thought that much of the time devoted to the protective devices and the expense could be employed in another direction, and the return for the outlay would be just as good as was afforded by the protective gear. With all due respect to manufacturers potential transformers were notoriously the weakest link on a system, and he should not like to think that the safety of the system was dependent upon such a device. It was mainly old systems that required to be linked up and connected, and they were the very systems in which compromise was required. He considered one of the finest forms of cable protection was a test sheet; it had the advantage that it did not wait for the fault to occur, but gave warning that such a fault would arise in the distant future, and one had ample time to cure it before any actual operating troubles arose. With regard to fireclay resistance in the various forms, and he had not, as a rule, found them reliable. He was a great believer in metal, and did not feel the necessity for a resistance having a negative temperature coefficient. A resistance in parallel with the current transformer did not appeal to him; such a transformer was not particularly suitable for operating instruments at any rate. The same amount of protection would be afforded to the transformer, and probably also to other apparatus in circuit, if choke coils or something of that sort were used.

Mr. G. A. Cheetham suggested that the difficulty was not the use of special conductors for protective purposes, but the fact that such systems were evolved at a rather late stage in the development of the art when a large number of transmission schemes were already in existence. The introduction of special conductors was only required for fault discrimination; a perfect system could readily be designed without such conductors, where discrimination was unnecessary. For example, a single feeder was completely protected by "core balance" and overload relays. He agreed that there was considerable danger in disconnecting apparatus too early when that apparatus had not itself developed a fault, but is merely disturbed due to a fault at another portion of the network. He was not in favour of retarding the operation of leakage relays. He failed to see why the addition of fuses in the pilot wires of Merz-Price apparatus slowed down the operation of the apparatus on the occurrence of an earth fault. With reference to the adaptability of protective gear to various portions of a network, he was impressed by the diversity and complexity of recent developments in protective devices taking place in America, where the underlying principle was the differential scheme as outlined by the author. As the system grew the interlocking necessary to provide for the changed conditions occasioned by the tripping of a breaker became complicated. The "watertight" compartment principle of the Merz-Price or Merz-Hunter schemes was here a decided advantage as it enabled a ready step-by-step extension without further complication. He supported the author's opinion that protective-gear connections should be kept entirely separate from the instrument connections.

Mr. J. S. Peck thought that all operating engineers were rather sceptical of the relay. Some of the relays mentioned by the author appeared to be a very great advance on anything which had been done before. That the leakage current could be limited by the amount of resistance in the earth connection was true to a certain extent, but the charging current on the system also had a very great effect upon the amount of current which flowed to earth or the earthed point. When the amount of cable connected to the system was comparatively small it was possible to run with an earth fault for several minutes; but as the amount of cable connected to the system increased the charging current became of very great value, and an earth would develop into a short circuit in a very short period of time. No matter how much resistance was put into the earth connection this very heavy current would always flow to earth. To prevent the risk of fire in the generator in the case of breakdown it was necessary to disconnect it instantaneously.

Mr. Hawkins, an inventor and co-patentee of a protective system which employs special conductors, explained the system for which he held himself responsible to some extent. He and his colleague started with the maxim that a main generating station should not be automatically disconnected except in the event of a fault to earth. By a process of elimination they came down to the Ferranti-field transformer as, in their opinion, the most stable type of protective device. The final idea was to fix a Ferranti-field transformer at each end of the feeder, and connect its secondaries by pilot wires. This system would give the advantages that had been put forward as desirable. In his opinion, pilot wires might in themselves have other and distinct uses, and further uses might arise in the future. Admitting that they might be desirable for such things in the future the addition of a few more was not really a very serious problem. The pilot cable was the only known means of obtaining an instantaneous valuation of the conditions prevailing at each end of the cable at any moment. That the Merz-Price and split-conductor systems worked in watertight compartments, he agreed was an advantage. With regard to rapidity of action, he claimed that the Ferranti-field transformer was one of the most rapid acting gears at present in use. As far as feeder cables were concerned, he agreed that the utmost rapidity of action was desirable. He did not agree that it was the function of time lag to prevent the ill-effects of a fault left on the system. With regard to the author's estimate of the possible magnitude of a fault, the speaker thought that of itself was a clear instance of the desirability of getting the fault off the system as soon as possible.

Mr. Romero, referring to the author's recommendation that the same type of differential reverse relay be used at the generating station end as at the sub-station end of parallel feeders, said it appeared that this would be a very uncertain system of protection, and almost as likely to trip the sound feeder at the generating station end as the faulty feeder.

Mr. H. Williams asked whether the author was satisfied that such close time-lag setting as ¼, ¾ and 1¼ seconds could be actually obtained in practice? Such tests could not be taken with an ordinary stop watch. He had tested various types of time-lag devices on much coarser settings than those mentioned above, and as a rule the errors were very considerable. In the speaker's opinion every effort should be made to avoid direct-current tripping, especially where batteries were required owing to the large increase in maintenance cost. With regard to the checking of relay settings he agreed that it was most important to check the relays with the current transformers, more particularly in order to ascertain if the ratio error was excessive as a result of the load on the secondary side being too high.

Mr. Ferguson thought that between the scheme put forward for a ring main and the split conductor or Merz-Price

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gear, there could be little doubt but that the split conductor or the Merz-Price would be infinitely preferable. A scheme employing overload and reverse relays would be very difficult for the operative engineer. It was all right to set relays with a difference in setting of a quarter of a second, but then account had to be taken of variations in the time for the operation of the oil switches themselves. Furthermore, changes in existing conditions would involve trouble, also extension would necessitate readjustment of all the relays. The Merz-Price and the split-conductor gear were the right forms of protective gear to employ for new systems. With regard to the scheme employing differential reverse relays for duplicate feeders, he thought this gear could be simplified at the generating station end by the employment of the Ferranti-Waters protective gear, which was the same generally in principle, the chief difference being that core balancing was employed. A ring transformer was slipped over each of the duplicate cables at the generating station end; there were two windings on each of these transformers. Two of the windings were opposed to one another, and were connected to two reverse relays, the other two windings being kept in series and were equivalent to the potential windings of the reverse relay. The result was that only two relays were required instead of six. The current transformers were of the ring type, and did not introduce trouble due to defective insulation; the potential transformers were entirely eliminated. For the generating station end, therefore, and double feeders, the Ferranti-Waters gear, which had not been described, was infinitely preferable. It was also applicable to sub-stations where there was an alternative source of supply. If there were three or four feedrs in parallel, or if it was connected up in the form of a ring, the same system was applicable. The tendency now was to eliminate relays as far as possible, and operate directly with the fault current on the oil switch, and thus do away with any necessity for an independent source of supply.

Major K. Edgcumbe, in reply, said that the gear he employed was simple. It was well tried and well understood, and there were no quaint devices about it, no contacts in series or anything of that sort. It was false economy not to spend a few pounds, it might be a matter of only £50 or £100, if one had a large amount of capital in which a much bigger amount of capital was tied up. Potential transformers were liable to break down, but that was not likely to happen just at the moment they were required to trip; if the potential transformers could be connected in star to earth it would be an advantage. He did not recommend a time lag for its own sake, but mentioned one or two incidental advantages of a time lag if it was used for any other reason. In a great many cases, particularly on the smaller systems, a time lag was not such a serious disadvantage, and it had a great many advantages in giving discriminative action. Special conductors unfortunately changed from year to year, so there was no finality about them. He agreed that generator protection should be as instantaneous as possible. If the machine was still doing useful work on the busbars, he did not know that it was necessary to cut it off instantly. He still thought reversal was the criterion, but would not say that definitely. Mr. Hawkins's scheme was very interesting. The Ferranti-field arrangement did not embody a leakage trip and core balance; it was simply a specialised form of transformer which got over the inequality of the action of the various cores on the transformer. Mr. Hawkins's scheme only dealt with leakage trip. If he got a more or less equal fault on it, any fault between phases, it would not trip his gear until it got to earth. It was essential for those who were keen on getting the thing out quickly to try to trip it out before it had got to earth. Some of the old relays did trip on a forward current, which was about twenty times full load. That was due to interaction between the fixed series winding and the fixed pressure winding and the compensating winding, but that had been got over now by putting the motors in parallel and not in series. He could not agree that D.C. tripping was a mistake or that batteries were unsatisfactory. That was the ideal method of tripping, and everybody seemed to be coming to that view now. In the States they were doing the same thing. To trip with the lead current was unsatisfactory, because it varied over such enormously wide limits. His reason for not introducing the Ferranti-Waters scheme as a solution was that it was not quite universal enough. It was perfectly all right at the generator end, but if one was using another relay at the further end it was a mistake to change the type of relay at the generator station end, because one might get a different shape of curve and different times, and so on. It was much better to use the same at both ends. Also the Ferranti-Waters scheme would not do for a cable where one might get reversal.

At Birmingham, on March 17th, Major K. Edgcumbe's paper was read and discussed before the South-Midland Centre of the Institution.

Mr. G. Rogers thought the paper contained a lot that was well known, but there were one or two new features of great interest, particularly the design of the reverse-current relay, which would have many useful applications providing that in practice the characteristics claimed in the paper were satisfactorily obtained. The leakage and overload protection of a feeder seemed to be, where the neutral of the system was earthed through a resistance, an almost ideal arrangement for a single outgoing feeder or for a consumer's supply. The use of fuse-shunted solenoid protection for a simple circuit in which a discriminating time lag was not required was not only the simplest method available, but was perfectly satisfactory in operation. Air dash-pots were not always satisfactory, and where the fuse-shunted solenoid could not be used the induction pattern inverse time limit overload relay with separately adjustable current and inverse time settings was the most satisfactory device to adopt. With reference to the split conductor system, it would not be advisable to rely entirely on the split conductor relay. Overload relays should be put in circuit at both ends of the feeder if it was possible for current to pass through the feeder from either end. This provided a complete system of protection, which was equally as good as the combined leakage and overload relay suggested by the author. The suggestion for the protection of parallel feeders with differential reverse relays was interesting, but since there was always the danger of an unbalanced load on the feeders, this method was not likely to have a very wide application. The author's suggestions for the protection of a ring main system was interesting, but, since the reverse power relays on the inter-connector cable between the two sub-stations might be called upon, in the event of one of the feeders from the generating station being tripped out due to a fault, to carry the full load current to the sub-station, it would be necessary for the setting of the reverse power relay to be very high. It was not clear, therefore, where the advantage of the reverse power relay came in over an overload relay which would operate with current flowing in either direction.

Mr. W. Wilson supported the use of suitable shunt fuses for affording a time-limit to trip coils, in spite of the author's condemnation of these as being capricious in their action. A fuse-wire supported in such a manner that it did not touch its supports except at its extremities, and composed of a metal that did not expand sufficiently to permit sagging against the walls of the glass tube in which the switchboard fuses were generally contained, would give a time curve of surprising regularity. It was, however, true that the operation of a fuse depended on other circumstances than the magnitude of the overload. Conductors would come to grief sooner when they were heated than when they were cool, and the fuse, by also blowing more readily when hot, afforded sound protection when an electromagnetic device would fail. The solenoid and dash-pot pattern only gave an approximate protection, for the plunger did not begin to move until the actual overload had occurred, irrespective of the state of the cables, &c. when the overload had come on. The thermal relay (or thermal breaker) would give the same protection as the fuse, in that it would represent the conductor in its behaviour, and its condition would vary just as that of the circuit did; it was much simpler, and was less susceptible to faulty use. At the same time, both fuses and circuit breakers gave excellent adjustment, the former by the alteration of the gauge of wire, and the latter by the adjustment of the sag of the resistance strip.

Mr. R. G. Jakeman said, with regard to single interconnectors, that if the fault occurred when the interconnector was lightly loaded, the full overload current must flow into the fault before the relays would act. The author stated that the circulating currents between two machines in parallel due to hunting were very much out of phase with the voltage. Actually, however, these currents were practically in phase with the voltage, since they represented the synchronising power, which was the power tending to pull the machines back into their correct relative positions.

Dr. G. Kapp thought that engineers would be pleased to learn that protection could be obtained without the use of pilot wires. Their utility became doubtful when, on account of subsidences in the ground there was a chance of pilot wires being broken without the staff at the power house knowing it. The author's method had, further, the merit of simplicity. It did not, however, touch the protection of machines from the heavy blow which the winding received in the first moment of an explosive short circuit. To a certain extent this was also the case with regard to heavy feeders. When the grading of time lag in the different parts of the distributing plant had to be done to the fraction of a second, it could not be very definite. If it were possible to permit a somewhat longer time all round the grading could be made more definite, and less delicate relays, not liable to act prematurely, might be employed. This meant giving up the use of circuit breakers in order to save machines or circuits from the first rush of a short circuit current, and adopt for this purpose the well-known method of added inductance. This meant that they must lower the power factor of the whole system to such a value that economical working became impossible. But there was a remedy. If they installed at the delivery end of the lines apparatus to inject leading K.V.A. they again raised the power factor, and it was this policy which seemed to solve the problem of something very near absolute protection. At a first glance the proposition might seem paradoxical, incurring additional expense without improving the general condition as regards protection, but this reasoning would be fallacious. If they recognised that only

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the P.F. at, say, from ¾ load upwards mattered, they might employ a cheaper source of leading K.V.A. than either condensers or synchronous machines, namely, any type of phase advancer fitted to individual motors. If the consumer used small motors or even large squirrel-cage motors static condensers were the only possible means of his obtaining in his own plant a good P.F. If he had large slip-ring motors he could use a phase advancer, and although his P.F. at light loads would not be so good as with condensers, his P.F. at full load or overload would be in the neighbourhood of unity, and that was all the supply company could reasonably demand in return for the concession in a tariff specially designed to induce customers to counterbalance the lowering of the P.F. due to the employment of inductances for protection of their plant.

Mr. W. BREW said, with regard to the leakage transformer, that special precautions would be advisable either in the design or location of this transformer to shield it from stray magnetic fields such as might be set up by violent disturbances upon neighbouring circuits. In connection with the protection of parallel feeders, he hardly thought the method suggested could be regarded as a general solution of the problem. With two parallel feeders of equal lengths and sections, but differing appreciably with regard to inductance and capacity respectively, it was obvious that the larger share of the load would pass from one cable to the other and *vice versa* according as the power factor was leading or lagging. In the case of short heavy current single cables also the current distribution might be seriously upset if the areas enclosed by each pair of cables forming flow and return were unequal. The magnitude of the triple frequency current loss assumed was, he thought, larger than was likely to be experienced with modern plant. Even were it much less, however, the annual loss capitalised should in the case of large generating units fully justify the adoption of efficient means to eliminate it. These triple frequency losses were not easily measured with accuracy, but if a generator could be run as a synchronous motor the difference between the two sets of watt-meter readings would give the loss. The power required to drive the motor measured by the two watt-meter method did not include the triple frequency loss, whilst the power measured under the same conditions by the three watt-meter method with pressure coils connected to neutral point did include it. He strongly urged that the most important feature of a relay-control system should be its power to indicate clearly when, and where, a fault had occurred. Under the mental stress of an emergency apparently logical conclusions might be quite misleading, and this was especially likely to be the case where the seemingly erratic action of a number of instruments and circuits had to be interpreted. A good deal of expensive apparatus had been installed and "tied up" in the past on this score alone.

Mr. A. T. THURMAN said the arrangement for the protection of a system comprising two generating stations and four sub-stations was all right providing the interconnector between the generating stations was large enough to transfer load from one to the other, in case of trouble at either station. With regard to the checking of relay settings, the initial test after the relay had been installed in its working position should be from the primary side of the current transformer. This method tested the current transformer, relay and wiring practically under working conditions.

Mr. J. MORTON referring to the use of reverse relays for the protection of generators, and that only an independent supply for the pressure element of the instrument would give any sense of security, said that such an independent supply might easily be obtained by installing a unity ratio potential transformer across a reactance, the voltage obtainable being governed by the current flowing in the reactor, and, further, under faulty conditions the normal current might be increased many times, thereby giving a proportionate increase in the pressure across the terminals of the potential transformer with a resultant increase in power for the satisfactory operation of the relays. It seemed to him that some advantage might be gained by putting half the total reactance in the machine itself, and the other half external to the machine. With this arrangement there would be no difficulty in providing the independent supply suggested for the relay potential coils, but it might be necessary to install some apparatus for the purpose of cutting the unity ratio potential transformer out of circuit at some pre-determined pressure limit, say, 400 volts, for in the event of the reactor being called upon to perform the function for which it was primarily installed, the voltage across its terminals would rise to any figure between zero and full phase volts.

Mr. W. E. GROVES said the four cardinal points mentioned at the commencement of the paper required a limitation of the number of protective devices employed. These considerations made the layout described more applicable to undertakings of moderate size than to large systems. With an unearthed neutral a fault on one phase only might hang on for a considerable time, ultimately developing a complementary fault on another phase and on an entirely independent line. These faults between phases simultaneously pulling two lines out of commission might occur at a very inconvenient time, and it was not possible to quickly locate a single-phase fault without resorting to earthing. A weak spot, which would not stand the extra strain imposed by the original fault, was better disclosed, but not when one was occupied with another breakdown. The Merz-Price system could be extended to cover any mains or gear, but it introduced complexity. In connection with closed ring mains, the speaker devised an adaptation of Merz-Price protection to cover a complete consumer's sub-station, and the adjacent length of main. In order to reduce the amount of apparatus overlapping current transformers were proposed, but even this modification did not make the scheme worth pursuing, and events had proved that it would not have been justified. For mains laid under favourable conditions it was illogical to protect cables and leave the more vulnerable switchgear unprotected.

AUTOMATIC ELECTRIC WEIGHING MACHINES AS USED WITH MACHINE PACKERS.

By VICTOR SIMS.

(Abstract of a lecture delivered at the JUNIOR INSTITUTION OF ENGINEERS.)

AUTOMATIC weighing machines comprise a large and varied field of mechanical ingenuity. Automatic electric weighing machines, as used with machine packers, are adapted for weighing granular and other substances. To appreciate fully the functions of the weighing machines it will be well to outline the process in which they play a part, in this case the conversion of the 1-cwt. chests of tea as imported, into the familiar packets. From the chests, the tea passes through a mill or grinder which is furnished with magnets for extracting nails, and an arrangement of inclined sieves by means of which pieces of paper, wood, &c., are separated from the tea. After this it is blended in revolving drums, and transferred in sacks to hoppers which feed the weighing machines. These weighers are situated over packing machines in conjunction with which they work.

The packing machines cut from a roll of paper, fold into a bag, and at the right instant the weighers drop a weighed quantity of tea, the bag is then folded at the top and pushed out along a slide. The rows of packets are next put by hand on trays, and the trays on trolleys. The folded ends of the packets are then sealed by sticking labels round them; this may also be done by machinery.

There are two types of packers, the principles being somewhat similar, but the mechanical details vary. One type is by Job Day & Sons, the other by Rose Bros. The "Rose" type may be fairly considered the more modern machine, as the design is such that it may safely be worked at double the speed of the "Day." The latter is furnished with a single funnel fed by two weighers, while the former has twin funnels fed by four weighers.

All types of weighers are operated by receiving an impulse from the timing switch. This starts a cycle of operations which consists of the release of a weighed quantity, followed by the weighing of another in readiness for the next impulse. By this means, any variation in speed of weighing occurs at the end of the cycle, and this necessitates means to prevent another cycle starting, if a previous quantity is not fully weighed.

To obtain accurate weighing, the substance should be fed on a beam in a fine stream when nearly balanced, but in many cases this would take too long to fill, so means are provided to perform the weighing in two or more operations. The methods of doing this vary in the different machines, but speaking generally one type operates by dropping a certain measure, and completes the weighing by means of a fine dribble. The other type weighs both quantities on beams, and a very excellent machine weighs any one quantity on four consecutive beams, attaining its full weight on the fourth.

One type of "Southall & Smith" machine, the simplest of which type has a single beam and performs the weighing in one operation, consists essentially of a box-type frame which contains the beam and a cam shaft. The pan consists of a receptacle, the bottom of which is closed by a hinged counter-balanced lid, which is normally held tight by a small electro-magnet. Behind the feed box is a slide, magnet, and contacts, which constitute what may be called the "cut-off" mechanism. On the side of the machine is another magnet, armature, slide, and clutch, so arranged that when the circuit is closed through the timing switch and magnet, the

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slide is released and the clutch operates, driving the cam shaft one revolution. During this single revolution, which may occupy one second or more, the following operations are executed. The circuit of the pan magnet is momentarily broken, releasing the previously weighed quantity. The slide behind the feed box is moved by cam and bell crank lever up to the magnet, which retains it against the tension of a spring. This opens a narrow channel from the feed box, which contains a revolving star wheel, ensuring a continuous and even feed. The feed continues till the beam is turned, the rear end rising and breaking the circuit of the magnet retaining the slide, which flies back, cutting off the feed.

The machines for weighing larger quantities have the addition of a "bulk feed." This is obtained by dividing the feed box into two portions. The fine feed is retained as described above, but the capacity of the other portion can be adjusted by means of a screw and movable plate. A cam is timed to depress the rear of the beam when the feeds open, to prevent bouncing, afterwards rising to permit free motion. For the smaller quantities, the measures are merely opened at the bottom during a brief interval. In the larger machines a slide cuts off above, before opening below. In a later type, this first quantity is weighed on a beam against the tension of a spring. The clutch for the fine feed is controlled by the slide which performs the "cut off." The other is operated by a magnet in circuit with a contact, which is closed when the primary weighing is complete. In this position the clutch is free, *i.e.*, feed is stopped. In operation, the contents of the first beam are dropped into the second, which has just released its own contents. Directly the first beam is thus lightened, contact is broken, a spring releases the trigger, which causes the clutch to engage and drive the feed till contact is again made. On all those types of "Southall" machines a contact in series with the side magnet is arranged to be broken while the fine feed is open. This prevents premature release of an incomplete weight.

The construction of an early type of "Driver" machine is somewhat different. Two machines are built together, constituting a twin or duplex weigher, but each may be considered as a separate unit. The clutches are released by magnets and plunger stops. The clutch for driving the fine feed is also released by a magnet which is interconnected with a relay on top of the machine. In operation, the central traverse cam shaft is rotated for one revolution, in consequence of the magnet in series with the timing switch releasing the clutch. This shaft mechanically opens and closes the pan, and electrically starts the second shaft, which simultaneously closes two contacts for a brief period, and operates the bulk feed by closing the measure at the top, opening at the bottom, returning to its original position by closing the bottom, and opening again at the top. One of the contacts is for energising a magnetic beam lock; the other starts the fine feed by releasing the clutch. When weighing is complete, the beam falls and energises the relay which breaks the circuit of the magnet for the fine feed clutch, thereby arresting its motion. Premature release is guarded against by connecting the beam contacts in series with the magnet which releases the first clutch. Thus, the beam must be down before another operation can be started.

The later type of "Driver" machine is an excellent design; being far less complicated than any other, and if adjusted correctly is quite as accurate. Weighing is performed on two consecutive beams, except for the smallest quantities. A friction clutch, when released, drives a cam shaft one revolution, opening the two pans mechanically; the full weight dropping down the funnel, and the half weight dropping into the next pan as soon as it is closed. The two beams are fed from a single trunk by means of roller feeds driven by magnetically released friction clutches. The magnets, in circuit with contacts on their respective beams, release the clutches till the beams are turned. To diminish bouncing, these are compounded. The cams are also contoured to steady them after opening the pans. A contact, broken by the magnet when the fine feed is running, prevents premature release.

The best machine from a mechanical point of view is the "Popoff." Here the weighing is performed on four consecutive beams. Essentially, it consists of four beam units arranged under a table which is capable of intermittent partial rotation. The table has five equally spaced circular excisions, which loosely support an equal number of light spun aluminium cups. In operation, a magnet in circuit with the timing switch, releases the one-revolution clutch. The table lifts the cups off the beams, shoots round one-fifth of a revolution, and lowers them on to their next. The fifth cup, which has already attained its full weight, is then tipped. As each cup attains its weight, the beam falls and completes the circuit through the magnet, drawing down the armature, releasing the lever, thereby stopping the corresponding feed by withdrawing the clutch. The levers in falling open the circuits by means of spring contacts, thus saving energy, also taking the inductive break instead of the relatively delicate beam contacts. A fifth spring contact is in series with the magnet which releases the one-revolution clutch, and constitutes the means for ensuring that all weighing operations are complete before being repeated.

Having now briefly described the various machines, I will indicate the manner in which they are generally arranged with regard to the packer. The "Day" packer, making about 30 bags a minute, is fed by two weighers, which are usually built right and left hand constituting a "duplex" weigher. In this case the funnels unite and feed through a single one on the packer. The "Rose," making about 60 a minute, is fed by two twin or duplex weighers forming a "quad set." "Southall" machines are arranged 1, 2, 3, 4, operating 1 and 2, then 3 and 4; 1 and 3, 2 and 4 funnels unit into two oscillating ones on the packer, filling two bags at a time. By arranging one wide funnel under each twin, and wiring so as to operate 1, 3, 2, 4, instead of 1, 2, 3, 4, a more simple funnel arrangement is obtained. "Driver" quads are arranged in this manner. The speeds of both type of packers can be varied within limits; the actual speed is governed by the best average speed of the weighers working in conjunction. Small quantities can be weighed faster than larger.

Timing and Bag Switches.—The former are operated by cam shafts on the packers, for making contact to start the weighers. The latter are operated by the pressure of the bags when they are about to be filled; if these are absent, the corresponding circuits are opened. A tumbler switch is also included in circuit on each packer, which should be switched off when the packer is stopped, otherwise if it happens to stop with the timing switch closed and a bag pressing against the bag switch, the weighers continue to operate, filling the funnel. The timing switch consists of a cam revolved, on a "Day" packer, at half the speed of the packer, making contact for each weigher at every alternate half revolution. It is set to make contact when the bag is pressing the bag switch, just before it is moved under the funnel.

For a quad, the cam revolves at a quarter of the speed of the packer, making two simultaneous contacts at every half revolution. Timing may be adjusted by bodily revolving the frame of the switch, thus altering its position in relation to the cam. All weighers require contact to be made a short period before the funnel is over the bag to be filled, as a brief interval must be allowed to enable the weighers to start their cycle of operations, and for the substance to fall through the funnel. For a quad set, therefore, contact is made when the funnels are just rising, preparatory to moving backwards and descending on to two fresh bags, which were at that time pressing their respective bag switches.

Accuracy.—It is quite possible with a uniform degree of granulation, to set these machines to weigh accurately to a very small fraction of a dram. It is obvious, however, that a true balance is never obtained on the beams; the inertia of the beam, the degree of rapidity of cut off, and the impact of the running feed all affect the weighing. The first and second of these factors, for a given machine, are practically constant, but the third varies with the degree of granulation of the substance being weighed. A fine substance feeds at a higher speed than a coarse, making a greater impact on the beam. In the machines with bulk feed also, the measures would hold a greater weight for the same capacity. With the usual blends of tea, the granulation is such that four ounces occupy between 325 and 375 cu. cm. of free space. In this case, the best speed of the weighers allows the packers to be driven at the speeds already mentioned, which allows about four seconds for each complete cycle. It is best to adjust the measures so that weighing is as slow as the packer will allow, and then adjust the jockey weight on the beam to obtain accurate weight. As mixing is seldom quite thorough it is not considered advisable to constantly alter the jockey or measures for the greatest accuracy. If the measures are set too "close," missing is liable to occur; and if the jockey is altered to obtain greater accuracy one minute, it may be necessary to replace it soon after. If a coarse blend is substituted for a fine one, attention is generally drawn by the weighers missing, but if the reverse occurs weighing is usually too fast, resulting in varying degrees of overweight. Machines with roller feeds may be finally adjusted by varying the aperture between the feed roller and plate by means of screws, instead of the jockey.

The mechanical power absorbed in any of the machines described is relatively very small. The electrical energy required varies according to type, but is not a great amount. The usual pressure is 110 volts. The "Popoff" machine probably takes the least quantity of energy, as current flows in any of the five parallel circuits only momentarily; while current is flowing continuously in certain circuits of the "Southall" machine, only being interrupted during operation, resistances are, therefore, placed in series to limit the current.

Upon consideration, the effect of varying degrees of granulation on accuracy of weighing does not appear to depend solely on the altered impact on the beam, but also on that quantity which passes during the brief operation of "cut off." As before mentioned, a fine substance passes through the feeds at a higher rate than a coarse. The effect of the greater impact on the beam, alone, would appear to cause the beam to be turned slightly early, resulting in a light weight, but experience shows that the reverse is the case, viz., other things being equal, a fine substance will weigh heavy compared with a coarse.

It should be noted that the term "degree of granulation" used to define fine or coarse substances, does not necessarily imply a definite uniform size of the grains, but uniform pro-

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portions of the various sizes throughout any particular blend. Thorough mixing will generally ensure this.

Having regard to the widely varying conditions met with in practice, it would be difficult to give definite figures relating to accuracy, but within the limits of the author's experience it has been found possible to set any of the machines to weigh a uniform suitable blend, such that inaccuracies could barely be detected on balances sensitive to about 1 grain. But any change of blend involving a different degree of granulation would cause an error. In extreme cases this may amount to as much as half a dram, but this is soon detected and remedied. The only type of machine described which is not liable to inaccuracy on this account is the "Popoff," due to the extremely fine final feed, notwithstanding the speed of the machine being twice that of any of the other types. Mechanical imperfections and the liability of the feeds to get choked more or less, by pieces of paper, wood, and nails, however, demand constant vigilance and checking of any machines in operation.

I have said sufficient to outline the methods adopted for rapidly weighing small quantities of granular substances. I have had no experience in dealing with finer substances, such as powders, or coarser ones, such as certain cereals, but if I have managed to convey in an intelligible manner some idea of a few of the principles involved, I shall feel amply rewarded for the preparation of these notes.

NEW PATENTS APPLIED FOR, 1920.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. Sefton-Jones, O'Dell and Stephens, Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

10,118. "Apparatus for manufacture of electrodes." Metrodes, Ltd. April 12th.

10,168. "Telephone systems." Western Electric Co. April 12th. (United States, April 11th, 1919.)

10,181. "Production of high-tension unidirectional currents or impulses." H. B. Mackenzie. April 12th.

10,184. "Thermo-electric systems for production of electrical energy." E. B. Potter. April 12th.

10,194. "Control of electric ignition systems of internal-combustion engines." R. M. Balston. April 12th.

10,204. "Radio-telegraphy signalling systems." W. J. Mellersh-Jackson (A. Taylor). April 12th.

10,216. "Telephonic apparatus permitting of automatic calling and connecting up." L. Turcat. April 12th. (France, March 6th, 1919.)

10,217. "Automatic telephony." L. Turcat. April 12th. (France, April 10th, 1919.)

10,232. "Electric circuit breakers, &c." R. A. R. Bolton. April 13th.

10,241. "Continuous-current voltage reducer cells." J. W. Goodman. April 13th.

10,248. "Terminal connections for flexible electrical conduits." F. A. Griffin. April 13th.

10,253. "Rotary electric transformers and converters." Accles & Shelvoke and H. F. L. Steventon. April 13th.

10,258. "Automatic telephone, &c., systems." A. Lambot. April 13th.

10,263. "Electric changing-colour sign." F. E. Ewer, Ewtill Manufacturing Co. and P. A. Tillinghast. April 13th.

10,293. "Electric rotating furnaces." C. E. Cornelius. April 13th.

10,299. "Electric muffle furnaces." Automatic & Electric Furnaces, Ltd., E. P. Barfield and L. W. Wild. April 13th.

10,300. "Electric clocks." F. T. Reid. April 13th.

10,319. "Controlling resistances for electric circuits." Igranic Electric Co. (Cutler Hammer Manufacturing Co.) April 13th.

10,363. "Dynamo-electric machines." E. G. Barter. April 14th.

10,365. "Sparking plug." C. S. Harrison. April 14th.

10,373. "Distributing arrangements for telephone, &c., systems." Automatic Telephone Manufacturing Co., R. Mercer and J. Savin. April 14th.

10,374. "Call-indicators for telephone systems." Automatic Telephone Manufacturing Co. and S. R. Smith. April 14th.

10,402. "Wireless telegraphy." F. O. Reid and H. Scott-Taggart. April 14th.

10,404. "Multiplex high-frequency electrical signalling systems." Western Electric Co. April 14th.

10,405. "Electric burglar-alarm systems." G. G. Portch. April 24th.

10,417. "Device for holding telephone receiver when in use." J. E. Saunders. April 14th.

10,466. "Transmission and distributing with alternating currents." A. M. Taylor. April 15th.

10,477. "Mounting electric motors on machines." W. Asquith, Ltd., and G. Feather. April 15th.

10,490. "Means for electrically indicating vacant seats in theatres, &c." F. H. Austin and R. Robertson. April 15th.

10,512. "Electric telephones." H. P. Rees. April 15th.

10,534. "Electric motor control." British Thomson-Houston Co. and N. Shuttleworth. April 15th.

10,539. "Thermo-electric measurement of temperature." Cambridge & Paul Instrument Co. and F. Rowcliffe. April 15th.

10,542 "Electric gas-ignition devices." J. O. Delen. April 15th

10,549. "High-frequency electric signalling." Western Electric Co. April 15th. (United States, August 21st, 1915.)

10,551. "Wireless telephone transmitters." A. R. Taylor. April 15th.

10,552. "Induction or reactance coils." A. R. Taylor. April 15th.

10,553. "Electric cables." W. P. Granville and W. S. Smith. April 15th.

10,561. "Electrolytic method, apparatus and product" M. M. Merritt April 15th. (United States, April 15th, 1919.)

10,566. "Overhead electrical conductors, cables, &c." A. Watts. April 15th.

10,612. "Spark plugs." R. R. Hill. April 16th. (United States, April 5th, 1916.)

10,620. "Electric gongs and hammers." C. H. Newton. April 16th.

10,631. "Portable magneto lamp." J. Lowe, S. B. Palmer and N. V. Pearson. April 16th.

10,644. "High-frequency dynamo-electric machines." British Thomson-Houston Co. April 16th. (United States, June 22nd, 1915.)

10,646. "Electric lamps." W. R. Bullimore. April 16th.

10,647. "Device for testing sparking plugs." G. Burch, Ltd. April 16th.

10,654. "Field pole-pieces for electric machines." H. de La Valette. April 16th. (France, April 16th, 1919.)

10,661. "Electric relays." M. D. Dimitrievitch. April 16th.

10,666. "Devices for protecting telephone, telegraph, &c., instruments against lightning or excessive electric potentials." A. E. Beattie. April 16th.

10,669. "Telephones." G. B. Buley and C. Kearton. April 16th.

10,690. "Electrolysis needle for face treatment." H. O. Bremner and Mrs. Manning. April 17th.

10,691. "Locking device for switches of direct-current electric motors." G. G. Addison. April 17th.

10,702. "Device for testing sparking plugs." G. T. White. April 17th.

10,707. "Electrical means for indicating relative movements of members of apparatus." W. H. Eccles. April 17th.

10,718. "Winding for electrical apparatus." G. Schroeder. April 17th.

10,719. "Insulated electric conductor." G. Schroeder. April 17th.

10,748. "Methods of preventing injurious earthing-currents in electrical nets." Akt. Ges. Brown, Boveri et Cie. April 17th. (Switzerland, April 17th, 1919.)

10,754. "Multi-pole junction box." M. J. Railing and W. Saunders. April 17th.

10,760. "Sparking plugs." K. E. L. Guinness. April 17th.

10,763. "Brush-gear for dynamo-electric machines." East Anglian Engineering Co. and H. C. Waters. April 17th.

10,772. "Electric insulators." R. Cox. April 17th.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1916.

16,250. Regulating mechanism for controlling speed of induction motors. British Thomson-Houston Co. (General Electric Co.). November 13th, 1916. (140,476.)

1918.

18,683. Arrangement of several electric generating groups for the purpose of supplying an equal number of electric motor groups. H. Crosbie. November 14th, 1917. (140,491.)

18,689. Method of electric arc welding, cutting and repairing. C. J. Holslag. April 30th, 1918. (126,271.)

19,388. Electric accumulator plates. C. P. Elieson. November 25th, 1918. (140,500.)

20,209. Lamp telephone relays. M. Latour. December 5th, 1917. (140,506.)

21,679. Magneto-electric machines. R. B. North and A. M. Allen. December 24th, 1918. (140,518.)

21,680. Magneto-electric machines. R. B. North and A. M. Allen. December 24th, 1918. (140,519.)

21,681. Interrupter devices for magneto-electric machines. R. B. North and A. M. Allen. December 24th, 1918. (140,520.)

1919.

33. Electric generating arrangements for vehicles. C. L. Kirk. January 2nd, 1919. (140,525.)

291. Control of hydro-electric power stations. R. J. Wilson. January 4th, 1919. (140,528.)

1,255. Electrical switches. R. B. Benjamin and A. N. Nilson. May 4th, 1918. (126,607.)

1,273. Wireless transmission. C. S. Franklin. January 17th, 1919. (140,538.)

3,136. Starting and synchronising of synchronous dynamo-electric machines. R. E. Grime and Mather & Platt. February 8th, 1919. (140,554.)

4,116. Intercommunication telephone system. L. C. Bygrave. February 19th, 1919. (140,561.)

4,382. Electrolytic cell. J. Harris. February 21st, 1919. (140,564.)

4,848. Electrodes and welding and like rods used in soldering and depositing metals. E. H. Jones and Alloy Welding Processes, Ltd. February 26th, 1919. (140,568.)

6,124. Electric lamps for cycles and the like. M. H. Goldstone and H. O. Farrell. March 12th, 1919. (140,582.)

6,595. Electric terminal. J. Chatwin (A. & O. Christ, Sons & Co.). March 17th, 1919. (Convention date not granted.) (124,729.)

8,924. Electric switches. R. K. Damey and C. A. Damey. April 8th, 1919. (140,607.)

10,336. High-tension magnetos. J. H. Runbaken. April 25th, 1919. (140,629.)

13,007. Automatic or semi-automatic telephone systems. Automatic Telephone Manufacturing Co. and A. J. Ray. May 23rd, 1919. (140,655.)

13,666. Electric coils. B. Ames and P. J. Gilinson. May 28th, 1919. (140,661.)

16,268. Composition for insulating and waterproofing electrical elements. G. Tucker. June 28th, 1919. (140,675.)

21,089. Dynamo-electric machines. Baron Clifford of Chudleigh. (W. H. Clifford). August 27th, 1919. (140,693.)

23,073. Electric induction coils for medical purposes. M. H. Goldstone. September 19th, 1919. (140,705.)

26,014. Electrical means for facilitating navigation on predetermined courses. Siemens & Halske Akt. Ges. July 11th, 1918. (134,226.)

31,199. Apparatus for electrically controlling railway trains or vehicles through the track. A. R. Angus. October 10th, 1917. (Divided application on 15,863/18.) (136,570.)

31,200. Apparatus for electrically controlling railway trains or vehicles through the track. A. R. Angus. October 10th, 1917. (Divided application on 15,863/18). (136,571.)

32,392. Sparking plugs. E. F. Burrill, S. E. Grubb and J. E. Stanley. December 24th, 1919. (140,733.)

E.D.A. Activities.—The latest piece of propaganda issued by the E.D.A. is a poster (E.D.A. 73, 28 in. by 18 in.), "Electric Cookery saves Food and Fuel," depicting a young lady attending to an electric cooker. It is attractively printed in several colours, with a space at the bottom for the insertion of the contractor's name and address.

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THE

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ELECTRICAL REVIEW.

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COAL CONSERVATION.

WITH a courage that makes one marvel, if not admire, Sir Dugald Clerk, in his "James Forrest" Lecture, resumes his attack upon the Report of the Coal Conservation Committee, sets up figures of his own in place of theirs, and on that basis proceeds to declare the Government scheme a "wash-out." He shows from his own figures that if the scheme is carried out on the Committee's lines for the supply of power, there will be an annual saving of 29·9 million tons when all private installations and most of the existing generating stations have been replaced by super-stations—and then he says: "small fuel savings are possible by limiting the use of electricity to light and power." *Small?* Is 30 million tons a small saving? And that is out of 48·7 million tons, as stated by Sir Dugald, instead of 44·7 million tons out of 65 millions, as estimated by the Committee. If the railways are electrified, the total saving may become 37·4 million tons per annum.

But a large amount of coal is used for heating purposes in mining and industry and in domestic use. The latter amount is estimated by the Committee at 35 million tons (in 1913); the former, on the basis of Mr. Brownlie's estimates, is given by Sir Dugald as 25 per cent. of 65 million tons, or 16·3 millions (in 1907).

However, turning to the question of heat production, Sir Dugald assumes that gasworks in existence use 18·8 million tons to generate heat with an over-all efficiency of 18·3 per cent., the same amount of coal as would be required by the electricity works to supply all the power required for industry, at present. Why he takes this figure—18·8 millions—we do not know. Assuming that to produce and distribute the same quantity of heat electrically would consume 2·65 times as much coal, he finds that to supply both power and heat electrically would require 18·8 + 49·8 = 68·6 million tons, instead of the present (assumed) total of 67·5 millions.

By this remarkable process he arrives at the conclusion that the super-station scheme is unsound, although he has demonstrated that a saving of about 30 million tons of coal would be effected by the scheme if electricity were used for everything but heating and railways.

Sir Dugald next deals with the rosy future of the gas industry under the new thermal-unit standard system. We reproduce elsewhere in this issue a remarkable instance of the possibilities that lie before the gas industry in this respect, extracted from the recent report of the Fuel Research Board; the curve speaks for itself. The lecturer states that "in a few years" the gas works will deliver to the consumer (in the form of gas) 75 per cent. of the heat in the coal, and the efficiency of use will rise from 42 to 55 per cent. We sincerely hope that these forecasts will be fulfilled; but 19 lines further on Sir Dugald says: "I have shown that gas will shortly be produced and distributed at 75 per cent., and used at 55 per cent. thermal efficiency for general domestic purposes." "*Shown*"—and "*shortly!*" A mere forecast is not proof. It is quite in order to attack the Committee's forecasts—but not to claim for the critic's own forecasts that they have been "shown" to be correct when they have merely been stated.

On the whole, Sir Dugald's address is a direct attack on the Committee's report, which signally fails so far as power and lighting are concerned; his only strong point is on the subject of heating, which he belabours lustily. In the meantime, under the existing conditions—without waiting for the super-stations—in every large centre there is a long list of would-be consumers clamouring for a supply of electricity. Collieries, which use their own coal; textile mills which, Sir Dugald claims, generate power as economically as electricity works; domestic consumers, for

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lighting, power, *and* heating—all alike want electricity, and they want it now. Why?

Simply because the advantages of "doing it electrically" are now appreciated by all classes; many of them are not capable of being set down in cash columns or in heat balance sheets—but they exist, all the same, under both heads. With electrical methods, far less energy is consumed than the paper calculations indicate—that is proved by the bills for energy; the motor is stopped when not wanted—the gas engine goes on running on light load, using nearly as much gas as it does on full load; the electric lamp is switched off for five minutes—the gas lamp is left burning; the electric radiator is carried to the desk—the gas fire is fixed in position, and therefore must be a big one—and so on. How can one assess the saving due to the fact that rooms lighted with electricity need redecoration only once in five or six years, where gas-lit rooms look shabby in two? Moreover, as we have pointed out before—and this is a most important point—the gas works cannot use the rubbish that passes for coal at the electricity works and gives good results when used by competent hands. Many electricity works burn stuff that would otherwise be dumped as useless waste.

No, Sir Dugald; calculations have many virtues—but facts are stubborn things!

BRITISH PRESTIGE ABROAD.

Some time ago a Foreign Office Committee was appointed to consider by what means the Government could foster a greater spirit of solidarity among British communities abroad, and make British ideals more generally known and appreciated by foreign nations. The subject is one of real interest, whether we study it from the standpoint of the Britisher abroad, or with the object of securing a correct appreciation of British character and achievement, and enhancing British prestige generally, among other races.

Many witnesses appeared before the Committee, and from the evidence given it was possible to form a number of conclusions, and these are set forth in a White Paper, Cmd. 672.*

Russia and the United States were excluded from the scope of the inquiry, the former because of the uncertainty as to the conditions which will obtain in Russia in the future, and the latter because the British community in the U.S.A. differs greatly from that in other countries. On the question to what extent State intervention is justifiable, marked difference of opinion was found to exist, and the conclusion of the Committee is that H.M. Government should take no action which would tend to interfere with the deeply-rooted British spirit of independence, but help should be given to our foreign communities whenever it could be done legitimately and with acceptance. The Government is recommended to make it known without delay that it takes a sympathetic interest in the activities of British communities in foreign countries, and is prepared in certain cases to afford them practical support, even though a call upon the taxpayer be thus involved. Such a call is considered justified, in order to promote the solidarity of British communities and the spread of British ideals.

Readers who are able to spare the time should secure the document and study it in its entirety. Under normal conditions we should have devoted more space to its consideration than we can now spare, but we wish to indicate generally the line of the recommendations which are advanced, and to express a hope that even in these crowded legislative hours with their overwhelming problems, the temptation to pigeon-hole the report and leave it to lie there until it is forgotten under an accumulation of dust, will be resisted. Among other things, it is proposed that there should be an effort to secure registration of all British subjects known to be resident in a given district so that they may be kept in touch with the British Consul, who will furnish their names annually to the Foreign Office. As this will necessarily be voluntary, it cannot be quite complete, but it will be most helpful if it be fairly so. It is desired that every British child abroad should have the opportunity of receiving an English education, and provision therefor is necessary. The Government should encourage the formation in foreign countries of British Chambers of Commerce fully representative of all British interests concerned. His Majesty's Representatives should consult these Chambers on subjects affecting British trade. Through such media as patriotic societies, churches, and other institutions, the promotion of British solidarity and the upholding of British ideals would be assisted.

So far as commercial propaganda is concerned, the real direction for Government assistance is considered to be through the commercial side of the diplomatic and Consular services, the organisation of missions to investigate foreign markets, the dispatch of touring exhibitions, the organisation of showrooms abroad, and the support of the British film industry.

Not the least important point dealt with is the dissemination of English technical books and journals and their filing at all British Consulates for consultation by British subjects. It is stated that in many foreign countries but little use is made of English technical books; translations into foreign languages are but rarely made. "It is not surprising, therefore, that foreigners gain the impression that Great Britain counts for little in the world of science." Further: "It was made quite evident that the English have fallen behind some other countries in making known their books abroad, confining their business to the sale of books specifically asked for." The question of circulation of English technical and other literature is one more directly concerning publishers than the readers of the Electrical Review, but the publishers need the co-operation of the Government if they are to set up a central distributing organisation to assist in maintaining British prestige in the interests of the nation; they also require, and it is recommended that they should have, cheaper and quicker postal facilities and transport. Facilities are lacking for imparting to foreigners information concerning new and current British books. It has been recommended that Great Britain should join in the international arrangements by which subscriptions to British papers and periodicals can be placed through the medium of foreign post offices; and that a body should be set up to prepare and issue catalogues of the most necessary technical and other works. One suggestion advanced is that publishers be invited to send copies of standard works included in such catalogues to British Commercial Secretaries and Consuls, in order that they may bring them to the notice of those likely to be interested. Another is that the Board of Education should encourage the translation of standard English technical works into foreign languages, the universities on one side, and industrial and commercial federations on the other, being asked to help in promoting this object.

It is finally recommended that a Standing Committee be appointed to give effect to such of the above and other recommendations contained in the report, as may be approved by the Government.

We earnestly hope that this course will be adopted. If the matter rests where it is, we despair of good emerging.

One matter which directly bears upon the whole subject of British technical and scientific prestige abroad is the postage rate for technical and trade publications. Postage rates at home are to be raised under the Budget provisions, but the Government ought to remember in any proposals it may contemplate for raising the distribution costs of such publications in the Colonies and abroad, that the imposition of restrictive postage rates will simply be playing into the hands of other nations which are flooding foreign markets with their literature. If the maintenance and expansion of British export trade are as vital as the Government says, and as we are convinced they are, the Government departments responsible for fixing postal rates and giving postal facilities, should not be indifferent to appeals that are made to them. The provision of technical journals for use on Consular and other public tables abroad is a service which publishers have not been unwilling to give in the interests of British manufacturing and trade, but the maintenance of British scientific and

* H.M. Stationery Office, 2d. net (Report of the Foreign Office Committee on British Communities Abroad).

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trade reputation is not altogether a private matter for publishers. If it is a national matter the nation should be prepared to assist in other ways, and not rest contented with appointing a committee which shall merely make recommendations—valuable as these may be.

Profit-Sharing: A Suggested National Scheme.

Under the auspices of the Industrial League and Council, an address was given at Caxton Hall, on April 21st last, by Mr. Herbert W. Jordan, on "A National Scheme of Profit-Sharing."

The scheme suggested is, briefly, that companies should be encouraged by some such means as a remission or rebate of income-tax, and the privilege of using the words "profit-sharing" after the name, to make use of a standard scheme, either formulated by the Board of Trade, or recommended by the Whitley Council for the industry concerned. After providing for depreciation under "the accepted scale" (whatever that may be), the net profits should, in Mr. Jordan's opinion, be divided up in the following way:—First, in the payment of a 6 per cent. cumulative dividend on the capital issued and paid up; secondly, in the payment of a further 3 per cent. non-cumulative dividend on the same capital. Anything over this 9 per cent. would be divided into three equal parts. Of these the first third would be paid out as a further dividend to the shareholders, the next divided among the employés, and the last applied for pension purposes. The rate of dividend, mentioned in this case as 6 per cent., would fluctuate according to the average rate of return on trustee securities.

The portion of profits available for distribution among employés would be paid in cash or shares, and the basis of distribution might be in proportion to remuneration or to position in the concern.

Reference is made by Mr. Jordan to the Report of the Ministry of Labour with which we dealt in our leading article of April 23rd last, and he complains that "it seems unfortunate that so valuable and comprehensive a Report does not explain the cause of the apathy of the employés (which is the root difficulty) or offer any suggestion as to how their interest could be aroused." He goes on to state his view that the reason for this apathy is that in general the employés have to leave the whole matter in the hands of their employers. That is true; but the chief point is that the amount receivable by each is insignificant. Human nature is human nature; and what is the use of a board of directors complacently nodding and smirking about their enlightenment because they have a profit-sharing scheme which results in an average extra remuneration of about half-a-crown a week all round? This is no exaggeration, and no isolated instance, as any interested person can discover by paying a shilling for a copy of the Report. And Mr. Jordan's standard scheme will fall down for the same reason. He gives 10 per cent. to the shareholders and 2 per cent. to the employés, half in cash or shares, and half by way of the pension fund.

Payment by results is, we believe it is fair to say, generally accepted as right in theory, so that the question resolves itself into one of a fair division of the profits. Each side takes, naturally and inevitably, the selfish view. Certain Trade Unions object to payment by results, because their control over the profits earned is not, in their opinion, sufficient to justify them in depending upon those profits for any substantial portion of their remuneration. Boards of directors, particularly during the present boom, have in several notable instances done away with bonus systems, and reverted to flat salaries, for the sole and simple reason that it is, on paper, the less expensive way. Whether it is not, in the long run, by far the *more* expensive way is, in our view, scarcely open to question. That atmosphere of goodwill and intensive co-operation which is so necessary to the requirements of the exhausted world can only be attained when both sides agree to lay their cards on the table, and between them to evolve a scheme which, bearing the full light of day, will make individual effort and collective success the criterion of the reward which each shall receive for his labours.

The Austrian Electrical Industry.

An appeal for assistance in the supply of raw materials to the industries in German Austria has been issued by Dr. Gustav Weiss-Wellerstein, secretary of the General Union of German Austria's Industry. The secretary points out that about 70 per cent. of the Austrian workmen find occupation in the metal and electrical industries, and the production of electrical manufactures which took place in old Austria is particularly located in the present German Austria, the industry having formerly supplied the requirements of the Austro-Hungarian market. The reason why the electrical industry formerly had no large market in the East was not backwardness, but the fact that the Austrian electrical firms had formed a syndicate with the works in Germany, which resulted in a division of the export markets, to the disadvantage of Austria. Now, however, the secretary states, the situation has become quite different, and the Austrian electrical firms can export on their own account, the East coming into consideration as their natural market.

Small Electricity Undertakings.

While the Electricity Commissioners are busy with the formation of big districts and the reorganisation of the great electricity supply undertakings of the country, there is a risk that the fortunes—or misfortunes—of the smaller undertakings may escape attention; this ought not to be allowed to happen, for the matter is one of pressing urgency for them, and they are as much entitled to justice and consideration as their big brothers. Where they are situated within range of a bulk supply scheme, it is true, there is no fear that they will be overlooked; but what of the isolated stations which are scattered about the country, in regions where there is not the least prospect of a transmission line approaching them for many years to come? What are they to do? They cannot meet the demands for supply which rain upon them, without new plant; new plant costs money, and they cannot raise funds for the purpose with the prospect of extinction hanging over them. In the meantime they have no option but to struggle along with what plant they have at command, while the public clamouring for electricity, knowing little and caring less about the national scheme, is becoming exasperated, and lays the blame upon the shoulders of the long-suffering undertakers. This ought not to be allowed to continue. A decision should promptly be arrived at, and each such isolated undertaking should be put in a position to raise the necessary capital for extensions by an explicit assurance that it will not be affected by the scheme. This alone is not sufficient; a guarantee is necessary that any capital so expended on *bonâ fide* extensions shall be fully repaid if and when the undertaking is purchased by an authority under the new Act. Even where it is definitely known that a bulk supply is to be given, extreme annoyance is being given both to contractors and the general public by the enforced postponement of all new connections to an unknown epoch in the future, owing to the existing station being fully loaded. Many undertakings have been authorised to carry out specified extensions, and no time should be lost in regularising the position of all statutory undertakers.

How seriously some of these are affected by the new conditions is well exemplified by the attempt of Edmundson's Electricity Corporation and other companies to obtain powers to increase their maximum prices; we regret to see that a Select Committee of the House of Lords, on Monday, summarily rejected the Bill without calling upon the opposition to give evidence. Are these companies to be compelled to fulfil their statutory obligations and yet to be deprived of the possibility of paying a modest return on the capital which they have invested? What else is this but a policy of confiscation?

These small undertakings are usually almost wholly dependent on the lighting load, and what that means may be imagined when to the introduction of the metallic-filament lamp and the gas-filled lamp is added the adoption of "Summer Time," together with the increased cost of labour, materials, and fuel.

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ELECTRICAL HAIR-DRESSING.

By E. AUSTIN.

One of the easiest and quickest ways of making money at the present time is to open an electrically-equipped hair-dresser's shop. With the aid of electricity, barbers can acquire wealth with extraordinary rapidity, and those who are not taking advantage of the fact must either be very dull and stupid or quite insane. This interesting and very informative article is the outcome of an inspiration derived from a well-known propagandist who directed the writer's attention to certain advertisements appertaining to electrical hair-dressing appliances, some intended for use in barbers' shops, others in the home. Incidentally, it should also be mentioned before proceeding further, that none of these things are of the slightest value to the writer, who lost his hair years ago in writing for the technical Press, but others engaged on less arduous work, and especially ladies, ought to find them extremely useful.

Whilst electric hair-cutting and shaving machines have not yet been introduced, there are nevertheless appliances for hair-drying, waving, and singeing. The orthodox method of singeing is gently to raise the hair from the scalp with the aid of a comb, and to apply a lighted taper to the extremities, thus causing the hair to be ignited or fused, and producing an unpleasant odour. This method, it seems, has been in vogue for a great many years, and would in all probability still be in vogue, had it not been for the introduction of Mr. I. Calvete's electric singer shown in fig. 1. This device, which is made of aluminium, and is consequently very light, and easily handled, has a horizontal electric heating element composed of a silica tube containing a resistance coil wound on a support, and when current is passed through the coil the silica tube becomes red hot, very much in the same way as an element or a Bastian electrical heater. All the barber has to do when operating upon a client is to apply the heated portion of the device to the extremities of the hair, which is singed without the slightest risk of setting the client on fire. No "hair-cut," it is said, can be perfect unless finished with this little machine, which requires only 40 watts to work it, and which is claimed to prevent premature baldness.

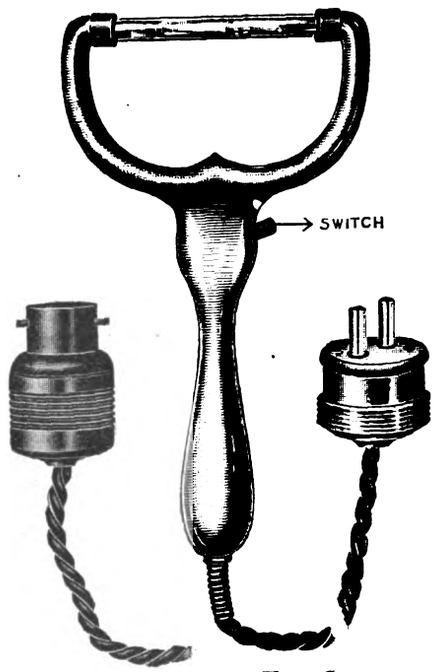
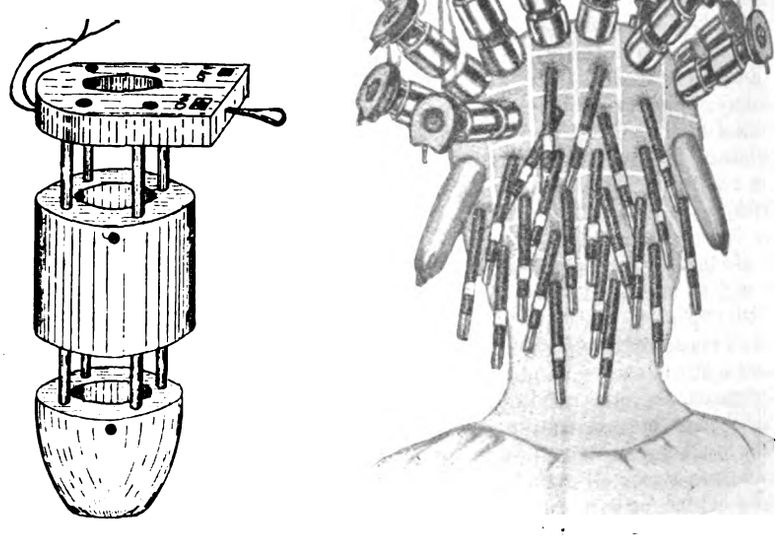


Fig. 1.—Electric Hair Singer.

We now come to the electric heaters supplied by Mr. Eugene, the great hair-waving expert. With the aid of these heaters (see fig. 2) straight hair is made wavy, and will remain in this condition, even after shampooing, sea bathing, or after the hair has been exposed to the influence of a hot bath or to rain. The waves, moreover, are smooth and handsome. Hair waving in accordance with Mr. Eugene's electrical system requires a certain amount of study and experience before proficiency in the art can be attained, but briefly, after the hair has been shampooed, sections are carefully twisted round small metal rollers and then bound round with twine, which in turn is covered with a damp fabric, charged with borax. Over each roll of hair bound with the twine and fabric a paper capsule is then slipped, the function of these capsules being to enable the heaters (fig. 2) to raise steam from the damp boraxed fabric. Readers who contemplate experimenting upon their lady friends should note that the part of the process so far described is the most important part, and that the success of the system greatly depends upon the neatness with which the hair is wound upon the rollers.

Having coiled the hair upon the rollers and applied the twine, damp fabric, and capsules in the manner described, the heaters, which have previously been connected up to the supply circuit, and have attained their maximum temperature, are slipped over the capsules as shown in fig. 3, and all the operator has to do whilst the heaters (suspended on the tape-measure principle) remain in position is to see that none of them touch the scalp. A special feature of the system is that the heaters are made in two sections, arranged one above the other, and separately controlled, and as the upper section is only switched on for a short period, all risk of frizzing the delicate points of the hair is avoided. The lower section gives the proper heating effect at the roots, where the hair is most stubborn, and where a nice wave is particularly advantageous. Usually the outfit is composed of 10 heaters, and after these have remained on 10 of the capsules for a period of 20 minutes they are removed one by one and placed upon a second set of capsules. When all the capsules have been subjected to the heat treatment, the heaters are put out of action, the capsules removed, the fabric and twine unrolled, and after the rollers upon which the hair is coiled have cooled down, a simple twist of the hair in the opposite direction to that in which it was coiled enables the rollers to be removed. The hair, which was originally straight, is now wavy, but by reason of the borax in the lint it has a white-powdery appearance, and the hair has, therefore, to be re-shampooed. Finally, it is dried and combed, when the lady, who at the outset may have been plain and unattractive, leaves the saloon looking beautiful.



Figs. 2 and 3.—Electric Hair Wavers.

Electrical hair-drying is another interesting branch of

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the hair-dressing industry. With an electrical machine as shown in fig. 4, hair can be dried without spending half the day in rubbing it with towels. The particular machine illustrated is one of the products of the Dexter Manufacturing Co., and, in common with the perhaps more familiar portable pattern composed of a small motor and blower with a handle, it is capable of supplying hot and cold air. A special feature of the machine is that the temperature of the air discharged from the nozzle and projected on

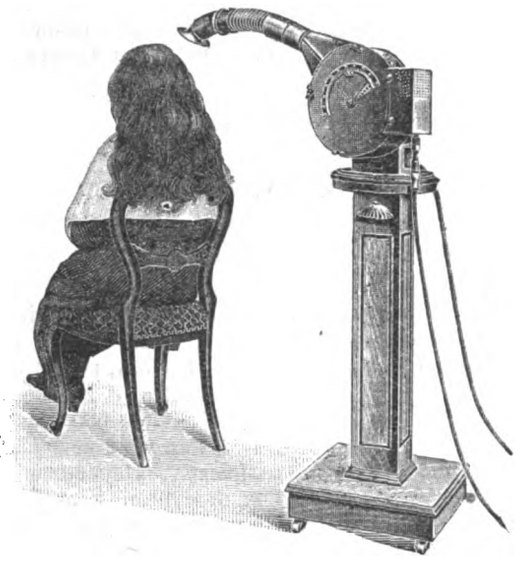

Fig. 4.—Electric Hair Drier.

to the lady's or gentleman's head can be regulated to a nicety, simply by manipulating a small shutter. The machine is fitted with a two-speed switch which enables the fan to give a medium or strong air blast, which in the case of this particular machine is heated by gas jets fixed to the periphery of the fan case. When the motor is running at full speed and the heat regulator is closed, the fan produces a large volume of hot air, capable of drying the thickest of hair very quickly. The cost of running the motor with electricity at 5d. per unit is said to be a farthing per hour, and the cost of the gas at 4s. 2d. per 1,000 cb. ft., exactly a penny per hour, the total operating cost thus being 1¼d. per hour, or 1s. 3d. for 12 hours' continuous use. Hair drying machines similar to the one illustrated, but with electrical heaters, are also supplied by Messrs. C. B. Wright and Co., and these heaters may be mounted on a pedestal as shown, or be attached to a wall bracket. Another of the Dexter Co.'s products is the electric stove (fig. 5) for heating hair waving irons or tongs, which is constructed of polished aluminium and made for all voltages ranging from 100 to 250 volts, D.C. or A.C. Yet another device of much use in hair-dressing operations is the electrically-driven rotary hair brush made by the Light Electric Motor Co., of Dundee..

Electric massage is, of course, an operation closely related to hair-dressing. Scalp massage is said to prevent dandruff, baldness, itching scalps and so forth. Daily applications of an electric massage vibrator invigorate the hair roots and

Fig. 5.—Electric Hair Tongs Heater.

are claimed to promote hair growth. Electric massage is also said to cure certain ailments, such as sciatica. Face massage, however, is the most common form of treatment practised by barbers, and those in any way interested in this lucrative branch of the electrical business should not fail to remember that there is a great and ever-increasing demand for face massage appliances.

THE REMOTE CONTROL OF ROTARY CONVERTER SUB-STATIONS.

By H. WILSON, Mains Superintendent, Maidstone Corporation Electricity Works.

Most supply undertakings which operate on a low-tension three-wire supply have outlying districts in which the supply pressure is anything but satisfactory. An inquiry from such a district for "6-kw. cooking" or "30 h.p.," generally leads to much speculation in the mains department, and the sequel is often a courteous reply from the supply authority, stating that: "We regret that with our present mains, &c.," or "We are considering the installation of a sub-station, and hope to go into your inquiry at a future date." Sooner or later that sub-station will have to be put down, and will probably consist of a rotary converter fed by an E.H.T. main through a transformer. Often the revenue from the section in question will hardly cover the capital charges on plant installed at the sub-station, and the E.H.T. main supplying it, and under these circumstances anything which will cut down the running expenses is worthy of consideration.

It is probable that the sub-station may have to run from 7 a.m. to 10 p.m., and this means two attendants, and possibly more. With the 47-hour week, and the proposed basic rates for the electricity supply industry, this will probably mean £8 to £10 per week in wages.

It is to those who have installed, or are about to install, such a sub-station that the following suggestions are offered, and the author may add that he has installed and successfully operated the scheme set out below.

The diagram, fig. 1, shows, as simply as possible, the connections between the sub-station and generating station.

The principle of the remote control is that the voltage regulation of the rotary at the sub-station can be accomplished either by the usual field rheostat provided at the sub-station, or by means of an auxiliary rheostat on the direct-current feeder panel at the works operating through a pilot cable between the works and the sub-station.

It is also possible to shut down the rotary at the sub-station from the works, provided that a second pilot wire is available, and that the H.T. oil switch at the sub-station has been fitted with a D.C. trip coil. When shutting down, the D.C. rotary breakers at the sub-station are operated through the second pilot wire by means of the over-speed trip coil, which is usually present on a rotary control panel. The same pilot wire operates the D.C. trip coil on the H.T. oil switch, so that both this and the D.C. breakers are operated at the same instant, current being admitted to the second pilot wire by means of a push-button on the D.C. feeder panel at the works.

The method of operation is that an attendant from the works starts up the sub-station rotary in the ordinary way, parallels with the D.C. supply, and when the rotary is running light on the bus-bars, he notifies the works by telephone that he has started up, and he is then at liberty to return to the works, or to go on to another sub-station and repeat the process.

The attendant at the works then watches the ammeters on the D.C. feeder panel—which are of the centre zero type—and when these begin to show that power is going out to the sub-station, he increases the rotary voltage at the sub-station by means of the auxiliary rheostat, until the ammeter pointers return to zero, or if necessary to some specified value, on the other side of the zero mark, representing power returned

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by the sub-station to the works bus-bars. Assuming that there are no consumers connected on the D.C. feeder between the works and the sub-station, a zero reading on the feeder panel ammeters at the works means that the sub-station is generating at the same pressure as the works' bus-bars. With a go-and-return resistance of 0·5 ohm in the D.C. feeder, 20 amperes going to the sub-station means that the sub-station pressure is 10 volts below the works' pressure. On the other hand, 20 amperes back to the works means the sub-station pressure is 10 volts high. These figures can be tabulated for all likely loads and placed on the feeder panel at the works, so that the D.C. ammeters at the works can be used to give a correct indication of the relative pressures at the works and sub-station, and thus of the actual voltage at the sub-station. This is important, as it may place at liberty an existing voltmeter pilot cable to supply the two conductors necessary for the remote control.

The works attendant proceeds during the day to regulate the sub-station voltage by means of the auxiliary rheostat, and when he decides that he can dispense with the sub-station, and pick up the remaining load from the works, he reduces the auxiliary rheostat to the last stop, and opens the auxiliary single-pole field switch. This leaves the sub-station running light, or exactly as it was left by the attendant after starting up in the morning, and the works attendant can then operate the H.T. oil switch and D.C. breakers at the sub-station by means of the push-button switch and the second pilot wire.

If two additional pilot wires are available between the works and the sub-station, it is a distinct advantage to have

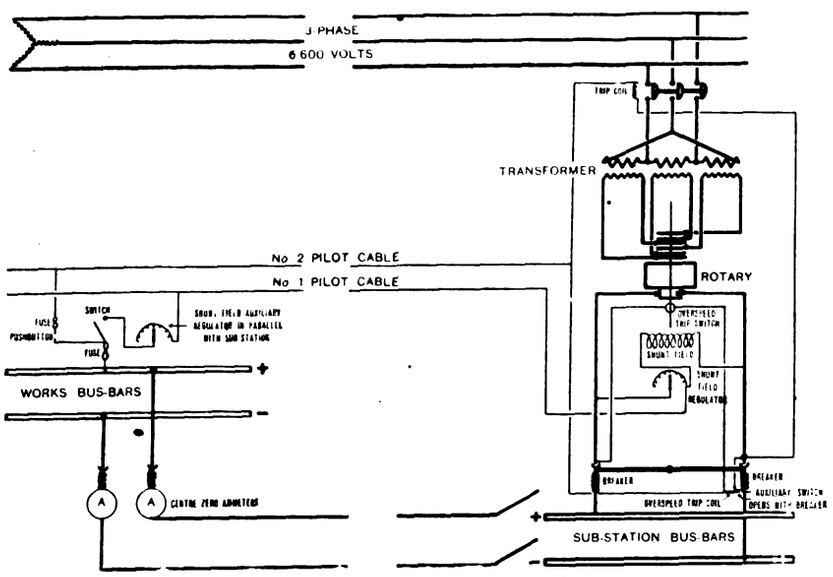

Fig. 1.—Remote-Controlled Rotary Converter.

a pilot lamp on the works feeder panel, connected directly across the rotary terminals at the sub-station, as when shutting down this removes any question whether the A.C. and D.C. switches have both been operated at the sub-station.

It should be noted that not only can the control of the sub-station be accomplished either from the works or the sub-station, but that it can be transferred in a few moments from either point to the other, without disturbing the distribution of the load at either end, simply by increasing the current through one rheostat, and decreasing it through the other, or *vice versâ*.

These operations may appear rather lengthy and complex on paper, but in practice they are easily understood and accomplished by the average attendant.

In favour of the system outlined it may be urged that in most rotary sub-stations the attendant does nothing after starting up except regulate the voltage and then shut down. Also, it is a great advantage to have the control of the plant at the works and the sub-station under the hand of one attendant, and saves a great deal of telephoning between the two places.

With regard to pilot cables, these are often in existence as voltmeter cables laid with the original D.C. feeder, and in the case of new sub-stations, they can be laid with the E.H.T. feeder; telephone cables will probably have to be laid in any case, and the control cable can be incorporated with these.

There is usually room on the D.C. feeder panel at the works for the hand-wheel of the auxiliary rheostat, the single-pole auxiliary field switch, and the push-button switch for shutting down. If not, these should be arranged, of course, as near the D.C. feeder ammeters as possible, to facilitate the regulation.

Where several sub-stations are in contemplation, the saving accomplished in wages will be considerable, and the initial cost of installation will be much below that of automatic voltage regulators, while the maintenance will also be much less.

INVERSE POWER FACTOR.

By C. TURNBULL.

The converse or inverse of an idea is frequently of much use; indeed one may, not seldom, come upon an entirely new idea by inverting one that is well known. Kelvin used the method quite frequently. Before his day, people tried to make the mariner's compass accurate by increasing the strength of the magnet. Conversely it was possible to make the compass work satisfactorily with a weak magnet, if one lightened the moving parts sufficiently. This seems obvious enough to us now, but no one thought of it until Kelvin introduced his improved compass. Similarly, it was possible to state certain thermodynamic propositions in terms of the thermometer scale. Kelvin inverted the process, and stated the thermometer scale in terms of thermodynamics.

Again, when everybody was working in ohms, Kelvin invented the mho, which has turned out to be so useful that we have now added to it the terms admittance and susceptance.

The time is now overdue for a term equivalent to "inverse power factor." It is well known that one of the great difficulties of charging adequately for energy at low power factor arises from the fact that commercial men cannot understand power factor. It is certainly very puzzling to a commercial man to understand that his motor is using a large amount of current because it has a power factor of 60 per cent. or 70 per cent. It sounds rather as if the motor were only using some 60 per cent. or 70 per cent. of the power that it ought to, and it seems to be a particularly good motor. If instead of speaking of power factor we used the term "current factor," and spoke of, say, 180 per cent. C.F., it would be much easier to get consumers to understand what it all means. The current factor of 180 per cent., indeed, would mean that the motor took 80 per cent. more current than it ought to. One can further explain that this excessive current means that the cables on the consumer's premises, and also the undertaking's mains, have to be 80 per cent. bigger than would be necessary if the motor had been designed on more efficient lines.

Not only would the term be easier to explain to consumers, but it would be more useful even to the technical man. It would give him his results directly, and that would lead to clear thinking.

Public Utility Companies Bill.—In the House of Lords, last week, says *The Times*, Lord Somerleyton moved the second reading of the Public Utility Companies (Capital Issues) Bill, which had come up from the Commons. The Bill provides for the variation of the provisions regulating the raising of capital by companies carrying on public utility undertakings for the supply of gas, water, hydraulic power, and electricity and tramway undertakings, including light railways constructed wholly or mainly on public roads. The Bill was read a second time.

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COAL CONSERVATION IN THE UNITED KINGDOM.*

By SIR DUGALD CLERK, K.B.E., D.Sc., F.R.S., M.Inst C.E.

Our present industrial civilisation depends upon our supplies of fuel and motive power, and without coal, oil, and motive power it would be impossible to support in comparative comfort our population of 46 millions.

According to Prof. Bone's estimates, power, gasworks, and domestic use consume between them 154 million tons per annum, or about 71 per cent. of the whole coal consumption of the United Kingdom.

The Coal Conservation Committee arrived at the conclusion that 80 million tons of coal were consumed in this country in 1917 for the production of power, including railways; they considered that only 25 millions would be required if the whole of the existing steam engines in separate factories, and the steam locomotives on railways were replaced by a great general system of electrical generation and distribution.

Are the facts dealt with by the Coal Conservation Committee such as to justify the sweeping conclusions arrived at? Many competent electricians and most capable motive-power engineers have the gravest doubt as to the accuracy of the data presented and as to the outcome of the ambitious scheme advocated.

The report assumes an approximate knowledge of four values:—

1. The amount of coal used in the United Kingdom for the production of power only.

2. The amount of mechanical or electrical energy produced from this coal and used in driving workshops, mills, factories, electrical generation and railways by steam engines, reciprocating and turbine.

3. Assumed (calculated from (1) and (2) consumption of coal per brake horse-power hour at present.

4. Possible reduction of total consumption of coal by the proposed super-stations.

With regard to (1), an attempt is made to arrive at this value by consideration of the values returned in the census of production for 1907. The conclusion is that in 1907 the estimated coal consumption in industry, including mining, was approximately 70 million tons, but the whole of this coal is not used for power production because it includes "important amounts of coal used for purposes other than the generation of power, as in brick making, in chemical trades and in bakehouses."

It is assumed that only 75 per cent. of the total coal is used for power production in industry, that is 52.5 million tons. If railways be included the total consumption is stated to be at least 65 million tons. It is further stated that the present (1917) consumption including railways is 80 millions.

In the list of purposes requiring the reduction by 25 per cent. above no allowance appears to be made for the large amounts of steam consumed in factories and mines for heating and general technical processes in industries like dying, bleaching, calico printing, tanning, hat manufacture, chemical trades, heating premises and others. Mr. Brownlie considers that the proportion of steam so included in power production is from 20 to 30 per cent. of the total. The 65 million tons consumed in mining and industry is thus subject to a deduction of, say, 25 per cent., and the real value for power producing purposes, including railways, is more probably 48.7 million tons.

With regard to (2), the total output of mechanical energy produced from the coal used in driving workshops, mills, factories, electrical generators by steam engines, reciprocating and turbine (excepting railways), during the year of the census 1907, is estimated by the Coal Conservation Committee as 14,691 million H.P.-hours. To estimate this value it is assumed that the nominal H.P. of steam engines may be used. The practice as to nominal H.P. of a steam engine is to expect the actual power obtained to be at least one and a half times the nominal value. This would cause the power of the separate steam engines returned in the census to be higher than that used to determine the total H.P.-hours of the plant per annum. For this reason I consider that the steam-engine H.P.-hours per annum are too low. The total H.P.-hours in 1907 was more probably 20,987 million H.P.-hours.

With regard to (3), my estimate of the total coal consumption under (1) during 1907 for steam motive power only, including railways, as explained is 48.7 million tons; deducting for railways 12.5 millions we get 36.2 millions. The coal consumption per H.P.-hour is therefore $36.2\times2,240/20,987=3.9$ lb. nearly.

In the committee report the value arrived at, without correcting for steam consumption other than motive power, and without correcting the nominal H.P. for steam-engines, is 8.03 lb. This number, however, is given up, and 5 lb. per H.P.-hour is adopted from typical cases.

According to Mr. D. Wilson, technical adviser to the Coal Controller, the electricity supply undertakings of the United Kingdom utilising coal generated in the years 1917-18, 4,674 million Board of Trade units on an average consumption of 3.47 lb. of coal per unit, or 2.59 lb. per electrical H.P.-hour. We have thus accurate knowledge of the fuel consumption of at least 10 per cent. of the whole power of the country.

The textile trades are large power consumers, and their reciprocating steam engines are highly economical. Compound engines working at about 100 lb. per sq. in., consume about 2.7 lb. of coal per I.H.P. net. Compound high-pressure engines consume about 1.85 lb. of coal per I.H.P. net, and about 1.45 lb. when superheated steam is used. At 90 per cent. mechanical efficiency the mean consumption is 2.33 lb. of coal per B.H.P.-hour. Allowing for some of the older engines, 2.5 lb. per B.H.P. seems a very probable figure for the textile industry.

In July, 1919, Mr. D. Brownlie published a critical examination by him of the performances of 250 boiler plants in different industries. He found that the maximum evaporation of water per pound of coal was 7.85 lb., and the minimum value was 4.96 lb. The average value was 6.56 lb. At 20 lb. steam per B.H.P.-hour this would give a mean of 3.05 lb. of coal per B.H.P. A similar examination by Mr. Brownlie of 100 typical colliery boiler plants gives 5.44 lb. of water per pound of coal. If we assume that the colliery engines require 30 lb. of steam per B.H.P.-hour because of the nature of their work, the average coal consumption for the collieries per B.H.P.-hour is 5.5 lb. of coal. Pumping engines for mines, however, consume about 2 lb. of coal per pump H.P.-hour.

To arrive at an approximate average for the whole country it is further necessary to study the distribution of the total steam power of the country among the different engines of greater and less economy. The data depend on the returns made at the census of production of 1907.

On this basis the average for the United Kingdom is 4.05 lb. of coal per B.H.P.-hour. I have thus arrived at two values. The first is 3.9 lb. of coal per B.H.P., estimated on census of production data, and the second is 4.05 lb. of coal per B.H.P.-hour, estimated by considering the average of many typical steam engines. The agreement is close.

With regard to (4), it has been shown that after allowing for steam used for purposes other than motive power the Coal Conservation Committee estimate of 65 million tons consumption is reduced to 48.7 millions. If we assume with the committee that super-stations in the early future will generate 1 E.H.P.-hour on 1.56 lb. of coal, then the possible consumption by the complete substitution of such stations for existing stations and power-producing steam engines, assuming the figure of 4.05 lb. is 18.77 million tons. The saving is 29.9 million tons.

The saving, as contemplated by the committee, on 65 million tons, the consumption for stationary engines, is 44.7 million tons.

Mr. R. T. Smith, in his presidential address to the Institution of Electrical Engineers, states that if all the railways of the country be electrified, it is possible to save from 7 to 8 million tons of coal per annum; we then get as total "saving" $29.9+7.5=37.4$ million tons per annum. The saving of 55 million tons expected by the committee is, in my opinion, based on fallacious reasoning.

The foregoing discussion assumes that power and light are to be generated, not heat; but the committee report clearly intends to generate heat also and expects to do so with economy superior to the existing systems of coal and gas combustion. To test this matter it is desirable to consider first the question of heat supply by electricity and by coal gas.

The average efficiency of gas production for the kingdom is 46 per cent. and the efficiency of distribution is 95 per cent., so that the consumer receives at his premises 43.6 per cent. of the heat used at the gasworks ready to produce that quantity of heat on combustion. The thermal efficiency of the gas in use for domestic and manufacturing purposes is 42 per cent.; that is, the final efficiency referred to the heat consumption at the gasworks is $43.6\times0.42=18.3$ per cent.

Electricity generated at a fuel consumption of 1.56 lb. of coal per E.H.P.-hour gives a thermal efficiency of production of 13 per cent. The efficiency of transmission for short distances is 90 per cent., and the electricity consumer receives on his premises $13\times0.9=11.7$ per cent. of the heat consumed in the thermodynamic transformation at the super-station.

The efficiency of electricity in use for domestic and industrial purposes such as electric heating of rooms, electric heating and boiling water, and industrial metal heating and melting is estimated by me as 59 per cent. The consumer thus uses in his apparatus $11.7\times0.59=6.9$ per cent. of the heat units consumed at the generating station.

For equal heat actually applied to the work, gas thus returns 18.3 per cent. of the heat of production, distribution, and use, while electricity only returns 6.9 per cent. For equal heat work electricity thus consumes 2.65 times the coal of the country to do the same work. How would this fact effect the conclusions of the committee report?

Assume for the purpose of testing the matter that the super-stations are in being—generating and distributing by electricity the whole of the power estimated as in present use—then the total coal consumption per annum will be 18.8

* "James Forrest" Lecture read before the Institution of Civil Engineers. Abstract.

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million tons at 1.56 lb. of coal per E.H.P.-hour. The old consumption under the present system of industrial and not collective power generation would be, as I have shown, 48.7 million tons; the saving shown is thus 29.9 million tons. This assumes all private power installations and nearly all existing generating stations to be abolished and replaced by the new super-stations.

Assume now that gasworks in existence use 18.8 million tons of coal to generate heat at 46 per cent. efficiency of production and 18.3 per cent. efficiency of production, distribution, and use. The total fuel consumption between power by electricity and heat by coal-gas will be $18.8\times2=37.6$ million tons. The total coal consumed for the combined supply of power and heat by way of electrical generation would be $18.8+49.8=68.6$ million tons, and the loss by adopting electricity for heating is 31 million tons per annum.

If then the ideas of the committee be carried out as to the supply of electricity for heating, cooking, and industrial metal melting and treating, as well as for power, the whole assumed saving on power will be lost, and 68.6 millions of coal per annum will be consumed instead of 67.5.

In my opinion, on the facts which I have shown, the super-stations will not justify their existence. The Government scheme is wrong, and the sweeping conclusions arrived at by the Coal Conservation Committee are unjustifiable. There is no possiblity of saving 55 million tons per annum of the fuel of the country by carrying out the full scheme. Small fuel savings are possible by limiting the use of electricity to light and power. In so far as electricity displaces gas for heating purposes, in so far would the coal consumption of the country be increased.

In considering a general scheme of fuel saving for the United Kingdom, it is necessary to take a broader view than has been done by the Government Committees. Not only should the efficiency for motive power be considered, but the whole heating systems of the country should be dealt with in order to obtain a combined efficiency of heating, lighting, and motive power.

In 1917 the gas industry carbonised 20 million tons of coal, and the heat of 10.8 million tons was used to produce and distribute the coal-gas utilised in the United Kingdom, while the heat of 9.2 million tons remained available for use in the form of solid coke and semi-liquid tar and oil.

Great changes are now in operation throughout the gas industry due to the adoption of the thermal-unit standard for sale and the passing away of the intrinsic illumination standards so long adopted. These changes allow of greatly improved thermal efficiencies of production and distribution. In a few years the majority of gasworks will deliver to the consumer in the form of gas 75 per cent. of the whole heat of the coal used, and the improvements in gas apparatus, construction, and design are so great that the efficiency of use of the gas will rise from 42 per cent. to 55 per cent.

The effect of these two changes will cause the consumption of coal to be reduced from 10.8 million tons per annum to 4.8 million tons giving the same service of heat, light, and power, as at present. If, however, the use of gas expands at its present rate a double service could be given on 9.6 million tons. If we retain the same service we save 6 million tons per annum on the gas industry alone.

I have shown that gas will shortly be produced and distributed at 75 per cent. and used at 55 per cent .thermal efficiency for general domestic purposes. That is, the ultimate efficiency from coal consumed at the gasworks to heat utilised by the consumer is $0.75\times0.55=0.41$. From this it is evident that at the new higher efficiencies of gas it will economise the country's fuel resources to introduce gas to all households instead of coal for all purposes where coal is at present burned. On the assumption of complete displacement of coal in households by gas, instead of using 35 million tons we should only use 17.5 million tons. We save 17.5 million tons on this item. Further savings will be made by the rapidly increasing use of gas for industrial purposes. Savings of 4 million tons out of the 20 millions estimated to be used for raising steam for heating purposes, and 4.4 million tons out of the 17 millions used by collieries for motive power, can be effected by improved methods of working.

I welcome the progress of electricity as shown from the Coal Controller's returns. Electricity is doing good work in the conservation of coal. The average consumption per B.H.P. for the whole country I estimate at 4 lb. of coal, but the electrical generation of the country has reached the lower figure of 2.6 lb. per B.H.P.-hour; it has become as economical of fuel as the textile industries. The purpose of reducing it still further to 1.5 lb. and even 1 lb. is good and commendable, but the Coal Conservation Committee Report advocates a line of advance which follows the direction of "colossal" standardisation so characteristic of German ideas and development which ultimately brought that country to ruin when pitted against the organised individualism of the British Empire.

The notion of the great gain to be expected from very large steam turbines is quite erroneous. Even with the most modern plant which can be built an increase in power from 10,000 kilowatts to 100,000 kilowatts only reduces the steam consumption per kilowatt-hour from 9 lb. to 8.5.

Of the whole 421 stations examined by Mr. Wilson, the most economical station is one with an annual output of 40 million Board of Trade units. The efficiency is 13.05 per cent. In the actual examples dealt with by Mr. Wilson, a rise in size of station from 0.2 to over 40 million units per annum only increases the thermal efficiency roughly from 11 per cent. to 13 per cent.

The town gas industry at present supplies about 4[illegible]0 B.H.P. of gas engines, or about 1,344 million H.P.-hours per annum, at the efficiency of 25 per cent. of the heat of the gas transformed into B.H.P., and 10.9 per cent. referred to the coal consumed at the gasworks. Electricity gives 6[illegible] per cent. But with the higher gas-producing and distribution efficiencies referred to, the gas of the near future would give 18.5 per cent. from gasworks to users' B.H.P.

Electricity at 1.56 lb. coal per E.P.H.-hour, and 90 per cent. efficiency of distribution, gives 10.7 B.H.P. from motor. Gas power has thus the advantage of $18.5/10.7=1.73$.

Gas power by suction and other producers mainly accounts for over half a million B.H.P. in internal-combustion engines, and here the ultimate thermal efficiency exceeds 20 per cent. This is the highest figure to which the electricians at present aspire. A recent examination by me of the limits of thermal efficiency of gas and oil engines, shows conclusively that 45 per cent. B.H.P. may be obtained in the near future. Sir Charles Parsons at the same time prepared an estimate of the limiting efficiency of the steam turbine as 28 per cent.

Obviously the use of the internal-combustion engine will have a great effect in future in increasing the power and reducing the fuel consumption required for motive power, and this without requiring any departure from the individual generation of motive power in small units up to 3,000 H.P. The great advantage of gas power is that small units such as even 50 B.H.P. give efficiencies quite as high as that of the larger units of gas and super-units of electricity.

So far small gas power driving for factories, whether by shaft and belt drive, or electric drive from a private works central station, has been superior in thermal and cost efficiency as compared with any public supply from great central electricity generating stations. The extension of the small power units, so long as it progresses in free competition with best electricity distribution, tends to reduce the fuel consumption and conserve the fuel resources of the country.

In factories large quantities of steam are used for many manufacturing and chemical operations. In some cases the steam so used is the exhaust from steam engines, and in such cases the more economical plan for obtaining the maximum general thermal efficiency within the works consists in discharging the exhaust steam from the engine at a pressure slightly above atmosphere, so that its temperature for the purpose of heat supply or chemical action is above 212 deg. F.

Although the engine does not show the maximum thermal efficiency, the combination of engine and heat-producing by steam gives extremely high thermal efficiencies.

To make use of this combined system in using steam engines, however, it is necessary to dispense with condensation of the steam and the power obtained by working at pressures below atmosphere. In the case of the steam turbine, the very high efficiency of 19 per cent. is obtained by the use of high expansions and low pressure in a condenser. In great central stations, turbine driven, the combined system therefore requires the discharge of the steam from the turbine above atmospheric pressure and therefore the limitation of thermal efficiency of the turbine to about 10 per cent. instead of 19. If the whole of the discharged heat, however, is required for, say, domestic heating in a city, then the combined efficiency will be very high.

The internal-combustion engine differs from the steam turbine in this, that the thermal efficiency is not disturbed by the use of the exhaust gases for the purpose of heating. It can be more readily applied to the combined system of producing heating and motive power than the steam engine.

If an electricity generating station is to seriously attempt to supply heat as well as light and power, then the only practicable course appears to be the production of a turbine using steam through a limited expansion, so that high-temperature steam becomes available for heat distribution at temperatures about the boiling point of water. The use of such high-pressure steam turbines without vacuum would be very convenient for other reasons. The choice of the position for the central station would be greatly extended, as the enormous quantity of water required for condensation would be entirely dispensed with.

There is another method of obtaining heating from steam, gas or electrical power, which was advocated by Lord Kelvin more than 30 years ago. In virtue of a perfect heat engine being capable of being worked backwards, in the case of a reversed engine working between 16 deg. C. and 36 deg. C., the heat equivalent of the electrical energy put into the engine is about 15½ times the energy put into it. By this device Lord Kelvin considered that with a reversible engine driven by motive power, rooms might be heated and ventilated by the same machine, with an expenditure of heat of 1/15½ of the heat in the air delivered. This is a most interesting and fascinating application of the Carnot cycle. It has never been put into practice to my knowledge, and even assuming only 50 per cent. efficiency of reversed transformation, we should still get nearly eight times the heat equivalent of the power used. Lord Kelvin's proposal would enable electricians to heat rooms to a moderate extent by interposing this machine, and using electricity to produce motive power and indirectly heat air. The difficulties of application are practical, not

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theoretical. In my opinion the practical difficulties can be overcome.

Further great savings of fuel are still possible by the utilisation of the water-power of our country. By this means we could add 3 million H.P. to the work of the country without consuming any additional coal.

From the preceding discussion it will be seen that I do not accept the conclusion of the Coal Conservation Committee that it is desirable to substitute the electric generation and distribution of power, light, and heat, by means of great super-stations, for the existing means of supply, consisting of smaller generating stations, works driven by steam-engines on the premises, turbine or reciprocating, and internal combustion engines supplied by town gas, producer-gas, oil, and tar.

The Coal Conservation Committee are quite wrong in considering that any advantage to conservation can arise from the use of electricity to produce heat by the existing means.

SWISS TRADE STATISTICS.

The following statistics, showing the import and export trade of Switzerland in electrical and allied goods, have been taken from the recently-issued official trade returns relating to the year 1918. The figures for 1917 have been set beside them, and notes added of any increases or decreases.

IMPORTS.

	1917 Frs.	1918 Frs.	Inc. or dec. Frs.
Electric cable, not insulated.—			
From Germany	3,000	—	– 3,000
„ France	4,000	—	– 4,000
„ United States	—	159,000	+ 159,000
Total	7,000	159,000	+ 152,000
Electric cable not lead covered or iron armoured; insulated wire.—			
From Germany	1,000	—	– 1,000
„ United Kingdom	5,000	1,000	– 4,000
„ France	18,000	1,000	– 17,000
„ Italy	3,000	2,000	– 1,000
Total	27,000	4,000	– 23,000
Cable ditto covered with lead and iron armoured.—			
From Germany	—	1,000	+ 1,000
Cable insulated with rubber or paper and covered with textiles.—			
From Germany	1,000	15,000	+ 14,000
„ Italy	81,000	6,000	– 75,000
„ United Kingdom	4,000	40,000	+ 36,000
„ France	6,000	1,000	– 5,000
Total	92,000	62,000	– 30,000
Cable ditto covered with lead.—			
Total	3,000	3,000	—
Dynamo electric machines and electric transformers.—			
From Germany	544,000	174,000	– 370,000
„ France	10,000	40,000	+ 30,000
„ Italy	6,000	5,000	– 1,000
„ United Kingdom	16,000	9,000	– 7,000
„ United States	56,000	106,000	+ 50,000
„ Other countries	9,000	1,000	– 8,000
Total	641,000	335,000	– 306,000
Accumulators, &c. (other).—			
From Germany	32,000	19,000	– 13,000
„ France	68,000	—	– 68,000
Total	100,000	19,000	– 81,000
Electric locomotives.—			
Total	43,500	—	– 43,500
Steam engines, cranes, pumps, turbines, &c.—			
From Germany	133,000	256,000	+ 123,000
„ United Kingdom	—	6,000	+ 6,000
„ United States	25,000	17,000	– 8,000
„ Sweden	18,000	—	– 18,000
„ Other countries	6,000	—	– 6,000
Total	182,000	279,000	+ 97,000
Accumulators, batteries, electrodes in combination with rubber or celluloid.—			
From Germany	8,000	40,000	+ 32,000
„ Italy	20,000	28,000	+ 8,000
„ France	4,000	—	– 4,000
„ United States	12,000	—	– 12,000
„ Other countries	5,000	—	– 5,000
Total	49,000	68,000	+ 19,000
Electric arc lamps.—			
From Germany	21,000	7,000	– 14,000
Electric incandescent lamps, unmounted.—			
From Germany	548,000	14,000	– 534,000
„ Austria Hungary	1,000	7,000	+ 6,000
Total	549,000	21,000	– 528,000
Electric incandescent lamps, mounted.—			
From Germany	3,394,000	3,109,000	– 285,000
„ Austria Hungary	1,109,000	1,173,000	+ 64,000
„ Holland	344,000	447,000	+ 2,000
„ United Kingdom	—	2,000	+ 2,000
„ Other countries	4,000	1,000	– 3,000
Total	4,851,000	4,732,000	– 119,000
Insulators, mounted.—			
From Germany	28,000	205,000	+ 177,000
„ Spain	2,000	—	– 2,000
Total	30,000	205,000	+ 175,000
Electric meters.—			
From Germany	532,000	564,000	+ 32,000
„ France	22,000	29,000	+ 7,000
„ United Kingdom	1,000	—	– 1,000
„ Other countries	19,000	1,000	– 18,000
Total	574,000	594,000	+ 20,000
Telegraph and telephone apparatus.—			
From Germany	276,000	399,000	+ 123,000
„ United Kingdom	4,000	29,000	+ 25,000
„ Sweden	9,000	64,000	+ 55,000
„ France	13,000	46,000	+ 33,000
„ United States	84,000	18,000	– 66,000
„ Other countries	—	5,000	+ 5,000
Total	386,000	561,000	+ 175,000

EXPORTS.

	1917 Frs.	1918 Frs.	Inc. or dec. Frs.
Dynamo electric machines and electric transformers of all kinds.—			
To Germany	4,764,000	3,786,000	– 978,000
„ Austria	1,386,000	1,775,000	+ 389,000
„ France	6,494,000	8,875,000	+2,381,000
„ Italy	838,000	442,000	– 396,000
„ Belgium	54,000	26,000	– 28,000
„ United Kingdom	474,000	238,000	– 236,000
„ Russia	1,190,000	120,000	–1,070,000
„ Spain	2,423,000	5,160,000	+2,737,000
„ British India	100,000	10,000	– 90,000
„ Brazil	534,000	846,000	+ 312,000
„ Argentine	674,000	53,000	– 621,000
„ Netherlands	1,806,000	4,368,000	+2,562,000
„ Norway	165,000	143,000	– 22,000
„ Other countries	815,000	2,400,000	+1,585,000
Total	21,717,000	28,242,000	+6,525,000
Accumulator batteries, electrodes in combination with rubber or celluloid.—			
To Germany	1,000	—	– 1,000
„ France	4,000	2,000	– 2,000
„ Italy	24,000	—	– 24,000
„ United Kingdom	7,000	2,000	– 5,000
„ Spain	5,000	6,000	+ 1,000
„ Other countries	2,000	1,000	– 1,000
Total	43,000	11,000	– 32,000
Accumulators, &c. (other).—			
To France	224,000	135,000	– 89,000
„ Italy	17,000	21,000	+ 4,000
„ United Kingdom	157,000	141,000	– 16,000
„ Greece	49,000	20,000	– 29,000
„ Spain	29,000	7,000	– 22,000
„ Other countries	25,000	13,000	– 12,000
Total	501,000	337,000	– 164,000
Insulators, mounted.—			
TO Germany	6,000	14,000	+ 8,000
„ France	12,000	21,000	+ 9,000
„ Holland	2,000	5,000	+ 3,000
„ Italy	3,000	4,000	+ 4,000
„ Sweden	—	4,000	+ 4,000
„ Argentine	—	3,000	+ 3,000
„ Other countries	12,000	—	– 12,000
Total	35,000	51,000	+ 16,000

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	1917 Frs.	1918 Frs.	Inc. or dec. Frs.
Cable, lead-covered.—			
To Germany	10,000	—	− 10,000
Cable, lead-covered and iron armoured.—			
To Argentine	41,000	—	− 41,000
,, Other countries ...	31,000	1,000	− 30,000
Total	72,000	1,000	− 71,000
Cable not lead-covered or iron armoured, insulated wire.—			
To France	458,000	492,000	+ 34,000
,, Brazil	1,000	—	− 1,000
,, Spain	—	1,000	+ 1,000
,, Other countries ...	3,000	—	− 3,000
Total	462,000	493,000	− 31,000
Cable, insulated with rubber or paper and covered with textiles.—			
To France	52,000	324,000	+ 272,000
,, Italy	15,000	2,000	− 13,000
Total	67,000	326,000	+ 259,000
Electric incandescent lamps, unmounted.—			
To France	—	14,000	+ 14,000
,, Other countries ...	10,000	—	− 10,000
Total	10,000	14,000	+ 4,000
Electric locomotives.—			
Total	165,000	—	− 165,000
Telegraph and telephone apparatus.—			
To France	2,000	15,000	+ 13,000
,, Italy	630,000	54,000	− 576,000
,, Holland	2,000	31,000	+ 29,000
,, Spain	8,000	18,000	+ 10,000
,, Other countries ...	6,000	9,000	+ 3,000
Total	648,000	127,000	− 521,000
Electric incandescent lamps, mounted.—			
To France	891,000	307,000	− 584,000
,, Italy	3,958,000	2,998,000	− 960,000
,, Portugal	106,000	12,000	− 94,000
,, Spain	321,000	66,000	− 255,000
,, Greece	—	121,000	+ 121,000
,, British India ...	—	80,000	+ 80,000
,, Other countries ...	319,000	37,000	− 282,000
Total	5,595,000	3,621,000	−1,974,000
Electric meters.—			
To Germany	129,000	65,000	− 64,000
,, Austria-Hungary ...	80,000	63,000	− 17,000
,, France	438,000	502,000	+ 64,000
,, Italy	1,052,000	963,000	− 89,000
,, United Kingdom ...	112,000	79,000	− 33,000
,, Russia	31,000	—	− 31,000
,, Spain	200,000	623,000	+ 423,000
,, Japan	499,000	612,000	+ 143,000
,, Netherlands ...	111,000	125,000	+ 14,000
,, Other countries ...	474,000	746,000	+ 272,000
Total	3,126,000	3,778,000	+ 652,000
Steam engines, cranes, pumps, turbines, &c.—			
To Germany	2,046,000	2,078,000	+ 32,000
,, France	4,470,000	5,847,000	+1,377,000
,, Belgium	65,000	63,000	− 2,000
,, Russia	1,570,000	40,000	−1,530,000
,, British India ...	4,000	17,000	+ 13,000
,, Japan	408,000	1,118,000	+ 710,000
,, United Kingdom ...	356,000	347,000	− 9,000
,, Spain	199,000	469,000	+ 270,000
,, Other countries ...	2,067,000	1,869,000	− 198,000
Total	11,185,000	11,848,000	+ 663,000

"Operratic" News.—Our acting correspondent informs us that a striking performance was given recently at Southampton, of a new electrical revue, entitled "Who the Ellis Hooper?" The leading rôle was taken by a super who should have been supported by a chorus of Trade Unionists, engaged by the management at great expense. In their endeavours to elucidate the problem in the title, the chorus left the show, even stopping people in trams and factories, and a wave (not sinusoidal) of curiosity and unrest surged throughout the country. Finally, with the assistance of the Town Council and the manager, who took the rôle of a strong man, the chorus returned, not having been entirely successful in their search. Our latest advice is that the show is running well, the chorus now being in perfect step.

CORRESPONDENCE.

Letters received by us after 5 P.M. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

The Decline of Production.

Mr. Annan Bryce, at the Metropolitan-Vickers meeting, raised an important question which has also come up at other meetings.

He stated that production had fallen as a result of shorter hours, despite arguments to the contrary.

This must be due to one of three things: (1) Hours have been reduced below the economical minimum. (2) Deliberate restriction of output on the part of the men. (3) Bad management on the part of employers.

No trade union has as yet been bold enough to openly avow a policy of restricted output. It therefore remains for the employers so to arrange things that output shall not be restricted. This is a difficult thing to do, but experience has shown that it can be done.

The first step is to assign every man as far as possible a definite task each day. The task must be such as can be shown to be well within the man's powers.

More or less elaborate time studies must be undertaken, and shop conditions must be standardised. A man must have no excuse for not doing substantially as much work one day as another.

Few workmen know themselves how much work they can do under right conditions—still less their employers.

The root cause of restricted output seems to be the idea of soaking up the unemployed, and there is a measure of truth in it.

The fallacy involved can easily be exposed, but the best argument is to remove the bad industrial conditions which foster such ideas.

John S. Rann.

Northampton Polytechnic,
London, E.C.
April 27th, 1920.

Battery Symbols.

Having examined recently a number of English, French, American, and German wiring diagrams, I find that some represent a battery thus: + ▮ | ▮ | ▮ | —, and others thus: + | ▮ | ▮ | ▮ —.

Again, I find that all English writers are not agreed on this point; that is, some show a long thin line positive and others a short thick line positive. Could any of your readers inform me which is absolutely correct?

It is very confusing when a drawing is not marked with either plus or minus signs. I have always been taught that long thin is positive, and short thick line is negative.

W. S. Brett.

East Ham.
April 26th, 1920.

[The correct form is a long thin line for positive and a short thick line for negative.—Eds. Elec. Rev.]

Illicit Commissions.

We recently sent you for publication a letter we received from a so-called electrical engineer inviting us to join him in robbing his employer.

We went to some trouble in ascertaining who were the employers of the rogue in question, and sent the firm all the information we had, and the episode has apparently ended with the following letter. We did not deal with the employé, and certainly will not deal with employers.

The Cantie Switch Co., Ltd.

Nottingham.
April 28th, 1920.

[Copy.]

Walsall, April 24th.

The Cantie Switch Co., Ltd.

Gentlemen,—We beg to acknowledge receipt of your favour of the 23rd inst., and thank you for the information contained therein.

We shall be glad if you will send us a list of your switches showing us the different types which you manufacture, as if they are suited to our purpose we shall be glad to ask you to quote when we are in the market.

We quite understand that you could not send us the letter in question, neither do we want to see it, as we are quite satisfied with the copy you have submitted to us.

We do not, of course, know what further action you will take in the matter, but whatever you do we leave it entirely in your hands.

We ourselves shall not mention the matter to Blank unless you ask us to do so.

(Signed by a director of a supposed respectable firm).

[On the previous occasion we expressed our view regarding this incident. We understand that, since the publication of the letters, Walsall has been in more or less of a ferment. Obviously, however, the employers of Mr. Blank are not an electrical firm.—Eds. Elec. Rev.]

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Wiring Small Houses.

In your issue of April 9th there appeared extracts from a paper read, I believe, at a meeting of the I.E.E., in which some figures were given regarding the cost of wiring workmen's houses. I do not know where the writer got his figures nor have I the plans of the houses referred to before me, but I feel confident in saying that the figures are too high. For a house of nine points in screwed tube £19 13s. 8d. is quoted. This works out at £2 3s. 9d. per point. Being estimator and supervisor of wiring contracts for a firm of electrical engineers, I was naturally interested in these figures, and accordingly paid a visit to the much-discussed houses at present being erected on Wormwood Scrubbs.

The house for the wiring of which I gave an estimate consisted of living room, scullery, bathroom, and three bedrooms, and would require the installation of seven points.

Incidentally, I may mention that these houses are apparently not to be electrically lighted as they have already been tubed for gas.

My method of tubing this house would be the American method, in which no tees or elbows are used, and no boxes of any description located under the floors. The tubing is simply looped from point to point. The wiring would not be looped in the usual English way, but connectors used at the ceiling outlets. With this method of loop tubing a very high speed can be attained.

I have worked on large jobs in America, where the minimum permissible output of ½-in. tube corresponding to English ¾-in. was five hundred feet per day for a wireman and mate.

The wiring would not be done until all plastering, &c., was finished, and as the tubing would be run in such a way that there would be only two wires in each tube the wiring becomes a very simple matter indeed.

All tubes from ceiling points to switches could, if desired, be of ½-in., which would do away with any necessity to sink them into the brick walls, as the plaster work even in this type of house is quite thick enough to effectively conceal a ½-in. tube.

I find that the actual *cost* of wiring these seven points and supplying and installing plain pendants, all necessary switches, fuses, &c., would be £8. If we allow the contractor a profit of £2 10s. per house the price would be £10 10s. for the job, or £1 10s. per point. Where a large number of houses were going up in the same locality a proper standardisation of methods employed would considerably reduce this figure.

Archibald J. Inch.

London, N.W.
May 2nd, 1920.

City of York Advertisements.

What are we coming to? In your issue of the 20th ult., I see that the engineer and manager to the City of York electricity department (J. W. Hame) is advertising for a mains superintendent at a salary of £228 per annum; in the next paragraph he wants a cable jointer at 1s. 10½d. per hour for a 47-hour week.

If intending applicants for the super's post take the trouble to work out the weekly remuneration for each they will find that the super will receive one whole sixpence a week more than the jointer, who will, presumably, be under him. The jointer only has to work half an hour overtime to receive more money than his super.

Moreover, under a recent award the jointer will be due for another 3s. per week in about a month; he will then receive 2s. 6d. more for a normal week than his super.

What a grand inducement for young men to take up the study of the higher branches of our profession!

If ever a man deserves to be let down by his staff, an engineer who can do such things as the above is surely that man.

Fed Up.

May 3rd, 1920.

I would draw your attention to an advertisement which appeared in the last issue of your journal, and am sure that it was with regret that you inserted it.

Mr. J. W. Hame, city electrical engineer of York, wants a mains superintendent, experienced not only in H.T., A.C., and L.T. D.C. cables, but also in the construction and maintenance of overhead transmission lines, and for this experience he is prepared to pay £90 per annum, plus the E.P.E.A. awards.

Mr. Hame takes the trouble to point out that at the end of four years of presumably satisfactory service, this sum would be increased by a further £42 per annum, but I am sure that what is of more interest to your readers is not what is to happen to the successful candidate in 1924, but whether the Corporation would bury his remains (there would not be much—just the bones and perhaps a little skin still attached to them), or whether the sorrowing widow would have to do that out of his savings. Further, we would like to know what happened to the previous occupant of that lucrative position, and how many the job uses up in a twelvemonth. They must have a pretty short life, else Mr. Hame would not make such extravagant promises to those who survive a year; just fancy another fourpence a day extra—it's worth taking a little stimulant to try and keep alive for that.

Mr. Hame and the Corporation of York are members of the I.M.E.A. Does that body approve of such starvation wages? and if it does not approve, has it the courage to protest to its members who are bringing it into discredit, and point out that they are not only a danger to the industry, but a disgrace to their Association?

If there were some plain speaking when required we might get a healthy public opinion formed. Besides, it is bad from a business point of view, because basic rates are being fixed for that grade, and it would pay the Corporation better to advertise at a figure that would get it a qualified man than to take on a man who only values himself at £90, and be forced to pay him wages for a good man in a short time.

What have the Associated Municipal Electrical Engineers to say to this? They are trying to get their own salaries put on a proper basis as at present they are only being paid from two to three times the salary of their deputies. Electrical engineers are not a superstitious race, but I would remind them of that legend of Ancient Greece which likens retribution to a bloodhound from which there can be no escape, and which, sooner or later, inevitably overtakes the culprit and those associated with him.

That story appears in one form or other in the literature of every nation, and is evidently the universal experience of mankind.

"As you have measured so shall it be measured to you again," is one of the few passages of the Bible, the truth of which the critics do not challenge.

John H. Parker.

Electricity Works, Croydon.
May 3rd, 1920.

I trust you will allow me a little space to comment on your "Situations Vacant" in the current issue.

The engineer to the City of York electricity department is advertising for a mains superintendent and a cable jointer, and is prepared to pay 6d. a week more to the superintendent than to the jointer provided that no overtime is worked, when the latter will, of course, draw more pay than the former. Presumably also the jointer will receive 3s. more per week at the end of May, and will then draw more money than his superintendent.

Many of us entered this profession with boundless enthusiasm. We spent our spare cash in purchasing technical books and our spare time in attending classes. We are beginning to realise that we were wasting our time. A professional footballer or a window-cleaner is far better off than a technical man.

Personally, I intend to use whatever influence I have in dissuading young fellows from entering this profession, and hope that in this way the short-sighted action of such employers will meet with its due reward.

Disgusted.

Fault Localisation.

Two single 7/14 V.I.R. cables, each 100 yd. long, are laid in glazed troughing, run in with pitch, and capped with tiles. On one of these cables a high-resistance break develops, due to water getting through the pitch, and eating away the copper strands.

The "megger" tests from each end are as follows: 60,000 ohms between each cable and between each cable and earth. The only voltage available is 100 v., and this will not break the fault down to E. There is continuity, through each cable, but on one the continuity is only due to copper sulphate between the two ends of the break. This acts as a condenser, with an amount of capacity.

Kindly state a quick and correct method of localisation.

April 26th, 1920. **Kon. Denser.**

Rist v. Vulco Magneto Co. and Another.

Our attention has been called to the report of this case, which appears in your issue of April 23rd, 1920, and we would like to make a correction to the last paragraph, which, through no fault of your own reporter, does not accurately represent the facts.

The facts are that "the defendants have agreed to deliver the 90 magnetos to the plaintiff as to 30 on the 15th May promptly, as to 30 on the 15th June promptly, and as to 30 on the 15th July promptly, and that an independent expert nominated by the secretary of the British Electrical Ignition Co., Ltd., shall inspect them and report the sum required to be expended to complete them as second-hand magnetos, such examination to take place at Long Acre on the dates mentioned in the presence of one representative from each side. Ordered that the action stand adjourned until a day before the Long Vacation to be arranged."

Kilner, Kilner & Co.,
Solicitors for the Plaintiff.

London, E.C., *April 29th*, 1920.

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The I.E.E. Council Election.

There has been in the past some considerable criticism upon the purely metropolitan character of the Council of the Institution, and it is interesting to note that of the Council's new nominations for the forthcoming election, apparently nine out of the twelve gentlemen mentioned live in or near London.

A point often raised in connection with the nomination of provincial members is the question of the expense of attending the Council meetings. Fortunately, in many cases, those provincial members who have served on the Council have had business necessitating their frequent attendance in London, but it is obviously unfair that, failing such, the provincial members of the Council should be asked to bear the heavy personal expense involved by the proper discharge of their duties on behalf of the Institution.

One can quite understand that this question of expense restricts the choice of representatives to those members who live in or near London, but the general body of members will, no doubt, agree that wider representation is essential to the well-being of the Institution, and therefore that the expenses of the members of Council attending Council and committee meetings should be paid by the Institution as is already done in the case of the chairmen of the territorial centres.

Members of the Institution will note that for the present election outside nominations have been sent in in favour of at least two provincial members, neither of whom require any introduction to the members. Both have had previous experience on the Council as chairmen of territorial centres, and have the welfare of the Institution and the profession generally at heart, and are real live men.

It is perhaps unfortunate that only a week elapses between the sending out of the ballot papers and the last day for their return.

R. M. Longman.

Middlesbrough.
May 3rd, 1920.

BUSINESS NOTES.

Automobile Head-lamps.—In the *Autocar* of March 27th an account was given of the demonstration organised by MESSRS. C. A. VANDERVELL & CO., LTD., at Oxshott Woods, where a variety of anti-dazzle devices were tested. It is stated that no device was wholly satisfactory, but most of them effected an improvement. Amongst the more successful were the Salsbury, Liberty, and Osgood lamps.

Inquiry from Nova Scotia.—H.M. Senior Trade Commissioner in Canada (Capt. E. J. Elwards) has been notified by a company in Nova Scotia that they are desirous of entering into communication with United Kingdom firms who are in a position to give reasonably early delivery of galvanised telephone and telegraph wire, and also of galvanised and leaded steel strand wire. The material has to conform to the specifications which have been received by the D.O.T. in London, and firms interested in the matter should apply to the Department of Overseas Trade.

Nitrates from the Air.—*The Times* states that the extensive site at Billingham-on-Tees, in County Durham, which the Government acquired over two years ago for the purpose of building a nitrogen factory, has been purchased by a syndicate comprising Messrs. Brunner, Mond & Co., Ltd., and Explosives Trades, Ltd., for the manufacture of ammonia from the nitrogen of the air, the capital required being about 5 millions sterling. The Haber principle will be adopted, which employs a non-electrical process.

Catalogues Wanted in India.—H.M. Trade Commissioner in India desires to receive from United Kingdom manufacturers additional copies of their catalogues for filing in his office library, where they can be consulted by prospective buyers. These should be sent in duplicate addressed to H.M. Trade Commissioner in India, Post Box 683, Allahabad Bank Buildings, 6, Royal Exchange Place, Calcutta, India.—*Board of Trade Journal.*

Catalogues Wanted at Kuala Lumpur.—The Government Electrical Engineer, Kuala Lumpur, Federated Malay States, will be glad to receive lists of electric lifts, washing machines, irons, vacuum cleaners, and fittings suitable for a large hospital; also of current limiters of small sizes.

Catalogues for Asia Minor.—Arrangements have been made by Captain Perring, the British High Commissioner's representative at Samsoun, with the local manager of the Imperial Ottoman Bank for British trade catalogues and literature to be exhibited in the offices of the bank, where they will be available for reference by the trading communities. Similar arrangements are also in course of negotiation at other centres in Asia Minor. British firms are invited to forward copies of their catalogues, &c., direct to the British Control Officer, Samsoun, Asia Minor. Catalogues should preferably be printed in either the French, Greek, or Turkish languages.

Industrial Administration.—The Institute of Industrial Administration, of 110, Victoria Street, S.W. 1, held its first general meeting at the Central Hall, Westminster, on Tuesday last week, 150 members attending. The Hon. Secretary announced very wide support from both London and the Provinces, and also a promise by Lord Haldane to address the members on the subject of administration. A strong Provisional Committee was appointed, representing many branches of industry. As an immediate step in the work of the Institute, a series of lectures on "The Organisation of Payment by Results" is being given at the Central Hall, Westminster; the series commenced yesterday (Thursday).

A Dutch Company.—The report for 1919 of the N. V. Hazemeyer Fabriek ven Electrische Apparaten of Hengelo, states that special attention still had to be paid to the acquisition of raw materials, although it was possible to complete the stocks, so that no serious stoppage of manufacturing was experienced. The net profits amount to 131,000 fl., and a dividend at the rate of 11 per cent. is proposed on the ordinary shares, and 6½ per cent. on the cumulative preference shares.

Swimming Club.—Glasgow Corporation Electricity Department has started a swimming club. Large attendances have been recorded at the opening practices.

Lead.—In their report dated May 1st, MESSRS. G. CAWSON & CO. say:—

> The position generally seems to be deteriorating, and lead is more plentiful than ever. There is lead in the River still unsold. . . . Stocks of actual lead are larger than at any time known, except at the time of the close of war. Mexico continues to send lead regularly. If France has lead sent in direct from producing countries, she will require less from England. America and other countries are sending us considerable quantities of lead products, which naturally interferes with the consumption of our own producers. We calculate the stock of lead available in the country at present at 40,000 to 50,000 tons, of which 20,000 to 25,000 tons are held by the Government, and probably some 20,000 tons are stored and held privately. Considering that in pre-war days the stock never exceeded 4,000 to 5,000 tons as maximum, there is ample margin for any increase in consumption. Consumption, however, seems to be on the decline, which is quite natural with the present unsettled state of finances and labour.

The Times of May 3rd stated that at a big mass meeting at Broken Hill (Australia) the miners unanimously resolved to continue the strike until a 36-hour week had been granted.

Electrical Machinery in S.A. Mines.—The following particulars are extracted from the S.A. Mines Department return of electrical machinery imported during 1919:—

Electric generators and engines driving same if directly driven...	£3,479
Electric hoists, including motors...	31,639
Electric locomotives	13,440
Electric motors driving pumps, including pumps if directly driven	27,582
Electric motors not included above	19.285
Power lines, transformers, &c.	88,392
Electric bells, telephones, and other fixtures ...	36,529
Miscellaneous machinery not particularised above	37,132
Electrical machinery spares	86,176
	£343,654

Electrical machinery manufactured in South Africa, £8,421 (including £6,430 electrical machinery spares).

British Magnetos.—In the international motor-boat races at Monaco, successes were achieved by the Sunbeam engine in the Cruiser Class from Lyons to Monaco, in the 21-Footer Class for the Championship of the British Motor-Boat Club, and in the Championship of the Sea. An important part was played by the British magneto; in the first-mentioned event a speed of 70 miles per hour was accomplished—a severe test for any magneto.

Electrical Vehicles in Sweden.—The directors of the A.B. Atlas-Diesel, reporting on the year 1919, mention that they have formed in conjunction with the Asea (Allmanna Svenska Elektriska A.B.) a company for the sale of the Diesel electric motor vehicles, with a share capital of 225,000 kroner.

Dissolutions and Liquidations.—ELECTRIC AND GENERAL WORKS, LTD.—Winding up voluntarily. Liquidator, Mr. F. H. Christlieb, 36, King Street, Cheapside, E.C. Meeting of creditors, May 17th, at King Street. Claims to be sent to the liquidator by June 30th.

VAUGHAN ENGINEERING WORKS, LTD., 22, Cross Street, Islington, London.—Liquidator (Mr. H. de V. Brougham) released April 26th.

WAKERLEY & WEBB, Electrical Contractors, 266, Witton Road, Aston, Birmingham.—Messrs. J. Wakerley and W. A. Webb (the younger), have dissolved partnership. Mr. Webb will attend to debts and continue the business under the same style and the same address.

Strike Threat.—The electrical power station men of the Lancashire and Yorkshire Railway, Mersey Railway, and Overhead Railway employed at Formby, near Liverpool, threaten that, unless their grievances are settled by May 15th, they will take drastic action. At a meeting they held, they complained of being left out of the recent engineering award and the railway shopmen's award, and said that the time had come when they should be paid on a level with other skilled workers. The conditions affecting power stations are supposed to have been the subject of negotiation for the last 18 months, and the men express their impatience at the delay in dealing with their claims.

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Bankruptcy Proceedings.—Bernard Pordes, 18-22, Christopher Street, E.C., trading as the United Electrical Manufacturers Co.—Creditors met at the London Bankruptcy Court on April 29th, under this receiving order. The proceedings were instituted by S. G. Bailey & Co., Ltd. It appeared from the debtor's statements that he had dealt chiefly in electric novelties, including electric pocket lamps. During 1917 and 1918 he was supplied—though he did not discover it till later—with defective chemicals for the batteries, with the result that batteries were returned to the value of some thousands of pounds. He estimated his loss at something like £8,000. Subsequently, with a view to raising capital, he formed the Unelma Co., Ltd., to which he transferred his business, and of which he became managing director. On April 15th a receiver was appointed in the interest of the debenture-holders. No statement of affairs was filed, but the debtor estimated his liabilities at £5,601, whilst the assets comprised a surplus of £150 from securities held by creditors, and £447 due from the Unelma Co., Ltd. In the absence of any offer, Mr. E. H. Hawkins, chartered accountant, 4, Charterhouse Square, E.C., was elected trustee to administer the estate in bankruptcy.

A. E. Channon, H. S. Naden, and C. G. Channon (A. E. Channon & Co., electrical engineers), 8, Orrisdale Terrace and 425, High Street, Cheltenham.—Receiving order made April 26th, on debtors' own petition. First meeting May 14th. Public examination May 27th.

Frederick Mitchell, electrical engineer (trading with John Mitchell as Fred Mitchell & Co), 97, Stockport Road, Ardwick, Manchester, and 58, Ashton Old Road, Openshaw, Manchester.—This debtor applied for his discharge from bankruptcy on April 27th, at the Court House, Quay Street, Manchester. The receiving order was made in March, 1913, on the partnership debtor's own petition, with liabilities amounting to £215 and assets which realised £6 0s. 9d. No dividend had been paid, or could be paid, to the partnership creditors. The separate estate of Frederick Mitchell realised 5s. 6d in the £ to the debtor's unsecured creditors. The Official Receiver stated that the debtor commenced business while a minor. In 1905 he purchased the business of his employers, which was being carried on in Stockport Road, Ardwick, Manchester. The firm's apparent success led the debtor to embark on work beyond his capacity; material and labour were locked up in contracts for which the firm was not paid, or only paid under pressure, with the result that it could not, in turn, pay its own merchants. The Official Receiver had no criticism to make on the debtor, except his lack of judgment in selecting customers. It was obvious, he said, that if the debtor's firms' debtors had paid their debts the business would not have been in financial difficulties. His Honour, Judge Mellor, granted the discharge, subject to two years' suspension.

Auction Sale.—By direction of the Disposals Board Ministry of Munitions Messrs. J. T. Skelding & Co. will sell by auction on June 9th and following days, and June 14th and following days at the Royal Arsenal and Dockyard, Woolwich, the electric equipment and stores comprising electric motors, generators, converters, cable and wire, telephone and telegraph instruments, lamps, &c. For particulars see our advertisement pages to-day.

Spreading the Light.—If you want to preach a sermon, it is necessary not only to have the light within you, but to preach it from the proper place. Unless the sermon be delivered from the Mount, it will not be heard by the great audience to whom it is intended to be addressed. The "Talks with Workers," which were originally published in *The Times* Trade Supplement, would, we think, have been surer of a popular audience, of getting home to those for whom they were meant, if they had been published in the *Daily Mail* or the *Evening News*. However, 38 of the talks—mainly, we understand, due to Mr. G. W. Gough—have now been collected together into the form of a handy little book, which will slip into the pocket, and published by Sir Isaac Pitman & Sons, Ltd., at the modest price of 2s. They are written in language that can be understood by all, but they are free from objectionable "talking down," a defect for which we have examined them closely, and with a hostile prejudice. Although it is made plain that the workers referred to are the manual workers, there is much in the talks that is well worthy of the careful attention of the trained brain-worker whose function is, broadly speaking, management, as well as of employers and members of boards of directors. The explanations of what capital really is, what it does, what money is, what banks do, and how credit works, are clear and in the main well illustrated; and it is precisely about these things—which every business man, whether he be engaged as most of our readers are, in some branch of electrical engineering, or in drapery or stockbroking, comes up against daily—that so much really lamentable ignorance and misconception exists. But it is a great pity that the functions of management are almost without exception, ascribed to the "bosses" (p. 54), or to the "governor" (p. 82). Selling, in the first-mentioned case, and the organisation of mass production in the second, are the function of, and in the main due to, co-workers with those Mr. Gough and his colleagues have in mind—men and women who work hard for their living, and who sometimes, because of their lack of the organisation which the manual workers have brought to such a state of advancement, have to put up with very unfair conditions.

Some of the illustrations are not very logical, and that on p. 49, drawing a comparison between too many wagons and too many currency notes, is singularly inept. The argument on p. 89 seems to prove the exact opposite of what it sets out to make clear. It starts by saying: "Cease to get wages and you cease to be free," and, if we read it rightly, concludes by finding that both wage-earning and wage-paying are conditions of servitude. We hope it is not true that neither employers nor employed are thinking of serving society, "and no sensible person wants them to" (p. 83). It was precisely because the Building Trades' Parliament set out for national service that we said bigger ideas had gone to its making than had gone to Whitley Councils.

Moreover, "ca' canny" is not indulged in for the reason given on p. 117—that the worker cannot make an extra shilling without putting an extra penny or so into the governor's pocket—but because of the fear, only too well-grounded hitherto, that the governor will cut the rate to sixpence.

We hope the book will be widely circulated, and that it may be helpful in spreading sounder ideas on the subjects with which it deals.

Inquiry into the Prices of Light Castings.—The Board of Trade announce that a Light Castings Sectional Committee has been appointed under the Profiteering Act to ascertain to what extent supplies, prices, and costs of light castings in this country are affected by trade combinations; and, further, to ascertain to what extent the manufacture of light castings is affected by trade combinations. The Sectional Committee would be glad to receive communications from any persons or firms who consider that their operations, output, or prices have been affected by any combination, either of manufacturers, merchants, or tradesmen. Such statements or offers to give evidence should be sent to the Secretary, Central Committee, 54, Victoria Street, London, S.W. 1.—*Times*.

Belgian Glassware Industry.—The *Economic Review* quotes the *Echo de la Bourse* of April 8th to the effect that the Belgian glassware industry is at present one of the most flourishing branches of industry. It was at first feared that the Japanese, who only pay their workmen 3.50 fr. per diem, had, during the war, captured all the Eastern markets, but this fear has proved unfounded. Former customers are again giving large orders for Belgian wares on account of their superior quality. About 6,000 workers, including 1,200 women, are engaged in the manufacture of every description of glassware. Salaries and wages have much increased since 1914, and are as follows:—

	1914. Fr.	1918. Fr.
	Per month.	
Blowers	195	595
Spinners	150	480
Lifters	250	400
	Per day.	
Cutters	1.60	4.50
Firemen	1.80	4.50
Trimmers	3	11
Skilled labourers	4	10
Packers	4	13.50
Cashiers	4	16
Engravers	12 to 15	25 to 30

The women's wages have been raised from 1.30 fr. and 2.40 fr. per day to amounts ranging from 4.20 fr. to 6.05 fr. per day.

German Socialisation Schemes.—The Socialisation of coal and iron was the subject of discussion in the German Economic Congress on March 31st. According to *Deut. Allg. Ztg.* (quoted in the *Economic Review*) the report of Herr Horten, Assessor of Mines, for many years director at Thyssen's, attributed the negative results of all socialisation measures up to the present to the want of practical men in the Government and the lack of any fixed programme among the workers. He arrived at the conclusion that socialisation must begin with coal and iron as the basis of all other undertakings, and at first with 10 to 15 per cent. only of the industry. The socialisation of industries dependent on coal and iron before these themselves were socialised was a great danger and the cause of failure. Georg Bernhard objected to the partial schemes of Horten as leading nowhere and advocated entire socialisation.

French Company Notes.—There has been formed at Lille (Rue Sans Pavé 1) a company under the name of Etablissements E. Bouchery et Cie, with a capital of 4,600,000 fr., for the manufacture of wire, cables, and electric accessories.

The balance-sheet presented to the shareholders of the Energie Industrielle, on March 27th, showed a net profit of 1,169,103 fr., and the directors fixed the dividend at 10 per cent. The situation of the branches and the various networks of the company was satisfactory. In the course of the year the company had acquired the network and works of the Société des Forces Motrices du Lac Bleu, as well as the Soustons concession. It had formed during the current year the Société Hydro-electrique du Sud-Est, with the object of equipping three waterfalls—the first on the Lot river, the second on the Surenne, and the third on the Roya; the last is shortly about to be harnessed, and will have a capacity of 7,000 H.P.

A "White Trade Ship."—According to the *Daily Mail*, British manufacturers are considering a proposal by the Federation of British Industries for sending a "White Trade Ship" to all foreign and Dominion ports as a permanent floating exhibition of British-made goods. If the proposal is adopted, a special ship will be built, and between 500 and 600 manufacturers will take allotments of space for the exhibition of their goods. We read in the same paper that the Department of Overseas Trade arrangements for a travelling exhibition of British-made goods to proceed to the various Colonies, &c., which was to have started on July 24th, have been rendered uncertain owing to difficulties experienced by a number of manufacturers in getting their displays together. It has further been decided to postpone the touring exhibitions to the Far East, South America, and U.S.A., because of the inability of many manufacturers to work off their present commitments.

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Gifts to Aston Technical School.—In connection with the scheme for the development of Aston Technical School (Birmingham), a good deal of assistance has been rendered by Midland manufacturers. The following are among the gifts of apparatus and samples recently received by the principal of the school for use in the classes, viz.:—Reason Manufacturing Co., Ltd., electric meters and indicator; Henley's Telegraph Works, showcase fittings and samples; Electric and Ordnance Accessories Co., Ltd. (Vickers, Ltd.), motor generator, &c., induction motor, and electric fittings; W. & T. Glover, Ltd., cable samples; Attwater and Co., samples of mica fibre, &c.; Ferranti, Ltd., electric meter; Thomson-Bennett Magneto Co., Ltd., magneto, &c.; E.I.C. Magneto Co., Ltd., magneto; Brown & Barlow, Ltd., car carburetter.

Profit-sharing in Italian Industries.—The *Basler Nachrichten* (April 15th) learns from Rome that the Secretary-General of the Italian Manufacturers' Association, Signor Olivetti, has announced that Italian manufacturers are prepared to make various concessions to the workers in the matter of profit-sharing, if only the workers will realise that by striking about trifles they harm themselves more than anyone else. Until production has increased, the manufacturers can make no profits. The workers ought to draw up a regular and final programme of their demands which provides for increased production as well. The Government will decide between the claims of the workers and employers and so put an end to the continual friction which exists.—*Economic Review.*

Book Notices.—"Metals in Aircraft Construction." By W. Hanby. Pp. viii + 112; figs. 56. London: Standard Air Press, Ltd. Price 6s. net.

"The Motor Ship." Vol. I, No. 2. May, 1920. Pp. 28.—In the second issue of this new journal, some remarkable proofs are given of the progress made by the internal-combustion engined vessels during the past month. A full description, with illustrations, is published of the largest motor ship in the world, the *Afrika*, a 13,000-ton 12-knot cargo and passenger vessel. A full report of the operation of standard motor ships over long periods, and a comparison between these ships and corresponding steamers is given, showing that the motor vessel effects a saving of over £200 per day in fuel cost. As an indication of the reliability of motor ships, the log is published of one of these vessels, in which it is proved that in voyages totalling well over 40,000 miles, there was only one involuntary stop of one hour's duration. Another illustrated article of great importance is a description of the highest-powered marine Diesel engine now being built for British standard 11,000-ton ships.

"Institution of Civil Engineers: Abstracts of Papers in Scientific Transactions and Periodicals." New series. No. 3. April, 1920. London: The Institution.

"The Theory and Practice of Lubrication: The 'Germ' Process." Pp. 37. By Henry M. Wells and James E. Southcombe, M.Sc. London: Central House.—Reprinted from the *Journal* of the Society of Chemical Industry, 1920. Also a booklet containing Press notices and criticisms of above paper (24 pp.).

"The Queen's Engineering Works Magazine." No. 17. January, 1920. Pp. 90. Bedford: W. H. Allen, Son & Co.—This well-produced and splendidly-illustrated journal contains a great deal of interesting matter, and includes articles upon "The Coaling of Ships," and "Civil and Commercial Flying."

"Was Switzerland Pro-German?" By S. Croft. Pp. 127. London: Hazell, Watson & Viney, Ltd.

"Industrial Administration: A Series of Lectures." Pp. vii + 203. London: Longmans, Green & Co. Price 7s. 6d.

"*Journal* of the American Institute of Electrical Engineers." Vol. XXXIX, No. 4. April, 1920. New York: The Institute. Price $1.

"Science Abstracts A and B." Vol. XXIII, Part 3. No. 267. March 31st, 1920. London: E. & F. N. Spon, Ltd. Price 2s. 6d. each.

"The English Electric Journal." Vol. I, No. 2. Pp. 34.—The April issue contains an interesting description of the Dick, Kerr Works at Preston, and also an article on the Seewer system of governing high-pressure water turbines.

"The Metropolitan-Vickers Gazette." Vol. V, No. 84. March, 1920. Pp. 23. Price 7d., post free.—This number of the Gazette includes a number of interesting articles, including notes on electrically-driven spinning mills, double-reduction gearing for marine turbines, and an abstract of a paper by Mr. H. Mensforth, C.B.E., &c., on "Some Phases of Works Management."

B.T.H. Operatic Society.—Originally formed in 1911, when an original topical play was performed, this society has continued to progress, and its latest departure is the presentation of "Iolanthe" at the Hippodrome, Rugby, from May 3rd to 8th. The rehearsals of the opera were interrupted by the outbreak of war, but were resumed a short time ago. The "cast" is of full strength, including about 50 members besides the principal characters. A notable feature is the orchestra, which is 26 strong. It is expected that the performance will compare very favourably with those of professional companies, and judging by previous standards ("H.M.S. Pinafore" and "The Mikado"), this would appear to be a certainty. "The Yeomen of the Guard" is to be produced later on in the year.

Electrical Man Charged.—At the Westminster Police Court, on April 28th, Edward Mason, aged 21, described as an electrical engineer, of Holloway, was charged with being concerned in stealing jewellery from a bedroom of a Chelsea residence, where he called to examine the electric light fittings.

The Crystal Palace Exhibition.—On June 9th the King, accompanied by the Queen and the Chief Officers of State, will open at the Crystal Palace the Imperial War Museum, to which is attached the Great Victory Exhibition, a dual enterprise which will tax even the capacity of the Palace, the largest exhibition building in the world. His Majesty's Office of Works has taken the whole of the main floor for Naval, Military, and Aircraft Exhibits. An important section of the Exhibition will be that devoted to the oil exhibits. In addition, the sections comprising electricity, engineering, and gas, will have a commanding interest. The Handel Festival is to be revived on June 22nd, 24th, and 26th, under Sir Frederick Cowen's conductorship, and there are to be nightly displays of Brock's fireworks, as in former days.

Australian Electrical Trade and 44-Hour Week.—The New South Wales branch of the Electrical Trades Union decided in March to submit the following questions to a ballot of the members:—

1. Are you in favour of the hours of labour being reduced to 44 per week, with no Saturday work?
2. Are you prepared, if necessary, to forego four hours' pay per week in order to enforce the principle?
3. In the event of the employers refusing to recognise the 44-hour week, are you in favour of obtaining it by legislation instead of by direct action?
4. Are you prepared to enforce the same by direct action by refusing to work on Saturday morning?—*Sydney Morning Herald.*

Trade Announcements.—MR. P. WILSON SMITH, of Messrs. Albert Lee & Co., will be opening stock rooms showing a comprehensive range of all the firm's specialities, from May 10th to 14th, at the Royal Hotel, Plymouth; from May 19th to 21st, at Queen's Hotel, Cardiff; and from May 31st to June 4th, at the Grand Hotel, Leicester. MR. W. P. KERR will be having stock rooms from May 31st to June 4th, at King's Head Hotel, Sheffield; June 7th to 11th, at the Griffin Hotel, Leeds; from June 14th to 25th, at the Albion Hotel, Manchester; and from June 28th to July 2nd, at the Neptune Hotel, Liverpool.

THE BASTIAN ELECTRIC CO., LTD., announce that its commercial department has been removed to Maymore Works, Wharfdale Road, Tyseley, Birmingham. All communications relating to orders, accounts, &c., will be dealt with there. The offices at 185, Wardour Street, W.1, are being retained as the technical department, and samples of the company's products can be seen there as heretofore. The company has made a special exclusive manufacturing arrangement with Messrs. May & Padmore, Ltd., of Birmingham, whose new large factory, just completed, is equipped with modern plant and tools. New designs of electric fires, flat irons, toasters, ovens, &c., are now in hand, and will be produced shortly for the coming season.

In our "New Companies" section last week, we gave particulars of the registration of the COVENTRY AUTOMATIC TELEPHONES, LTD. The £60,000 capital is in 6½ per cent., income-tax free, preference shares of £1 each. The company has been formed for the purpose of promoting the use of and designing, installing, and equipping automatic telephone exchanges, and manufacturing and supplying machine switching telephone apparatus.

THE ELECTRICAL SUPPLIES (LIVERPOOL), LTD., of North John Street, Liverpool, have a new telephone number—"1493 Bank."

THE COVENTRY ELECTRICAL AND ENGINEERING CO., of 23-24, Hertford Street, Coventry, have been appointed agents there for the Wild-Barfield electric furnaces. They are erecting a demonstration furnace at the address given.

Gas Workers and a Strike.—It is stated that a ballot of members of eight Unions of gas workers is to be taken on the question of a strike to enforce their claim of 10s. per week increase, and other alterations. The members of the National Amalgamated Union of Enginemen, Firemen, Mechanics, Motormen, and Electrical Workers are among the 100,000 concerned.

Catalogues and Lists.—LEEDS ELECTRICAL CONSTRUCTION CO., LTD., Charmouth Street, Leeds.—Three photographically-illustrated leaflets dealing with electric furnaces for heating rivets and carbon and alloy steels.

MESSRS. NEWTON & WRIGHT, LTD., 72, Wigmore Street, W.1.—Catalogue Section 11, with list of current prices for "Simplex" apparatus for dental radiology and hospital-ward work. Illustrated. A brief description of this apparatus was given in the ELECTRICAL REVIEW of March 5th (page 320).

MESSRS. HIGGS BROS., Dynamo Works, Sand Pits, Birmingham.—Monthly Magazine (No. 3, Vol. II). 24 pp. Contains stock list of motors and dynamos, as well as the usual "Hints and Tips."

MESSRS. ISAACSON & BROWN, LTD., 39, Furnival Street, Holborn, E.C. 4.—Priced leaflet of copper earthing clips.

THE GENERAL ELECTRIC CO., LTD., 67, Queen Victoria Street, E.C. 4.—A coloured card advertising "Osram" lamps.

THE LONDON ELECTRIC WIRE CO. AND SMITHS, LTD., Playhouse Yard, Golden Lane, E.C. 1.—Price-list, 1920 (56 pp.), and trade-terms sheet. The latest price-list includes bare copper wire and strip, trolley wire, rubber cable, flexible wires, &c.

NATIONAL X-RAY REFLECTOR CO., 31, West 46th Street, New York, U.S.A.—"Eye Comfort"—a quantity of literature published to aid advocates of good lighting, containing articles upon theatre lighting, measuring the strength of light, industrial lighting, &c. Profusely illustrated by actual photographs.

MESSRS. DAVIDSON & CO., LTD., Sirocco Engineering Works, Belfast.—"Side Talks with Sir Occo, No. 1:—The Intelligent Observer" (16 pp.). A breezily-written discussion on the merits of the "Sirocco Fan."

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The Chancellor and the Excess Profits Tax.—In the House of Commons, last week, the Chancellor of the Exchequer promised to take hard cases into consideration and to hold consultations before deciding what concessions he could make in respect of the 60 per cent. excess profits tax. The Financial Secretary, speaking on his behalf, said that the Finance Bill would contain substantial concessions to small and new businesses. An amendment against the tax was negatived without a division, and another amendment for reducing it from 60 per cent. to 40 per cent. was defeated by 287 votes to 75. The new Corporation tax was approved.

The Chancellor was to receive a deputation from the Federation of British Industries and the Association of British Chambers of Commerce on Wednesday.

Engineers and the Excess Profits Tax.—The *Financier* states that at the annual general meeting of the British Engineers' Association, a resolution was unanimously adopted protesting against the proposed continuance and increase of the excess-profits duty. As an alternative means of raising the required revenue, the meeting supported the proposals submitted by the Federation of British Industries for a flat-rate tax upon business profits of all descriptions, including agriculture.

LIGHTING AND POWER NOTES.

Ammanford.—Purchase of Undertaking.—The Council is arranging to purchase the electricity undertaking from Mr. Herbert, the proprietor. The price agreed upon is £14,375, with a stipulation that Mr. Herbert be allowed to charge 80 per cent. more for electricity supplied during the six months succeeding the expiration, on December 31st last, of a previous agreement.

Australia.—Electricity Tariffs.—The Melbourne *Age* states that the Minister in charge of the Tasmanian Hydro-Electric Department has issued a return setting out that the price of electricity supplied by the Melbourne City Council per unit is 1¾d.; by the Melbourne Electric Supply Co., 2¼d.; by the Sydney City Council, 1½d.; by companies at Geelong, 3d.; at Ballarat, 1½d.; at Adelaide, 2¾d.; Perth, 1¼d., and Brisbane, 3¾d. (first hour, then 1d.), while the Hobart price is 1d., or ½d. for continuous use. The Minister attributes the starting of new industries at Hobart to the supply of the cheapest power in the Commonwealth and to the small number of strikes. While Victoria is not favoured like Tasmania with abundant water power for the generation of electricity, the opening up of the brown coal fields at Morwell will provide a source of cheap electricity.

Blackpool.—Water Supply.—In connection with the future development of the electricity undertaking, the Corporation has appointed a deputation to interview Fylde Water Board, upon which, in the event of the present works being extended, the Corporation will depend for an adequate supply of water for condensing purposes.

Bolton.—New Generator.—The electrical engineer has made arrangements for the purchase of a 6,000-kw. turbo-alternator for immediate delivery and installation at Back-o'-th'-Bank works, to be ready for use during next winter. The traders of the town have asked for preferential rates for shop lighting.

Burnley.—Bulk Supply.—The Town Council has sanctioned an application to the Electricity Commissioners for an order permitting the supply of electricity in bulk to Colne Corporation.

Chester.—Price Increase.—The Electricity Committee proposes the following increases to take effect as from June 25th next: Lighting to be 5½d. per unit; small power consumers to be charged 2½d. per unit for the first 1,000 units; 2¼d. for the next 1,000; 2d. for the third 1,000; 1¾d. for the fourth 1,000; and thereafter 1½d. per unit. Large consumers, £6 per kw. of maximum demand plus ¾d. per unit. These recommendations have been agreed to.

Chesterfield.—Lighting Scheme Abandoned.—Owing to the heavy cost of cables, estimated at £5,528, the Town Council has abandoned the proposal to supply electricity to the houses to be built on the Boythorpe Estate.

Dublin.—Proposed Price Increase.—An application for sanction to increase charges for electricity is being made by the Corporation. The price of energy for private lighting is to be raised by 30 per cent. (the present rate is 7d. per unit). For public lighting, power, and heating purposes the proposed increase is ½d. per unit. A proposal to refer the report back to Committee for further investigation, upon the ground that the charges were already too high, was defeated.

Ellesmere Port.—Power for Docks.—The Commissioners have granted the Mersey Power Co. an order to supply electricity to the Manchester Dry Docks Co., subject to revocation when the Council is able and willing to give a supply on reasonable terms.

Falkirk.—Extensions.—The Town Council is to ask the Scottish Central Electric Power Co. for a further supply of electricity, and is negotiating with the Electricity Commissioners for the installation of additional plant at the power station.

Glasgow.—Opposition to Bill.—The Electricity Committee has in a report to the Parliamentary Bills Committee requested the latter to take the necessary steps to oppose the Electricity Supply Act [Amendment] Bill recently introduced to Parliament, or to make arrangements to safeguard the Corporation's interests.

Ireland.—Coal Shortage.—The coal shortage in all parts of Ireland remains acute, and an all-Ireland conference of merchants, manufacturers and officials of electricity, gas and tramway companies has made urgent representations to the Irish Coal Controller, who has been in consultation with the authorities in London. Lack of shipping is the reason assigned for the shortage.

Leyton.—Loans.—The Urban District Council has applied for loans of £10,000 for mains extensions, and £2,000 for services.

Morley.—Year's Working.—For the first time since the works were established in 1898, the electricity undertaking has made a profit, the amount being nearly £200. Last year there was a loss of £1,758.

New Zealand.—Extensions at Auckland.—The city electrical engineer recommends large extensions, for which it is estimated a sum of £448,450 will be required. These include the installation of one 3,000 and two 5,000-kw. turbo-alternators and the necessary boiler plant. It is also proposed to make one of the present generating stations into a sub-station by the installation of four 1,500-kw. rotary converters. It is stated a saving of £20,000 a year will be effected if the scheme is proceeded with.

Oswaldtwistle.—Electricity Supply.—The Urban District Council has written to the Accrington Corporation asking upon what terms the latter would be prepared to supply electricity in that district for power, lighting and heating, and a meeting is to be held to consider the matter.

Rawtenstall.—Extensions Sanctioned.—The Town Council has been informed that the extension of the Hareholm Works may be proceeded with, and that no inquiry will be necessary. Formal approval will be given by the Commissioners in due course. The borrowing of £116,000, the cost of the extensions, has also been informally sanctioned.

Rothwell.—Electric Lighting Scheme.—An expert has been requested to prepare a scheme for the lighting of the whole of the district by electricity.

Severn Valley.—Linking-up Scheme.—One of the first pieces of work to be undertaken by the Electricity Commissioners under the Electricity (Supply) Act, 1919, is what is known as the Lower Severn Valley scheme. The area includes a wide track of country, and the idea is the linking up of centres of electric power supply with a view to the promotion of economy and the pooling of reserve plant. Objections to the scheme which may be raised by municipal bodies and others, must reach the Ministry of Transport, says *The Times*, by the end of July. It may be pointed out that the proposal has no connection with the scheme known as the Severn Barrage, a projected dam across the river to provide water-power, which is not likely to materialise for the present at least.

South Wales.—Power Company's Bill.—The South Wales Electrical Power Co.'s Bill, which is purely a financial one, recently came before the House of Commons Committee as an unopposed measure. The Bill seeks power to raise additional capital of £500,000 for the purposes of the undertaking by the issue of prior lien debentures, most of which would be taken up by existing consumers in Glamorganshire and Monmouthshire. Explanation of the company's present financial position having been given, the Bill was passed for third reading.—*South Wales Daily News.*

Stoke-on-Trent.—Extensions.—A large scheme of extensions, costing an aggregate of £260,000, is contemplated by the Council; 1,000-kw. turbo-alternators are to be installed in the Burslem and Stoke stations, and a 5,000-kw. turbo-alternator, with the necessary auxiliaries, at the Hanley station.

Walthamstow.—Extensions.—The Electricity Committee has considered the report of the electrical engineer with respect to the extension of the plant at the generating station and sub-station, and recommends that application be made to the Electricity Commissioners for their consent to the installation of the following plant, and that application be made to the Ministry of Health for sanction to the borrowing of the sum of £95,850, made up as follows:—Induced draught plant, £2,500; water-tube boiler, complete with economiser, pipework, &c., £11,500; one 1,000-kw. converter, £7,850; cooling tower, £6,000; 5,000-kw. turbo-alternator, complete with condensing plant, switchgear, &c., £40,000; water-tube boiler, complete with economiser, £11,500; extension to boiler house, £500; cooling tower, £6,000; sub-station: one 1,500-kw. converter, £9,000; buildings and foundations, £1,000.

Worcester.—Distribution of Power.—Although the generating plant is at present able to cope with all demands, it is stated that the distribution system requires attention, and an expenditure of £15,000 is proposed.

Yeovil.—The Minister of Transport has extended until October, 1920, the time of the Yeovil Electric Lighting Order, 1914, for the extension of mains, &c.

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TRAMWAY AND RAILWAY NOTES.

Barrow.—LOSS ON SERVICE.—At a recent Town Council meeting, the chairman of the Tramways Committee said that for the first three months since the Corporation took over the service, the receipts had been £9,857, and expenses £12,310; a deficiency of £2,453. The receipts per car-mile were 16·46d., and the expenses 20·54d., a deficiency of 4·08d.

Bolton.—DEPRECIATION FUND.—The Tramways Committee has decided to increase the contribution to the depreciation fund from 1½d. to 2½d. per car-mile.

Bradford.—STRIKE AVERTED.—A ballot of the tramway employés resulted in a decision in favour of a stoppage on May 1st, but this raised such a storm of public indignation that a second ballot was resorted to, with the result that the motion in favour of a strike was defeated.

PROPOSED FARE INCREASE.—During the past three months there has been a loss on the running of the cars in the city, and the Tramways Committee is seriously considering the desirability of increasing the fares still further. It is stated that an additional £100,000 will be needed if the tramways are to be run on a paying basis.

Bristol.—WOMEN EMPLOYES.—Several cars were damaged in the recent protest of ex-Service men against the continued employment of women upon the tramways. The Tramways Co. states that its attitude towards these men has always been sympathetic, and 1,416 employés have been re-instated upon demobilisation, while their dependents received allowances while the men were with the Forces. Although it is not intended to make the employment of women a permanent arrangement, it is considered that those who have rendered good service are entitled to some consideration.

Continental.—FRANCE.—In spite of the general strike in Paris on May 1st, the "Metro" trains were kept running by volunteers organised by the Union Civique Parisienne. Tramcars and omnibuses were also kept on the roads, and the services were quite as adequate as in ordinary times.

At Marseilles, the chief engineer of the tramway establishment has formulated a new scheme for the linking up of the underground railway lines with those of the suburban tramways. The realisation of the scheme will take from four to five years, and the estimated cost totals as much as 100,000,000 fr., this outlay includes construction of lines, supply of rolling stock, &c.

Doncaster. — WAGES. — The tramway employés are insistent in their demand for an increase of 10s. per week instead of the 5s. already granted. The Doncaster employés are affiliated with the Sheffield Trades Union branch, and it is stated the members of both towns are acting in concert on the question.

Dublin.—TRAMWAY PURCHASE.—A report to the Corporation on the proposed purchase of the United (Electric) Tramways Co.'s interests by the Council, states that the only power of purchase in existence would come into operation on December 31st, 1938, or at the end of any subsequent period of seven years, and that if the Corporation wishes to anticipate this period, it can only do so by promoting a private Bill.

Glasgow.—FARE INCREASE. — The Corporation has decided to add ½d. to all fares on the tramway system. This increase is necessitated chiefly by the increased wages bill which, it is stated, means an increased expenditure of £100,000.

RENEWALS FUND.—The Council has agreed to contribute £700 per mile of route to the renewals fund as during the last period. The renewal of 10 miles of track exceeded the sum reserved last year by £42,606.

Halifax.—STOPPAGE.—Cars were recently stopped for an hour on the Triangle route, in consequence of the breaking of a trolley wire at one of the standards.

Hull.—FARE REVISION.—The Tramways Committee has recommended a revision of fares on the basis of 1½d., in place of the existing 1d., fares, and 2d. instead of 1½d., for the full journey. The accounts for 1919 show a deficit of £8,726, which is to be met out of the reserves. In future no cars are to be run between 2 a.m. and 5 a.m., and the practice of allowing soldiers in uniform to travel for half-fare is to be abolished.

Japan.—TRAMWAY "STRIKE."—The employés of the municipal tramway department of Tokio, in order to enforce their claims for a minimum wage of 5d. per hour, recently resolved on a novel form of "strike." Each driver examined his car for defects, and these being discovered in most cases, as the cars are in a bad state of repair, practically every car was returned to its depôt to be overhauled. The strikers' claim was settled after the first day.

Leeds.—FARES.—A proposal to increase tramway fares to the statutory limit of 1d. per mile was recently rejected by a majority of the Council.

Manchester.—NEW STOCK.—During the present financial period, the Corporation proposes to expend £250,000 on rolling stock, and £100,000 on buildings. The funds for this will be obtained by means of loans.

WAGES AWARD.—After protracted negotiations, the terms of the award by the Lancashire, Cheshire and North Wales District Joint Industrial Council have been accepted by the Manchester and Salford tramway employés. The men are to receive an increase of ½d. per hour on the basic rates, and the total increase will be 8s. per week with an additional 1s. in June. The increase will cost Manchester over £30,000 annually.

Motormen and Conductors' Wages.—Leeds Corporation now pays experienced drivers 67s. 9d. for a 48-hours' week, and in addition provides a uniform, and grants eight days' holiday with pay. At Birmingham motormen are paid 64s. to commence, and 70s. maximum; conductors receive 60s. 6d. minimum, and 67s. maximum. At Sheffield the top rate for motormen with 14 years' service is 69s. 8d. for a 48-hours' week, which includes 4d. per day for a merit badge. The top rate for conductors is 65s. per week. The motormen's minimum is 66s., and that of conductors 60s. per week. For Sunday work, time and a quarter is paid, employés work only on alternate Sundays. Overtime is paid for at the rate of time and a quarter. At Pontypridd motormen receive 68s. At Leicester the present bonus is 34s., in addition to the pre-war rate of 32s. per week.—*Tramway and Railway World.*

Taunton.—ELECTRIC VEHICLE.—We learn from Mr. A. J. Howard, borough electrical engineer, that an Edison 2-ton electric lorry fitted with electrically-operated tipping gear has been delivered to the Corporation, and is to be used for refuse collection and general haulage purposes. A street watering tank, which is interchangeable with the ordinary body, is also being supplied.

TELEGRAPH AND TELEPHONE NOTES.

Dutch Indies.—WIRELESS TELEGRAPHY.—A report from Bandoeng to the Dutch East Indian *Locomotief*, states that from four to five years may elapse before it will be possible to send wireless messages from Holland to the Dutch East Indies. The installation sent out by the Telefunken Co. is not sufficiently powerful to bridge over the distance. The receiving station at Sonsbeek, which is ready, is less satisfactory than that at Blaricum. The question of the *personnel* raises difficulties for the seven wireless connections with the authorities in the outer districts, and six of the 15 technical officials have resigned in one month. The newspaper adds that a telegraphic order has been received from Holland not to begin the construction of five wireless towers to the south of Bandoeng for the account of the Telefunken Co., the costs of which would amount to 10,000,000 florins.

France.—On April 27th the French Administration announced the withdrawal of all restrictions on telegrams to and from Germany, occupied and not occupied. The Polish Office also notifies the restoration of telegraphic service *viâ* Germany, as from April 24th.

A wireless telegraphic aerial has been set up on the eastern side of Le Bourget aerodrome, near Paris, marked by fabric pennons during the day and a white light at night.—*The Times.*

Italy.—*The Times* announces that the postal, telegraphic and telephonic services are again working regularly in Rome.

Liverpool.—NEW EXCHANGE.—Last Saturday, after the usual hours of business, the first batch of 1,250 subscribers were switched over from the Central to Bank Exchange. This step has been rendered necessary owing to the growth of the telephone system in Liverpool, and the unavoidable necessity for removing the oldest of the Exchanges to the new Bank Exchange. The total number of subscribers to both Bank and Central is 7,500, and when the scheme is completed, there will be accommodation for 17,000. During the past nine months, in order to enable the change to be effected, over 6,000 miles of underground cable had to be laid.

New Cables.—We are informed that a contract has been concluded, and the order placed, for a second cable between Bamfield and Fanning Island, and that the laying of an Atlantic cable is under consideration.

Czecho-Slovakia. — As from January 10th last, the Republic of Czecho-Slovakia became an adherent to the Telegraphic and Radio-Telegraphic Conventions.

Telephone Charges. — SELECT COMMITTEE. — Mr. Illingworth, the Postmaster-General, stated in the House of Commons, this week, that the Select Committee which is to inquire into telephone charges will be set up after Whitsun.

U.S.A.—WIRED WIRELESS.—A further step forward has been made by Major-General G. O. Squier, chief signal officer, U.S. Army, in what is termed "wired wireless" telegraphy. The possibility has been demonstrated of using bare wires laid in the sea for the transmission of messages by the new method which consists of sending a radio current between two or more points with the wire as a guide. The advantages of "wired wireless" consist, it is said, of its multiple possibilities and its secrecy. It is reported that experiments have been successfully conducted with ordinary copper wires on the Potomac River, the messages being sent, not through, but alongside the wire as a guide. General Squier is to explain the method in a paper before the National Academy of Sciences on "Multiplex Telephony and Telegraphy over Open-Circuit Bare Wires Laid in Earth or Sea."

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CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the ELECTRICAL REVIEW *in which the "Official Notice" appeared.)*

OPEN.

Australia. — PERTH. — May 14th. Government of Western Australia. One 7,500-KW. turbo-alternator and condensing plant. (April 9th.)

MELBOURNE.—June 18th. City Council. Gas-filled metal-filament lamps. City Electrical Engineer's Office, Town Hall, Melbourne.

May 31st. Victorian Railways Department. Four 4,500-KW., 1,500-volt traction converter sets, and eight 1,000-KW., 1,500-volt ditto. (April 30th.)

SYDNEY. — August 4th. N.S.W. Government Railways and Tramways. Two 1,000-KW. sub-station units. Chief Electrical Engineer, 61, Hunter Street, Sydney.

July 18th. City Council. Maximum demand indicators. Electric Lighting Department, Town Hall, Sydney.

Belfast.—May 19th. Electricity Department. Coal-handling plant. (See this issue.)

Belgium.—ANTWERP.—June 28th. Harbour Authorities (Town Hall). Two electric cranes of 30 tons and 10 tons respectively, for the new dry dock, and No. 61 of the Bassin Lefebvre. Copies of the specification in French, with tender form, price 4 fr., may be obtained on making application to: M. le Bourgmestre d'Anvers, Hotel de Ville, Anvers, Belgique.

Formosa.—August 15th. Specifications and blue prints are on the way to the Department of Overseas Trade from H.M. Ambassador in Tokio, particularising the machinery needed in connection with the Formosan hydro-electric scheme. No British firm is included in the preliminary inquiries made for turbines. The power to be developed eventually in connection with this scheme is 185,000 H.P. in two units, one of 130,000 H.P. and one of 55,000. Tenders for three water-driven turbo-electric generators, each of 11,000 KW., to be used in the construction of the preliminary works, were obtained some time ago. British firms will probably desire to get into touch with the engineer of the Formosan Hydo-Electric Co., Ltd., Tamsui, Formosa, and in the first instance they should approach the Department of Overseas Trade at 35, Old Queen Street, S.W. 1.

Lincoln.—May 24th. Electricity Department. Coal-handling plant. (April 23rd.)

May 15th. Electricity Department. New or second-hand turbo-alternator, 1,000 to 2,000 K.V.A., 6,600 or 3,300 V., 50 periods, complete with condenser and all accessories. (See this issue.)

London.—ST. PANCRAS.—The Electricity Committee recommends that tenders be invited for the remaining two boilers for the King's Road Power Station.

HACKNEY.—June 9th. Electricity Department. Four water-tube boilers, each 33,000 lb. per hour capacity, with superheaters, mechanical stokers, &c.; four induced-draught plants; four fuel economisers; one 10,000-KW. turbo-alternator and exciter, with ventilating fan and air filter or cooler; one surface condensing plant; two circulating water motor-driven pumps; E.H.T. switchgear; two 20,000-KW. coupler panels; one 10,000-KW. generator panel; six 2,000-KW. and one 4,000-KW. feeder panels. (See this issue.)

Manchester.—June 7th. Electricity Department. Main and auxiliary switchgear; Section A, 33,000-volt and 6,000-volt main switchgear; Section B, pressure-testing switchgear; Section C, 420-volt A.C. auxiliary switchgear; Section D, 240-volt D.C. auxiliary switchgear. (April 30th.)

New Zealand.—WELLINGTON.—June 30th. Tender Board Public Works. Electrical equipment for the Arthur's Pass section of the Midland Railway. Particulars from the Department of Overseas Trade, 73, Basinghall Street, E.C.

AUCKLAND.—September 1st. Harbour Board. For the supply of electric capstans and spares. Messrs. W. & A. McArthur, Ltd., 18-19, Silk Street, Cripplegate, London, E.C. 2.

Rochdale.—One 1,250-KW. (alternatively 1,500-KW.) rotary converter. Mr. F. H. Rudd, borough electrical engineer, Electricity Works, Dane Street.

Salford.—River Irwell Conservancy Committee. Pumps and motors at the Corporation Sewage Works, Weaste. J. Diggle and Son, Civil Engineers, Hindhill Street, Heywood.

South Africa.—MOSSEL BAY.—Electric lighting equipment. (See this column, April 23rd.)

Spain.—The municipal authorities of Santiago (Province of Corunna) have recently invited tenders for the concession for the electric lighting of the town during a period of 10 years

Stockton-on-Tees.—May 10th. Board of Guardians. Electric lighting installation at the offices in Nelson Street. Mr. J. Rodham, 16, Finkle Street, Stockton-on-Tees.

St. Helens.—May 14th. Electricity Department. Rotary converting plant. (See this issue.)

Tasmania.—LAUNCESTON.—June 7th. City Council. One 1,000-K.V.A. hydro turbo-alternator, with switchgear. City Electrical Engineer, Town Hall, Launceston.

CLOSED.

Ayr.—Education Committee.

Electrical installation, Newton Park Schools.—Reid & Co., £218.

Australia.—SYDNEY.—City Council. Accepted:—

L.T. insulators, £1,161.—Australian Porcelain Co.
5-amp., 240-v., single-pole, A.C., Ferranti meters, £594.—Noyes Bros.
5-amp., 230-v., D.C., and 10-amp., 230-v., D.C., Chamberlain-Hookham amp. hour meters, £425.—British General Electric Co., Ltd.

In view of the requirements of the Council of bare copper cable, and the difficulty of obtaining supplies on account of the importation of copper wire having been prohibited by the Federal Government, except under licence issued by the Minister for Customs, the Council has decided to enter into a contract with Metal Manufacturers, Ltd., to take the whole of the bare copper cable required by the Council for two years from the Company. The price to be the published price of electrolytic wire bars on the date of the receipt by the Company of the order, plus certain figures per lb., representing cost of manufacture. These figures per lb., representing cost of manufacture, vary from 10½d. for the smallest cable to 5d. for the largest.—*Tenders.*

Commonwealth. Department of Works and Railways. Accepted. Electrical materials for the new post office, Perth, W.A.:—

Conduits and fittings and lighting fittings, £1,747.—British General Electric Co., Ltd.
Main switchboard, £395.—Elec. Equipment Manufacturers (Pty.), Ltd.
Distribution boards, £792.—W. Cumming & Co.
Cables and wires.—W. T. Henley's Teleg. Works Co., Ltd. —*Tenders.*

P.M.G.'s Department, S. Australia:—

420 wall-pattern magneto telephones, £2,373.—J. Bartram & Sons (Pty.), Ltd.

Victorian Railways:—

One electric capstan, with tools, &c., £555.—Thompson & Co. (C'maine), (Pty.), Ltd. —*Tenders.*

Glasgow.—Electricity Committee. Recommended:—

Clarke, Chapman & Co., three electrically-driven capstans for Dalmarnock Power Station at £520 each.

Tramways Committee. Recommended:—

One mile copper wire.—Western Electric Co., Ltd.

London.—ST. PANCRAS.—The Electricity and Public Lighting Committee recommends that sanction be given to the installation of an "Erith Riley" stoker in the No. 2 Niclausse boiler at the King's Road station at an additional cost of £2,000 over the contract amount.

Two 1,000-KW. motor converters, 375 revs. per minute, at £6,330 each.—Bruce Peebles & Co., Ltd. Recommended.

SHOREDITCH.—Lighting Committee. Accepted. Extension of plant, Whiston Street generating station.

One 2,500 KW., 3-phase, A.C., feeder equipment, &c., £1,935; one set of protective gear; £54 (delivery 42 to 45 weeks).—British Thomson-Houston Co., Ltd.

Coronet Street sub-station.

One 2,500 KW., 3-phase, A.C., feeder equipment, &c., £1,230.
One 1,500 K.W. do. do. £1,190.
Two L.T. feeder panels, complete, £1,700 (delivery 27 weeks).—Metropolitan-Vickers Electric Co., Ltd.

Manchester.—Electricity Committee. Accepted:—

Cable.—Enfield Ediswan Cable Works, Ltd., Connolly's (Blackley, Ltd.), Western Electric Co., Ltd.
10-ton over-head travelling crane.—H. Morris, Ltd.
Circuit-breakers.—British Thomson-Houston Co., Ltd.
Two water-tube boilers.—Babcock & Wilcox, Ltd.

Education Committee. Accepted:—

E.L. installation at Stretford Road Clinic.—R. Seddon & Sons.

Rawtenstall.—Corporation. Accepted:—

Coal bunkers and conveyors.—Babcock & Wilcox, Ltd.

Salford.—Tramways Committee.

Increase agreed to, in consequence of the advance in wages, of 8 per cent. on the tender of the English Electric Co., Ltd., for the supply of five single-deck omnibus bodies and for the supply of two QB 1, Form B 3, tramway controllers.
500 tons Sandberg Silicon steel girder tramway rails, £13,250.—Bolckow, Vaughan & Co., Ltd. Accepted.

Electricity Committee:—

One 88-H.P. motor, complete, £202; one armature for 105-H.P. circulating pump motor, £219; 100 K.V.A. transformer, £206; extension cubicle for the new E.H.T. switchgear with the addition of two new single phase potential transformers, £331.—Metropolitan-Vickers Electrical Co. Accepted.

Motor Tramway Cars.—The Ford Motor Co., of America, and Henry Ford & Son, the latter being the tractor manufacturing branch, are to be consolidated and reorganised, with a capital of £20,000,000, to undertake the manufacture of aircraft, internal combustion locomotives and petroleum-driven tramway-cars.

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FORTHCOMING EVENTS.

Junior Institution of Engineers.—Friday, May 7th. At 39, Victoria Street, S.W. At 7.30 p.m. Lecturette on "Pulverised Fuel," by Mr. J. G. McBryde.

Association of Engineers-in-Charge.—Saturday, May 8th. At the Holborn Restaurant (Venetian Chamber). At 6 p.m. Annual dinner.

Salford Technical and Engineering Association.—Saturday, May 8th. Visit to Messrs. W. G. Armstrong, Whitworth & Co.'s Works at Openshaw.

Illuminating Engineering Society.—Tuesday, May 11th. At the Royal Society of Arts, John Street, Adelphi, W.C. At 8 p.m. Annual meeting. Lecture on "Recent Developments in Portable Types of Cinema Outfits," by Capt. J. W. Barber.

Edinburgh Electrical Society.—Wednesday, May 12th. At the Philosophical Institution. At 7.30 p.m. Annual general meeting.

Institution of Electrical Engineers.—Thursday, May 13th. At the Institution of Civil Engineers, Gt. George Street, W. At 6 p.m. Paper on "Permanent Magnets in Theory and Practice," by Mr. S. Evershed.

(North-Midland Centre.)—Tuesday, May 11th. At the Hotel Metropole, Leeds. At 7 p.m. Annual general meeting.

(Students' Section).—Friday, May 14th. At King's College, Strand, W.C. At 7 p.m. Annual general meeting. Paper on "Electrical Motor Control Devices," by Mr. E. G. Humfries.

Physical Society of London.—Friday, May 14th. At the Imperial College of Science, South Kensington. At 5 p.m. Ordinary meeting.

Electrical Power Engineers' Association (Derby and District Section).—Saturday, May 15th. At the Arcadia Café, High Bridge, Lincoln. At 3.30 p.m. Open general meeting.

NOTES.

Tramcar Accident: Damages.—In the Sydney Courts, a man who was driving an ice cart in Sydney when a tramcar collided with the vehicle, was awarded £2,000 as compensation for injuries to his head which impaired his mental faculties.

Service Notes.—Colonel C. G. Burnaby, who has just retired from the Royal Engineers, was chief instructor of electric lighting at Plymouth for some years, and was well known in electrical professional circles as an expert.

The Admiralty has drawn attention to the danger of high-power telegraphy causing fire in woodwork topmasts and yards.

The following are the rates of pay provided in the Naval Estimates of the current year for the various grades of naval telegraphists:—Boy telegraphist, 1s. 9d. per diem; ordinary telegraphist, 2s. 9d.; telegraphist, 4s. 3d.; after three years' man's time, 4s. 6d.; after six years' man's time, 4s. 9d.; leading telegraphist, 5s. 9d.; after one year as such, if passed for P.O. telegraphist or higher standard, 6s.; petty officer telegraphist, 7s. 6d.; after one year, if recommended by his commanding officer, or after three years in any case, 7s. 10d.; after three years from receiving the preceding rate, 8s. 2d.; chief petty officer telegraphist, 9s.; after three years as such, 9s. 6d. per diem, with subsequent triennial increments of 6d. a day.

The electrical apparatus, torpedo apparatus, and apparatus for lighting at His Majesty's dockyards this year are put down at a cost of £2,011,000, and for reconditioning electrical installations in properties taken over under the Defence of the Realm Act.

A Central Hot-Water Supply.—A central hot-water supply is to be established for the 2,000 houses which the Manchester Corporation proposes to erect on the Blackley and Hill Lane estates, says the *Daily Dispatch*. A central station will be built where water will be heated in boilers to about 150° F., and distributed to the houses, which will have a constant supply of hot water. No kitchen range will be provided, but there will be a gas cooker and gas copper in the scullery, with an open fire in the living room. It is estimated that the cost of upkeep and management of the central plant, including labour, fuel, &c., will, at present prices, be between 9d. and 1s. per week on a basis of 25 gals. of hot water supplied to each house for 24 hours. It is proposed that this should be met by a charge on the rent. The saving on the fitting of kitchen ranges and boilers will, it is stated, more than meet the cost of the central system.

Parliamentary.—The *London Gazette*, of May 4th, contains the full official notice respecting the provisional determination of the Lower Severn Electricity District by the Electricity Supply Commissioners.

A Direct-Reading Amplifying Voltmeter.—In a paper read before the Société Française des Electriciens, by Messrs. Abraham, E. Bloch, and L. Bloch, an account is given of a voltmeter capable of reading very low voltages. Hitherto, the authors point out, there has been no direct-reading electrometer for an alternating pressure of one volt, and no direct-reading thermal ammeter for one milliampere. With the aid of three-electrode valves they have produced an instrument of higher sensibility than has been previously attained. The alternating current to be measured is first amplified, usually in two stages, but sometimes in five, then rectified, and the rectified current is read by means of an ammeter. The potential difference applied to the terminals can be determined from the ammeter reading with the aid of a calibration curve. The instrument behaves like a voltmeter of very high resistance, and is suitable for all frequencies. It can detect a millivolt at the terminals of any circuit; if this circuit has a resistance of 100,000 ohms, the pressure of one millivolt corresponds to a current of a hundredth of a microampere, and a power of one hundred-thousandth of a microwatt. The connections and properties of the apparatus are fully described in the paper.

Inquiry.—Makers of an electric vulcaniser are asked for.

Educational.—FARADAY HOUSE ELECTRICAL ENGINEERING COLLEGE.—Mr. A. T. Morris, B.Sc., A.M.I.E.E., has been made Superintendent of the Testing Department, in succession to Dr. F. T. Chapman, M.I.E.E., who has been appointed one of His Majesty's Inspectors of Technological Education. The Rev. L. Van Vestraut, M.A. (Cantab), has been appointed Chief Assistant in the Testing Department. Mr. J. K. Catterson-Smith, M.I.E.E., has been appointed Lecturer on Dynamo Design. Mr. A. Regnauld, B.Sc., A.M.I.E.E., has been appointed Superintendent of the Workshop Department.

UNIVERSITY OF LONDON.—A course of four advanced lectures on "High-Frequency Alternators for Radio-Telegraphy," by M. Marius Latour, of Paris, has been arranged provisionally to be given at the Institution of Civil Engineers, Great George Street, on May 25th, 27th, 28th and 31st, at 5.30 p.m. For particulars see our advertisement pages to-day.

Summer Time in Canada.—Daylight saving came into force on the morning of May 2nd in many cities in Canada. While the cities of Montreal, Quebec, and nearly the whole of the Province of Quebec advanced the clock, the Maritime Provinces generally retained the standard time, as also did Ontario; but the cities of Toronto, Ottawa, Kitchener, Sarnia, and Niagara Falls adopted the daylight-saving scheme. Some confusion is likely to be experienced on account of the changes in the railway time-tables to conform with local conditions.—*The Times.*

The Resources of India.—The Chemical Services Committee, presided over by Prof. Jocelyn Thorpe, recommends the constitution of an Indian Chemical Service and the establishment of an Imperial Research Institute at Dehra Dun (United Provinces), and a provincial institute in each province, also the creation of a Ministry of Science as soon as possible. Prof. Thorpe states that very few of the great natural resources of the country are being exploited to advantage; if they were developed to the fullest extent, India would take its place in the front rank of industrial communities.—*The Times.*

Appointments Vacant.—Cable jointers, for the Eccles Corporation Electricity Works; assistant instructors in pattern making, drawing office, electrical switchgear fitting department, electrical maintenance department, general engineering fitting; stores superintendent, for the Loughborough Technical College; power station superintendent (£750, with house, light and fuel), for an English Railway Co. in Buenos Aires; rental clerk (60s.), for the Walsall Corporation Electric Supply Department; shift engineer (90s.). for the Kingston-on-Thames Corporation Electricity Department; plumber-jointer for the Borough of Derby Electricity Supply Department; assistant mains engineer (£290), for the Walsall Corporation Electricity Works; overhead linesman, for the Rawtenstall Corporation Tramways. See our advertisement pages to-day.

Fatality.—A verdict of "Accidental Death" was returned at an inquest held last week on Arthur Alcock, aged 25, a married man, who was killed whilst following his employment as assistant foreman at the Metropolitan-Vickers Electrical Co., Trafford Park. The fatality occurred when deceased was taking the temperature of the oil in the transformer. Immediately over the tank was an electric wire charged at 5,750 volts, which deceased had himself fixed up the previous day, and in a moment of forgetfulness he did not switch off the current. He was seen to fall from the ladder. Artificial respiration was continued for over an hour. Alcock was badly burned about the face. The live wire had only been temporarily put up for the purposes of testing, and deceased had warned others about switching off the current when taking temperatures. The Coroner said it was a pure accident, and if anyone was to blame it was the deceased himself.

Plant Growth.—The researches of Prof. Sir J. C. Bose on plant growth have lately been somewhat prominently before the scientific world in London. While admitting the beauty of the "crescograph"—the exceedingly delicate instrument devised by Prof. Bose to record the growth of the tissues of plants—Prof. W. M. Bayliss suggested that, in view of certain adverse criticisms, his apparatus should be tested in a laboratory before a number of scientists. This has been done, and we are pleased to see that, in a letter to *The Times* of May 4th, Profs. Bayliss, Blackman, Clark, Clinton, Donnan, and Lord Rayleigh bear witness to the performance of the crescograph as follows:—

"In accordance with the results given by the application of various tests, we are satisfied that the growth of plant tissues is correctly recorded by this instrument and at a magnification of from one to 10 million times. We saw in particular that a flower-bud in active growth, if treated by immersion in a solution of potassium cyanide for some hours, no longer gave a movement of the recording spot of light. We conclude that such movement when shown by a similar bud in the active state is not due to accidental stretching or to undetected effects of currents of air, radiant heat, &c. We agree that the instrument correctly records changes of length in the growing tissue, or, indeed, of any substance attached to the lever of the instrument, however such changes may be produced. Naturally, under the conditions of the experiments, it was impossible for us to analyse completely the complex effects produced by the passage of an electrical current."

Although not present at the demonstration, Profs. W. H. Bragg and F. W. Oliver express their agreement with the statement, having witnessed similar demonstrations by Sir J. C. Bose. The reliability of the apparatus is, therefore, no longer in question.

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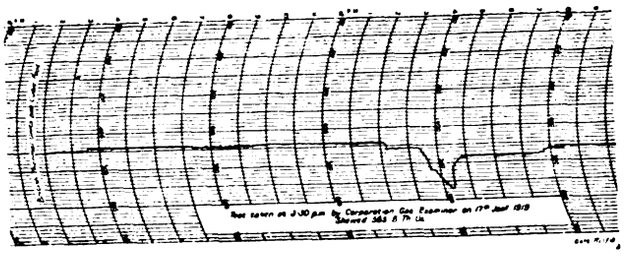
Fish Preservation.—As an outcome of several years' experimenting, Mr. Frank Croft, a fish merchant, of Grimsby, claims to have invented a new process of fish preservation. The system embraces the use of electricity and hot air, and Mr. Croft has now in his possession fish that he cured seven years ago which, it is claimed, is still in good condition.

The Edison Medal.—A French newspaper publishes a cable from New York, announcing that the American Institution of Electrical Engineers has conferred the Edison Medal for 1919 on Mr. William Leroy Emmott as a reward for his system for the electric propulsion of ships.

Thermal-Standard Gas Supply.—The accompanying record is of considerable interest in connection with the proposal to supply gas in future on a heat-unit basis. It is taken from the recent report of the Fuel Research Board, which states that an association of large consumers finding the gas supply irregular and unsatisfactory, installed a Simmance total-heat recording calorimeter, unknown to the gas examiner or the gas suppliers. The slip reproduced was taken on January 17th, 1919. The calorific value of the gas from midnight to 3 a.m. was 450 B.TH.U. At 4 a.m. it had fallen to 440, at which value it remained till 2.15 p.m.,



when it rose to 460. A sharp rise began at 3.15, reaching 560 at 4.15, after which a quick fall followed. By 5 p.m. the value was 480, and at 7.45 p.m. it was down to 450 again.

Some weeks later the Association learnt that at 3.30 p.m. on January 17th the Corporation gas examiner had made a test, which gave 565 B.TH.U. as the calorific value of the gas. "The wave of rich gas had evidently reached the calorimeter of the gas examiner some little time before it reached the recording calorimeter, for this slight lag is similarly shown on all the monthly charts." The report states that the test was prearranged; it was made at or near the summit of the wave. This experience, it is remarked, may be regarded as exceptional. We hope it is.

It will be noted that the scale reads downwards, so that a dip means an increase in the calorific value.

South African Scientific Societies.—The scheme to secure housing for the Associated Scientific and Technical Societies of the Rand has, through the munificence of the Chamber of Mines, been brought to successful fruition by the acquisition of a building at Johannesburg. The movement was, according to the *South African Mining and Engineering Journal*, originated five years ago, when it was recognised that the financial position of several of the local societies gave cause for anxiety, and that the return made to members was in no way adequate. Another cause was the lack of co-ordination between not only the societies themselves, but also amongst their members individually. It was felt that if expenses could be reduced and better provision made for the social amenities for members, there would be an increase in the efficiency and usefulness of the societies. A small committee was appointed, consisting of members from the three major societies responsible for the movement, namely, the South African Institution of Engineers; the Chemical, Metallurgical and Mining Society of South Africa; and the South African Institute of Electrical Engineers, which has carried into effect the resolutions agreed to. The terms of the Chamber's offer are as follows:—It will make a loan not exceeding £10,000 on second mortgage on the property to be purchased at 5 per cent. interest; provide the interest on this loan and also on the first mortgage loan, which is not to exceed £12,500, for two years; and undertakes to subscribe 10s. for every £1 raised by the societies concerned, the total under this head not to exceed a contribution of £5,000 from the Chamber. The societies concerned number 13, and the building purchased will house them all, as well as provide general club advantages for the members. The Associated Societies will need a considerable sum of money before they can qualify for the Chamber's generous offer, and every effort is being made towards this end. The title of the Institution has been agreed as the "Associated Scientific and Technical Societies of South Africa."

Water-Power Development in Canada.—According to the statistics just compiled, there is installed throughout the Dominion some 2,418,000 turbine or water-wheel H.P., of which 2,215,000 H.P. is actually and regularly employed in useful work. The larger figure includes the total installed capacity at full rate, including reserve units. It does not, however, include hydraulic exciter units. A large number of the plants now operating are designed for the addition of further units as the market demands. The ultimate capacity of such plants, together with that of new plants now under construction, totals some 3,385,000 H.P.

Of the total power installed, 1,756,791 H.P., or 72·7 per cent., is installed in central stations. Central station power is sold for lighting, mining, electrochemical and electrometallurgical industry, milling, and general manufacturing. In the pulp and paper industry 473,265 H.P. is utilised, of which 381,631 H.P. is generated directly from water in pulp and paper establishments, while 91,634 H.P. is purchased from hydro-electric central stations.

Hydro power used for other purposes and other industries may be listed as follows:—For lighting purposes, 434,613 H.P.; in mining industry, 177,728 H.P.; in flour and grist mills, 42,736 H.P.; in lumber and saw mills, 37,918 H.P.; in other manufacturing industries. 172,955 H.P. These figures are evidence of the widespread manner in which the Dominion's water-power resources are being applied to the furtherance of its industrial development.

The figures of 70 representative hydro-electric stations throughout the Dominion, with an aggregate turbine installation of 745,797 H.P., show a total construction cost of $50,740,468 (pre-war figures), or an average of $69·11 per installed H.P. This cost includes the capital invested in construction of dams, flumes, penstocks, and all hydraulic works, and of power stations and equipment. It excludes real estate and transmission and distribution equipment. The figure in brief represents the capital cost of construction at the power site.

INSTITUTION NOTES.

Institution of Electrical Engineers.—In addition to the Council's nominations for the new Council, of which a list was given in our issue of April 9th, the following names have been put forward by members of the Institution:—Mr. R. F. Ferguson, borough electrical engineer, Hastings; Mr. A. H. W. Marshall, engineer, Clevéland and Durham Electric Power, Ltd., Middlesbrough; Mr. C. Vernier, mains engineer, Newcastle-upon-Tyne Electric Supply Co., Ltd. The ballot papers have to be delivered at the Institution offices not later than May 8th.

The arrangements for the remainder of the session, in addition to those already notified, are as follows:—

Ordinary Meetings.—(To be held at the Institution of Mechanical Engineers, Storey's Gate, Westminster, S.W.). June 16th: Discussion on the paper entitled "Distribution of Heat, Light, and Motive Power by Gas and Electricity," read by Sir Dugald Clerk, K.B.E., &c., before the Royal Society of Arts, and also on "The Report on the Coal-Gas and Electrical Supply Industries of the United Kingdom to the President of the Institution of Gas Engineers," by Sir Dugald Clerk and Profs. Arthur Smithells, and J. W. Cobb. June 30th: Paper on "Overhead and Live Rail Conductor Systems," by Mr. P. Dawson.

Wireless Sectional Meeting.—June 9th: Paper on "High-Frequency Machines," by Marius Latour.

SCOTTISH CENTRE.—The following is a complete list of officers and members of the Committee elected at the annual general meeting:—Chairman, Mr. J. G. Sayers; vice-chairmen, Messrs. E. T. Goslin and Alex. Lindsay; hon. secretary, Mr. Joseph Taylor (Glasgow); assistant hon. secretary, Mr. W. F. Mitchell; chairman of Students' Section, Mr. F. H. Whysall. Committee: Messrs. A. S. Hampton, W. Wood, R. B. Mitchell, Frank Onslow, W. J. Kelsey, J. M. Scott Maxwell, J. A. Bell, John Prentice, D. S. Munro, H. Richardson, and J. L. Nicholson.

Mr. Roger T. Smith, President of the Institution, was present, and gave a brief address. He congratulated the Scottish Section on having given two members—Messrs. W. W. Lackie and Arch. Page—as Electricity Commissioners. The electrical supply industry, he said, after many attempts at legislation, was now in the hands of Commissioners, the engineering members of which thoroughly understood their job. One of the things the Commissioners would have to do was to see that wherever it was economical the water-power of this country should be applied for the generation of electricity.

After MR. J. M. M. MUNRO had read his paper on "Highland Water-power," the Chairman intimated that arrangements were being made by the London Students' Section to visit Glasgow in the last week in July. There would probably be a joint meeting with the local Students' Section, and a programme of visits to places of interest and entertainments.

Institution of Civil Engineers.—At the annual general meeting, on April 27th, the result of the ballot for the election of officers for the year 1920-21 was declared as follows:—

President: Mr. John A. Brodie, M.Eng. Vice-presidents: Mr. W. B. Worthington, Dr. W. H. Maw, Mr. Charles L. Morgan, C.B.E., Mr. Basil Nott, C.B. Other members of the Council: Mr. E. A. S. Bell, C.I.E.; Dr. C. C. Carpenter, C.B.E.; Colonel R. E. B. Crompton, C.B.; Mr. Maurice Deacon; Sir Archibald Denny; Sir William H. Ellis, G.B.E.; Mr. Albert Gordon; Mr. W. W. Grierson, O.B.E.; Sir Robert A. Hadfield, Bart.; Sir Brodie H. Henderson, K.C.M.G.; Messrs. E. P. Hill; G. W. Humphreys, C.B.E.; Summers Hunter, C.B.E.; H. G. Kelley; C. R. S. Kirkpatrick; James Marchbanks; H. H. G. Mitchell; Engineer Vice-Admiral Sir Henry J. Oram, K.C.B.; Mr. Frederick Palmer, C.I.E.; Captain H. Riall Sankey, C.B., C.B.E.; Sir John F. C. Snell; Messrs. W. A. P. Tait, A. M. Tippett, E. F. C. Trench; Prof. W. H. Warren; Sir Alfred F. Yarrow, Bart.

This Council will take office on the first Tuesday in November, 1920.

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The Council has made the following awards for the Session 1919-1920:—Telford Gold Medals and Telford Premiums to Mr. David Lyell, C.M.G., C.B.E., D.S.O. (London), Mr. J. K. Robertson (London), and Major-General Sir Gerald M. Heath, K.C.M.G., C.B., D.S.O., R.E. (London); a George Stephenson Gold Medal and a Telford Premium to Mr. Maurice F. Wilson (London); a Watt Gold Medal and a Telford Premium to Mr. P. M. Crosthwaite, B.A.I. (London); Telford Premiums to Major E. O. Henrici, R.E. (London), Sir Francis J. E. Spring, K.C.I.E., M.A.I. (London), Mr. F. O. Stanford, O.B.E. (London), Mr. James Mitchell (Hursley), Mr. J. W. Sandeman (Newcastle-on-Tyne), and Mr. A. R. Fulton, D.Sc. (Dundee).

Royal Institution.—The annual meeting was held on May 1st, Sir James Crichton-Browne, treasurer and vice-president, in the chair. The annual report of the Committee of Visitors for the year 1919, testifying to the continued prosperity and efficient management of the Institution, was read and adopted, and the report of the Davy Faraday Research Laboratory Committee was also read. Sixty-four new members were elected during the year, and 62 lectures and 19 evening discourses were delivered. The following gentlemen were unanimously elected as officers for the ensuing year:—President, The Duke of Northumberland; treasurer, Sir James Crichton-Browne; secretary, Colonel Edmond H. Hills.

At a general meeting on May 3rd, it was announced that the President had nominated the following gentlemen as Vice-Presidents for the ensuing year:—Mr. J. H. Balfour Browne, Mr. W. A. B. Burdett Coutts, Dr. Donald Hood, Earl Iveagh, Sir Charles Parsons, Sir James Reid, Sir James Crichton-Browne, and Colonel E. H. Hills.

Liverpool Wireless Association.—A meeting was held at McGhies' Café, 56, Whitechapel, on Wednesday, April 28th, when the subject of "Battery Power for Use with Valve Circuits" was gone into. The next meeting is on Wednesday, May 12th. New members are invited; subscription, 5s. per annum. Mr. S. Frith, 6, Cambridge Road, Crosby, Liverpool, is hon. sec.

Electrical Power Engineers' Association.—The National Executive Council of the Association having considered the nominations put forward for the members' vacancies on the Council of the Institution, is of opinion that the list, as submitted, is insufficiently representative of the electric supply industry, and has accordingly issued a circular, of which we have received a copy, recommending its members and friends who are corporate members of the Institution to record their votes in favour of Messrs. C. Vernier, A. H. Marshall, F. Gill, P. V. Hunter, and Dr. A. Russell.

The Incorporated Municipal Electrical Association.—The twenty-fifth annual convention is to be held at Bradford and Ilkley, June 21st to 25th. It will commence at Ilkley on Monday, June 21st, with an informal reception at the Winter Gardens; on Tuesday the convention will be opened at "The Windsor" (Queen's Hall), Bradford, when the Lord Mayor will welcome the Association; Mr. T. Roles, president, will deliver an address; and a paper on "The Design of Distributing Networks" will be read by Mr. C. A. Giffin, mains engineer, Bradford. The afternoon will be occupied with visits to works, and in the evening there will be a reception at the Winter Gardens, Ilkley, followed by a social evening.

On Wednesday, at the King's Hall, Ilkley, Mr. I. V. Robinson, of the B.E.A.M.A., will read a paper on "Power Station Design in Relation to Thermal Efficiency"; the afternoon will be devoted to visits to places of interest, and in the evening the annual dinner will be held.

On Thursday, at Bradford, a paper will be read by Mr. J. W. Beauchamp, of the British Electrical Development Association, on "The Standardisation of Tariffs." Visits to works, and a reception by the Lord Mayor of Bradford, will occupy the afternoon; in the evening the "Committee" members and the Associated Municipal Electrical Engineers will hold separate meetings.

On Friday the Council will meet at the Winter Gardens, and the annual general meeting will be held in the morning; a motor trip to Pateley Bridge and the Nidd Valley in the afternoon will bring the proceedings to a conclusion.

Accommodation is likely to present considerable difficulties; all communications on this subject should be addressed to Mr. T. Roles, President I.M.E.A., Town Hall, Bradford.

The papers and reports will be taken as read; advance copies can be obtained from the Secretary.

Institution of Gas Engineers (Inc.).—Arrangements are being made for the annual general meeting to be held in London on June 1st, 2nd and 3rd, under the presidency of Sir Dugald Clerk, K.B.E., D.Sc., F.R.S.

Society of Engineers (Incorporated).—A paper on "The Assessment to the Poor Rate of Engineering Undertakings" was read on 3rd inst., by Mr. W. G. Cooke. The first part of the paper dealt with companies such as gas and water, where the rateable value was ascertained from the yearly accounts as issued to their shareholders; the second with general engineering works, breweries and the like, where the rating is ascertained on the basis of cost and adaptability of the premises to the particular trade carried on. Mr. Cooke showed that, the working expenses being increased, the hypothetical tenants' share (a further deduction) was also increased by the high prices of meters, tools, and other chattels. The most marked increases were in the statutable deductions, that is, over the cost of repairs, renewals and insurance. The cost had gone up from 200 to 300 per cent. over pre-war figures, and even if the gross value, accordin to the statutory definition, were unaffected, the rateable value or basis upon which the rates were payable, should be considerably reduced.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

The electrical engineer at Barrow has been authorised to appoint a charge engineer in place of Mr. H. F. Marshall, who has left the Corporation service. Mr. C. Kilner has been appointed junior charge engineer at £100 plus 20 per cent. plus £120 per annum.

Through the appointment of Mr. W. W. Lackie as an Electrical Commissioner and the promotion of his assistant, Mr. R. B. Mitchell as chief engineer and manager of the Glasgow Town Council Electricity Department, a re-arrangement of the staff has taken place. Mr. R. B. Maccall, chief clerk and accountant, has been made secretary and treasurer, and Mr. G. L. Black, at present superintendent of street mains, has been recommended for the position of assistant to the chief engineer. Other appointments recommended are:—Mr. G. Morgan, assistant power stations superintendent, to be power stations superintendent; Mr. J. R. Cowie be continued as sub-stations superintendent; Mr. C. W. Marshall, laboratory superintendent, to be appointed chief technical assistant; Mr. D. Berry, assistant mains superintendent, to be mains superintendent; Mr. W. T. Caldeerwood, chief draughtsman, to be appointed constructional engineer. These officials will be known as principal officers, and will hold their appointments direct from the Town Council at such salaries as may be fixed by the committee on conditions of service with the approval of the Town Council.

Mr. Salter, chief engineer and manager of the Hamilton Electricity Works, who is leaving for Tasmania, has been presented by the staff with a sporting gun and case, and Mrs. Salter with a case of silver fruit spoons.

The salaries of the electrical department staff of the Liverpool Corporation have undergone a triennial revision, and most of the members have received substantial increases.

Blackburn General Purposes Committee recommends the Town Council to increase the salary of Mr. J. H. Cowell, the tramways manager, from £600 to £800 per year.

Barnsley Town Council has adopted the scale of the A.M.E.E. for the salary of the electrical engineer, Major Barker, which will be approximately £740 a year.

A communication has been sent to municipal electrical undertakings by the President of the Incorporated Municipal Electrical Association, stating that the hon. secretary, Mr. H. Faraday Proctor, found it necessary to relinquish his position in June last. The Committee had passed a resolution that, in view of the great services which he had rendered to municipal electricity supply undertakings, the local authorities who are members of the Association should be invited to associate themselves with a scheme under which some tangible recognition could be made to Mr. Proctor for the long and valuable services he has rendered in a purely honorary capacity. It is suggested that contributions might be made in accordance with a scale based on the number of units sold per annum, under which the Council's contribution would be six guineas.

Manchester Corporation Electricity Committee has appointed Mr. W. G. McCracken, resident civil engineer, during the construction of the Barton power station, at a salary of £450 per annum, which includes bonus.

The following increases of salaries are recommended by the Sub-Finance Committee of the Leeds Corporation:—Tramways department: Mr. J. Burrows, senior chief engineer, from £750 to £780; Mr. J. S. Hamilton, chief assistant engineer, £500 to £530; Mr. J. Burbridge, jun., second assistant engineer, £350 to £380; and Mr. J. Kidd, power-station superintendent, £462 to £492. Electricity department: Mr. C. N. Hefford, manager, from £1,260 to £1,510; and Mr. W. T. Green, assistant manager £690 to £760.

Mr. Edwin T. Parker, an electrical engineer, residing at Walsall, has been made an Officer of the Order of the British Empire in recognition of war services as technical adviser and chief dilution officer in the Labour Supply Department, West Midlands Division.

At Cambridge, on May 21st, Honorary Degrees, Doctor of Science, are to be conferred on Sir J. J. Thomson, O.M., and Sir Joseph Larmor, M.P.

Obituary.—Mr. J. H. Pope.—The death took place on April 24th, after a short illness, of Mr. John Henry Pope, for a long period assistant manager of Messrs. Newtons, Ltd., electrical engineers, of Taunton. He was 47 years of age.

Mr. Edward Noyes.—Mr. Edward Noyes, governing director of Messrs. Noyes Bros., Ltd., the well-known Australian firm, passed away at Medlow, aged 61 years, after a few weeks' illness. Mr. Noyes, who was born in England, went out to Australia in the eighties of the last century, and founded the above firm, in conjunction with his brother, Mr. Henry Noyes, in 1888. The business was turned into a company in 1907, and Mr. Edward Noyes became first governing director, and continued so until the end. He was also a director of Noyes Bros. (Melbourne) Proprietary, Ltd. The deceased gentleman carried out numerous important electrical contracts for tramway and other works in Australia, New Zealand, &c. He was a vice-president of the Electrical Association of New South Wales in 1906-7.

We regret to learn that Mr. Herbert Standring, who had been a director of the Greengate and Irwell Rubber Co., Ltd., of Salford, for many years, died, on Sunday last, from pneumonia.

We regret to learn of the death, at the age of 79 years, of Mr. Henry Charlton Stewardson, who was for 47 years with the British Association for the Advancement of Science.

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NEW COMPANIES REGISTERED.

Alliance Electrical Co., Ltd. (166,835).—Private company. Registered April 27th. Capital, £10,000 in £1 shares. To take over the business of electricians and electrical engineers, &c., carried on by the Alliance Electrical Co. Ltd. (in liquidation). The first directors are: W. F. White, 93, Hamlet Gardens, Ravenscourt Park, W.6, engineer; H. J. Grant, 89, Carlton Mansions, Maida Vale, W.9, engineer; Elizabeth McArthur, 11, Dorset Road, Merton Park, S.W.19, secretary. Secretary: Elizabeth McArthur. Registered office: 32, King Street, Covent Garden, W.C.2.

Northern Electric Vehicle Services, Ltd. (166,883).—Registered April 28th. Capital, £100,000 in £1 shares. To carry on the business of manufacturers, builders, designers, repairers and owners of and agents for electric or other mechanically-propelled vehicles, lorries, wagons, locomotives, &c. The first directors are: G. S. Newall, Sunniside, Hexham, Northumberland; R. S. Barrett, Brookside, Seaton Burn, Northumberland; F. Nicholson, Silksworth Close, Sunderland, Durham. Minimum cash subscription: 7 shares. Solicitor: C. L. Poyser, Pilgrim Street, Newcastle-on-Tyne. Registered office: Northumberland Road, Newcastle-on-Tyne.

London Armature Repair Co., Ltd. (166,916).—Private company. Registered April 29th. Capital, £1,500 in £1 shares. To carry on the business of manufacturers and repairers of and dealers in accumulators, dynamos, magnetos and electrical apparatus and appliances, &c. The permanent directors are: F. Poulter, 63, Well Street, Hackney, E.9, mantle manufacturer; F. N. Feirn, 108, Earlham Grove, Forest Gate, engineer. Solicitor: G. J. Dowse, Bank Chambers, 1, Kingsland High Street, E.8. Registered office: Eastern Works, Forest Lane, Stratford, E.

Armature Winding Co., Ltd. (166,778).—Private company. Registered April 24th. Capital, £5,000 in £1 shares. To carry on the business of electric and steam engineers and contractors, suppliers of electricity, manufacturers of tramway, electric, magnetic, galvanic, oil and other apparatus, &c. The first directors are: H. G. Wainscott, 9, Rochdale Road, Edenfield; G. Marshman, 18, Raymond Avenue, Bury. Registered office: 44a, Bolton Street, Bury.

Premier Electric Welding Co. (Ireland), Ltd. (3,963).—Private company. Registered in Dublin April 20th. Capital, £10,000 in £1 shares. To acquire the business carried on at Belfast by K. Edwards as the "Premier Electric Welding Co." The subscribers (each with one share) are: J. G. Coke, Bank Buildings, St. James's Street, London; A. Haggerty, Bank Buildings, St. James's Street, London. The first directors are not named. Solicitors: Moore, Kieley and Lloyd, 31, Molesworth Street, Dublin.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Hydro Electric Concessions, Ltd.—Satisfaction in full on April 12th, 1920, of mortgages dated June 29th and November 25th, 1914, securing £750 and £250 respectively.

Uneima, Ltd.—F. T. Shearcroft, of 36 and 37, Queen Street, E.C., as receiver and manager on April 16th, 1920, under powers contained in first mortgage debenture dated August 11th, 1919.

Correction.—For **Howard Electrical Engineering Co., Ltd.** (see ELEC. REV., p. 404, March 26th, 1920) read Howard *Pneumatic* Engineering Co., Ltd.

CITY NOTES.

Indo-European Telegraph Co., Ltd.

At the annual meeting, on April 28th, Mr. J. Herbert Tritton, the chairman, said that the one great need of Russia was economic, and foremost among all that this word connoted were communications and transports. The recognition of this fact was so universal and so pressing that the telegraph system must be one of the first cares of the authorities everywhere. Added to this, their route of telegraphs throughout its length was not only of national, but of international importance. On these two facts they based much of their hope for the future. They had had an anxious time during the year under review. The question that had chiefly engaged their attention was the re-establishment of the Indo route, first as a political entity and next as a physical line. After careful consideration of the various alternatives, they came to the conclusion that the interests of the company would be best served by the retention of the portion of the route traversing Germany. They had to look at the matter solely from the point of view of providing the most efficient telegraph line possible, and there could be no doubt that the German section fulfilled this requirement. Any other route would have involved long and exceedingly expensive cables, the provision of which would have seriously altered the financial outlook of the company. They had, therefore, entered into negotiations with the German Government, and had agreed with them the heads of a concession satisfactory to both parties. They had no doubt that this concession would soon be an accomplished fact. The managing director, Mr. Stratford-Andrews, himself proceeded to Berlin and Warsaw and conducted the negotiations under local conditions that were in the former city, distinctly uncomfortable. He was accompanied and assisted by Mr. Berg. On the route of their old line the Poland of the Peace Treaty extended farther west than it did into Prussia, and a good deal farther east into Russia; negotiations with the Polish Government for a concession were now in progress, and should offer no difficulty. The portion of the new Russia traversed by the route extended from Rowno to the Persian frontier; it was, however, not under one Government as before, but under many, each of which was at present claiming separate political control. The directors' difficulties had recently focussed in Odessa and its neighbourhood, all British subjects having been evacuated. Odessa was one of the most important stations, not only as a junction, but as the one through which the maintenance of the whole of their Russian section was kept supplied. They were hoping to be able to reoccupy the station before long. East of Odessa they anticipated no difficulty in agreeing terms with the young and vigorous nationalities that had arisen as a consequence of the war. The directors had long felt the great desirability of providing an alternative section to that through the Caucasus, always most exposed to interruptions, and had initiated negotiations with that object, which had at present not gone sufficiently far to enable them to refer to the matter in detail. Their Persian concession and communications remain undisturbed, as before the war. Turning to the restoration of the route from a physical point of view, their difficulties only began East of Poland. Between Poland and Odessa much of the country had been fought over; the same remark applied to a good deal of the line in the Caucasus. Notwithstanding this fact, they had had communication between Odessa and Teheran for weeks at a time. In neither case was there any serious difficulty once the necessary material was on the spot. This was the difficulty now confronting them. The directors had concentrated the necessary staff at Odessa and had provided a great deal of the material necessary, in anticipation of reopening the line this spring, when it became necessary to evacuate Odessa. The material would, however, be found as near that place as practicable, and no time would be lost as soon as political difficulties had been removed. The speaker went on to refer to the accounts, the dividend, and the equalisation fund.

English Electric Co., Ltd.

Sir Charles E. Ellis presided, on April April 28th, at the Connaught Rooms, W.C., over the first annual meeting of this company. Referring to the proposals of the Chancellor of the Exchequer regarding taxation for the ensuing year, he said that it was doubtful whether any alterations in the proposals were either possible or expedient for this year. It was, however, imperative that definite steps should at once be taken to prepare in time for the next Budget some new scheme, which, whilst producing the necessary revenue, would not react so unfavourably upon young and only partially developed industries such as their own—the electrical industry—which, after long years of unfair competition at home and abroad, was just beginning to raise its head. At December, 1919, the share capital stood at just under two millions. Since then it had been increased by £253,921, allotments in exchange for additional shares acquired in certain of their subsidiary companies, also in respect of an exchange of shares arranged with J. G. White and Co., Ltd., and an issue of shares in part payment of the purchase of the works of Siemens Bros. Dynamo Works, Ltd., at Stafford. The entire expenses of the debenture issue (including discount) amounting to £115,660, and also the preliminary expenses of the company, amounting to £17,385, had been written off in the profit and loss account, so that they would start the next year's account with a clean sheet in that respect. £100,000 had been placed to capital reserve account. It was satisfactory for the company to be in a position to place a substantial sum to reserve in its first financial year. This reserve would, of course, be available for meeting any further expenses which might be incurred in the issue of further capital or debentures, or it might be held to meet any special depreciation in the assets should any unforeseen contingency arise in years to come. They had, of course, charged the profits of their subsidiary concerns with proper depreciation, before taking them into the accounts. From the "assets" side of the balance sheet it was obvious that at the end of last year the company was in the main a holding company, the item for "buildings, plant, machinery, &c.," representing for the most part purchases from the Ministry of Munitions. In next year's accounts it was anticipated that certain assets in the subsidiary companies would have been transferred or leased to the company. They had already made some progress in this direction. Dick, Kerr & Co., Ltd., were in liquidation, and they hoped the liquidator would be in a position to transfer the assets during the current year. Leases in favour of the company of two of the other works had been prepared, and it was expected that these would be completed shortly. The most important transactions since the formation of the company were as follows: First, the purchase of the Stafford works of Siemens Bros. Dynamo Works, Ltd., together with the engineering and sales organisation connected therewith. This not only provided an immediate increase of manufacturing capacity, but also provided a working arrangement with the parent company—Siemens Bros. & Co., Ltd.—covering the supply on favourable terms of their specialities, notably cables of all sorts, which might be required in connection with comprehensive contracts undertaken by the

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English Electric. Secondly, an amalgamation of the contract department of Dick, Kerr & Co., with that of J. G. White and Co., in the form of the Consolidated Construction Co., which eliminated one of the strongest competitors of the past. This new company would be useful in carrying out civil engineering work which it might be necessary to undertake from time to time. It should be made clear that J. G. White & Co., with their many ramifications, were unaffected other than in the contract department, and that while the transaction had been carried out by exchange of shares, there was no binding agreement between the two companies to the exclusion of their respective competitors. In the third place, a subsidiary company, the English Electric Supplies, Ltd., had been formed to take over the assets of the Britannia Lamp & Accessories Co., Ltd., which formerly marketed incandescent lamps and other accessory electrical apparatus on behalf of Dick, Kerr & Co., and arrangements had been made for considerably expanding the variety of this class of manufacture. Finally, a negative transaction was the disposal of the Scotstoun Works of the Coventry Ordnance Works, Ltd. These works were built on the banks of the Clyde by the Coventry Ordnance Works to deal with the heaviest form of naval gun mountings. Having regard to the problematical future of the armament industry it was felt that if a satisfactory arrangement for their disposal could be made, it would be good policy to take advantake of it, and accordingly the sale had been completed on terms which the board considered reasonable. There were certain indications that the relations between employers and employed were becoming less strained. The disturbance which quite naturally resulted from the rapid demobilisation of so many workmen from the Army, and the quite natural anxieties of the trade unions concerning their post-war working conditions were being slowly, but he felt nevertheless surely, overcome, and the recent decision of the National Federation of General Workers to accept payment by results, together with the agreement of the Amalgamated Society of Engineers to subject this question to a ballot of its members, were favourable portents for the future. While, therefore, for the next year or so the position could not be free from anxiety, he believed that the more moderate elements of labour showed indications of their willingness to co-operate with them, provided they could see a fair and reasonable basis for compromise. This was a general outline of the activities at home, and, generally speaking, the year had been mainly devoted to the consolidation and organisation of the different units. It was believed that for the most part this had now been accomplished, although much had yet to be done in detail. During last year very little real production of electrical and allied apparatus took place. The earlier part of the year was devoted to rearrangement of shops and remodelling in design, and they were just getting on to a producing basis when the unfortunate strike of moulders found them with none of the stocks of their raw material which would have been available in normal times, and therefore they were under the necessity of immediately reducing output by in some cases discharge of employés, and in others the working of short hours. The effect still remained even after 13 weeks since the settlement. They were perhaps more fortunate than some in that they had three most excellent foundries in their group, but they were handicapped by the shorter hours worked, and the fact that piece-work arrangements had not been yet agreed to. The importance of this question could not be over-estimated, as the engineering output of the country was at present limited by its foundry capacity. Their order book was large, sufficient to keep all our 10,000 employés fully employed for 18 months if only they could get the necessary material; indeed, if material were forthcoming they could double their pay-roll without any risk of running short of work. They have now on the books orders amounting in sale value to £4,750,000, some of which would cover a long period of time to complete, but the bulk was what might be termed quick turnover and repetition work, the demand for which was practically unlimited if only they could secure that production was sufficiently expeditious to compete with America and other foreign makers. Abroad they had not been idle. The manufacturing arrangements made by Dick, Kerr & Co., with the Constructions Electriques du Rhone in France and the Toyo Denki in Japan were being taken over by the company and considerable expansion had taken place, especially in the case of the French company, now known as Constructions Electriques de France, with a subsidiary company known as Les Constructions Electriques de Belgique. The combined capital of these two concerns was 90,000,000 francs, and they had granted them extended manufacturing rights under their various designs and patents. In Australia the English Electric Co. of Australia, Ltd., had been formed with a capital of £600,000, all subscribed locally. This company, like themselves, was a consolidation of existing manufacturers, and was now erecting new shops especially for production under their various designs. Similar arrangements would be entered into in other Dominions when opportunity offered. He would like, in conclusion, to say a few words on the present position and prospects of the electrical industry generally both in this country and abroad. In this country the Electricity (Supply) Act which became law at the end of last year marked the first step on the road towards the systematic development and organisation of the supply of electric energy. In the past the uncertainty of tenure, the lack of technical uniformity and the unnatural areas of distribution which they owed to the legislation of the eighties had hampered and obstructed electrical progress. Now, for the first time, it might become possible to look at the problem of providing a cheap and efficient supply of electricity as a whole. In the Electricity Commissioners there was created a competent national authority with this express object. The new Act was shorn of some of the features of the scheme contained in the original Bill. In particular, the financial powers and responsibilities of the authorities which it set up had been severely restricted, and it was to be hoped that there would be no immediate revolutionary change in the ownership of the concerns which supplied and distributed electricity, even if Parliament should find it advisable to grant the increased powers now asked for. A comprehensive system would come gradually, and there was reason to think that in that way there was a better prospect of its successful introduction. An essential part of the scheme contemplated by the Government was the provision of a number of large generating stations at strategic points, the so-called super power stations. The most suitable centres for these stations and the type of plant to be erected in each had not yet been determined, and could not in fact be determined without the fullest preliminary inquiry, which it was the duty of the Electricity Commissioners to conduct. But it was clear that the attainment of the cheapest possible national supply of electricity would ihvolve, *inter alia*, the construction of generating stations containing larger units and giving a greater total output than had been commonly found in this country in the past. This was a task which would give full scope for the designing and manufacturing skill of the electrical industry. They were already engaged on a comprehensive contract for the construction and equipment at Blackburn of what, from its strategic position and its ultimate destiny as the supplier of a wide industrial area, might be described as the first of the super-power stations. In another sphere, that of electric traction, they looked forward to the progressive extension of railway electrification. In the uncertainty which at present surrounded the future ownership and management of the transport system, it was not surprising that there was a disposition to mark time. But at least one important main line electrification had already been decided on, and the system to be ultimately adopted throughout the country was now under consideration by a special Commission inquiring into a number of important points of detail which must be settled before electrification proceeded. In the next ten years they would see important developments in electric traction. Abroad, as at home, the future was full of promise, wherever they turned they found in progress or in contemplation the extended application of electric power to industry or to transport. Where, as in India, abundant water power existed, hydroelectric schemes were being developed. In South Africa an important scheme of railway electrification was contemplated. Everywhere electric drive was being introduced into collieries and mineral works, cotton and jute mills, oilfields and sugar plantations, and various other industries. Coming nearer home, the French company with which they were associated, the Constructions Electriques de France, had recently obtained large contracts spread over a term of years for the electrification of the greater part of the system of the Chemins de Fer du Midi. He had indicated the problems they had to face, and the road over which they had to travel. As days and years went by the English Electric Co. would maintain its high reputation for excellence of design and good honest workmanship, and so play an honourable part in the development of this great industry.

Mr. W. L. Hichens seconded the motion, and it was carried.

Johnson and Phillips, Ltd.

Mr. W. Claude Johnson presided at the annual meeting on April 29th. He said that the profit for the year, after charging to revenue upwards of £27,000 for maintenance of buildings, plant, &c., amounted to £89,964, or very nearly £10,000 more than in the preceding year. The share capital now stood at £350,000, and there was a balance to the credit of share premium account amounting to £7,790. On the other side of the account it would be seen that they had expended during the year £53,581 on additions to buildings and plant. The stocks and work in progress amounted to £468,352, which was an increase over the preceding year of approximately £130,000. The whole of that increase was for work in progress and finished goods ready for despatch, which would all show a reasonable profit as soon as sales and delivery were effected. The directors thought the profit on the year might be considered very satisfactory, although it was not as great as anticipated. That was due to the many difficulties they had had to contend with in changing over from war work to their ordinary commercial business, and more particularly to the enormous trouble they had had in obtaining raw materials. Had they been able to obtain raw material more readily the turnover and profits would have been so much the greater. The orders booked during the current year far exceeded anything that they had had to deal with in the past. The orders in hand for the Post Office alone at one time totalled well over £250,000. Their foreign business had also increased very satisfactorily, and included some important orders not only for Europe, but

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also for Japan and the United States of America. That increase in the business was confidently expected by the directors, and it was for that reason that they had made such extensive additions to the buildings and plans at the works. Unfortunately those extensions had taken a great deal longer to complete than was anticipated, owing to various circumstances, particularly to the shortage in steel work and building materials, and also to the strike in the foundry trade. If these additions had been completed by the contract time they could have given employement to many more workpeople, increased the turnover, and the profits would have been larger in proportion. The extensions were now nearing completion. Some of the new building and plant had already been in working order for the past two or three months, and he thought they might, therefore, look forward confidently to further increased profits for the current year.

Following the transaction of the usual business, the chairman proposed a resolution increasing the nominal capital of the company from £350,000 to £700,000 by the creation of a further 350,000 £1 ordinary shares.

Mr. J. Macgregor, the managing director, said that the extension of the works and the increased business which was being done entailed further capital outlay, and if they were to reap the full advantage of the enormous demand for their manufactures they must have more money. They had a great deal more work offered to them than they could at present do, both for home and foreign markets. They had the buildings and machinery, the staff, and everything ready to do the business, but they had not sufficient money to tackle the ever-increasing business which was offered. The directors, after very careful consideration, had come to the conclusion that it would be of great advantage to the company to have that additional capital at command. It would indeed be a pity if such a golden opportunity of using money at a very profitable rate were missed. It was not proposed to issue all the new shares at present; they wanted to go cautiously and feel their way, and for that reason it was proposed to issue only 87,500 at par, but to have the power to issue the balance from time to time as business and circumstances demanded. That would mean that they could offer the shareholders one new share for every four shares they now held.

The motion was agreed to.

Woking Electric Supply Co., Ltd.—Revenue for 1919 £33,326, less expenses £20,116. Including balance brought forward and income tax accumulations there is £14,193 available, out of which debenture interest absorbs £2,726, loan interest £665; dividends of 6 per cent. on the cumulative preference shares, and 7 per cent. on the "B" cumulative preference shares are paid; £3,000 is put to depreciation and renewals, £2,000 to reserve, £500 is written off goodwill, and other sums off other items; the dividend on the ordinary shares is 5 per cent. per annum. The number of consumers has increased from 2,227 to 2,317; the lamps connected from 143,490 to 167,710; and the revenue from £28,184 to £33,326. There has been a considerable improvement in gross revenue. A new turbo-alternator was put into commission in 1918, and has effected a marked improvement in the working which has more than offset the increase in the cost of fuel and wages.

Craigpark Electric Cable Co., Ltd.—Net profit for year ended March, 1920, £17,454, after making provision for excess profits and corporation taxes, plus £1,560 brought forward. There is to be appropriated to depreciation off buildings and machinery £3,000; to reserve £5,000; dividend on 6 per cent. preference shares £2,850; 12½ per cent. dividend on the ordinary shares £4,687; carried forward (subject to directors' fees) £3,476. Mr. G. A. Buchanan has resigned his seat on the board. Mr. Donald Maclean has been appointed a managing director.

Indian Electric Supply & Traction Co., Ltd.—The surplus on working in Cawnpore in 1919 was £27,933, against £19,271 in 1918. The total to credit of net revenue is £28,243. London expenditure was £2,309; debenture interest £3,796; to depreciation and renewals reserve £6,000; general reserve £2,500; debenture issue expenses written off £2,500; final dividend of 6 per cent., making a total of 9 per cent. for the year; directors' commission on dividends £405; to be carried forward £3,808.

Shanghai Electric Construction Co., Ltd.—Dividend of 2 per cent. and a bonus of 6 per cent., less tax, on ordinary shares, making 20 per cent. for year; £43,000 to reserve for excess profits duty, £35,000 to general reserve, £10,000 to reserve for renewals, £5,779 carried forward.

James Keith & Blackman Co., Ltd.—The *Financier* states that the directors have decided to offer to proprietors 40,000 ordinary shares at par.

Stock Exchange Notices.—Application has been made to the Committee to allow the following to be officially quoted:—

Adelaide Electric Supply Co., Ltd.—250,000 5 per cent. (free of tax) "A" cumulative preference shares of £1 each, fully paid.

Doulton & Co., Ltd.—Dividend of 5 per cent., less tax, on the preference shares for 1918.

Fellows Magneto Co., Ltd.—Dividend of 25 per cent. on the ordinary shares, against 24 per cent. The preference shares receive a participating dividend of 1½ per cent., making a total of 9½ per cent. for the year, the same as for last year.—*Times.*

City Electric Light Co., Ltd. (Brisbane).—Credit balance £42,519, plus balance brought forward, making £42,934. Dividend on the preference shares has been paid and 5 per cent. on the ordinary. Balance forward £431.

Adelaide Electric Supply Co., Ltd.—Interim dividend on the ordinary shares at the rate of 10 per cent. per annum, free of British tax, for the half-year ended February 29th.

Melbourne Electric Supply Co., Ltd.—Interim dividend on the consolidated ordinary stock at the rate of 10 per cent. per annum, free of British tax, for the half-year ended February 29th.

Chiswick Electricity Supply Corporation, Ltd.—Dividend 7½ per cent.; £2,000 to depreciation reserve; £1,208 carried forward.

STOCKS AND SHARES.

TUESDAY EVENING.

GOVERNMENT borrowing is again a disturbing factor in the financial world. Money is asked for 6 per cent. Housing Bonds and for a new kind of Treasury Bond, to replace floating debt, carrying variable rates of interest. The latter issue offers 7 per cent. per annum for at least six months before the interest can be changed, and its novelty consists, of course, in the interest being subject to fluctuations. It is thought that with these two Government loans before the public, the fear of an 8 per cent. Bank Rate no longer presses. On the other hand, the City is under no misapprehension as to the probable result, in the shape of a levy on capital, which a failure of the new Treasury bonds may entail. At the outset, the bonds are attracting little more than languid attention from the ordinary investor. His experience of the course of prices of British Government loans from November, 1913, to the recent 5½ Exchequer bonds has hardly given him a keen appetite for such securities.

All investment markets in the Stock Exchange are tempered by the monetary outlook. Yet, as on previous occasions, the presence of domestic difficulties leads capital to seek the safer paths, and for this reason, gilt-edged issues manage to maintain a less slippery tendency than many others.

The position of Underground Electric Railways 6 per cent. income bonds interests so wide a circle that even the modest recovery of a couple of points affords subdued satisfaction. Some of the holders do not entirely admire the extreme candour with which the company advertises its financial struggles with the ever-increasing burden of costs. They are inclined to think that the policy may induce proprietors to become nervous and to throw out their stock, although doubtless the advertisements are framed with the intention of preparing the public for the increased fares that Parliamentary sanction is sought to permit. Certainly, the statistics convey the impression that under existing conditions the Tubes, Undergrounds and 'buses can scarcely hope to make more than some meagre profit which may not suffice to pay, for instance, even the 4 per cent. at present distributed to holders of Underground incomes. The price therefore dropped very close to 60 before longer-sighted buyers came in and picked up a little stock to put away for future appreciation.

Metropolitan ordinary braced up to 20 on somewhat similar purchases. The stock returns 6¼ per cent. even now, on the basis of the 1¼ per cent. dividend paid last year. One philosopher pointed out that buyers of the stock limit their loss to 20 points at most, while on the other hand, they run the risk of seeing the price double in a few years' time, and that the outlay of a modest hundred pounds will secure £500 stock. Districts have gone back to 17½, and Central London assented ordinary is flat at 44½.

Fears of how the increased Excess Profits Duty may affect dividends on commercial undertakings are considered sufficient reason to explain falls in such shares as General Electrics, Callender's, Telegraph Constructions, Siemens, and others. (Electric Constructions were marked down to 21s. 3d. last week, but apparently somebody blundered and the quotation is restored to 23s.) Doubtless this E.P.D. anxiety has much to do with the declines in such shares, but another cause for selling has been that when losses arising out of undue speculation have to be met, the operators have to realise anything that will provide cash. Heavy liquidation has been going on for at least five weeks. This selling is now thought to be finished. In some Stock Exchange markets a brighter tendency is discernible. If the forced sales are indeed at an end, prices will recover. There will be a discounting of what shall happen next year, and the cheapness of many good investments is undeniable. But that the convalescent stage is still not far advanced is manifest from the way in which prices break whenever a little selling puts them to the test. British Columbia Electric Railway 4½ per cent. debentures fell 9 points on Tuesday, to-day, when attempts were made to realise stock, and the company's 4½ per cent.

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Vancouver debentures dropped 7, both prices meeting at the common level of 65½.

More revolutionary excitements are reported from Mexico, and the Utilities continue flat. Calcutta Electric Supply ordinary have gone back to 8½. Bombay Electric preference are down to 13½, and the ordinary shares to 112—both being ex rights. The allotments of the new River Plate shares are now distributed. Melbourne Electric and Adelaide Electric both declare interim dividends at the rate of 10 per cent. per annum, free of tax.

Brush ordinary at 150 is now ex the £15 dividend deducted last week, and stock changed hands at this figure. Canadian General Electric, quoted nominally at 116–119, was sold the other day at 111. Victoria Falls preference are attracting a little interest on the basis of a guinea. Brazilians exhibit something of a heavy tendency. London and Suburban 5 per cent. cumulative preference came to market this week at 3s. 9d. The last dividend paid was in June, 1918.

Electricity Supply shares are little changed. City Lights have shed 5s. and South London 2s. 6d., the latter bringing the price to 50s. It is doubtful, however, whether there are many shares about. Business amongst cable issues is also uninteresting. Cuba ordinary and Globe preference are both 10s. lower. Marconis fell from 3¾ to 3 7-16 in sympathy with dulness in other departments. Canadians gave way to 11s. 3d. Armaments are lower; Vickers easing off to 31s. The Rubber share market is upset by considerations of the Excess Profits Duty, nor does a slight fall in the price of the produce encourage shareholders. Quotations are mostly lower on the week. One of the older companies, the Selangor, has just issued its report, showing all-in costs of only 8¾d. per lb., which must be something near a record of cheap working.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1918.	Dividend 1919.	Price May 4, 1920.	Rise or fall.	Yield p.c.
Home Electricity Companies.					
Brompton Ordinary	8	12	6½	—	£9 4 8
Charing Cross Ordinary	4	7	5½	—	9 0 8
do. do. do 4½ Pref.	4½	4½	2½	—	8 8 8
Chelsea	3	4	3	—	6 8 4
City of London	8	10	11½	— ½	8 8 4
do. do. 6 per cent. Pref.	6	6	9	—	6 13 4
County of London	7	8	9	—	8 17 10
do do. 6 per cent. Pref.	6	6	8½	—	6 17 2
Kensington Ordinary	6	7	5	—	7 0 0
London Electric	Nil	2½	1½	—	5 2 6
do. do. 6 per cent. Pref.	6	6	8½	—	9 4 8
Metropolitan	5	6	3½	—	8 17 10
do. 4½ per cent. Pref.	4½	4½	2½	—	8 0 0
St. James' and Pall Mall	10	12	6½	—	8 16 10
South London	5	6	2½	— ½	9 12 0
South Metropolitan Pref.	7	7	18/9	—	7 0 0
Westminster Ordinary	8	10	5½	—	9 10 6
Telegraphs and Telephones.					
Anglo-Am. Tel. Pref.	6	6	77½	—	7 14 10
do. Def.	22/6	1½	18½	—	8 0 0
Chile Telephone	6	6	6½	—	*4 13 2
Cuba Sub. Ord.	7	7	9½	— ½	*7 7 4
Eastern Extension	8	10	15½	—	*6 9 1
Eastern Tel. Ord.	8	10	160	—	*6 5 0
Globe Tel. and T. Ord.	8	10	15½	—	*6 7 0
do. do. Pref.	6	6	8½	— ½	7 1 2
Great Northern Tel.	22	—	22½	—	9 15 6
Indo-European	13	10	40	—	6 5 0
Marconi	25	—	3 7/16	— 1/16	7 5 4
Oriental Telephone Ord.	10	—	2 1/16	—	8 11 0
United R. Plate Tel.	8	—	7½	—	*5 1 7
West India and Panama	1/8	—	⅛	—	7 13 10
Western Telegraph	8	10	15½	—	*6 7 0
Home Rails.					
Central London Ord. Assented	4	4	44½	—3	8 19 9
Metropolitan	1	1½	20	+ ½	6 5 0
do. District	Nil	Nil	17	— ½	Nil
Underground Electric Ordinary	Nil	Nil	2	—	Nil
do. do. "A"	Nil	Nil	5/-	—	Nil
do. do. Income	5	4	68½	+2	6 6 0
Foreign Trams.					
Anglo-Arg. Trams. First Pref.	Nil	Nil	3½	—	—
do. do. 2nd Pref.	—	—	3	—	—
do. do. 5 Deb.	5	5	57½	—2	8 18 10
Brazil Tractions	—	—	49	—2	—
Bombay Electric Pref.	6	6	18½	—1½	4 9 0
British Columbia Elec. Ry. Pfce.	5	5	54½	—2	9 8 6
do. do. Preferrred	2½	5	50½	—	9 18 0
do. do. Deferred	Nil	3	44½	—	6 14 10
do. do. Deb.	4½	4½	54½	—1	7 16 8
Mexico Trams 5 per cent. Bonds	Nil	Nil	31½	—	Nil
do. 6 per cent. Bonds	Nil	Nil	20	—	Nil
Mexican Light Common	Nil	Nil	12½	—	Nil
do. Pref.	Nil	Nil	17½	—	Nil
do. 1st Bonds	Nil	Nil	36	—	—
Manufacturing Companies.					
Babcock & Wilcox	15	—	8	—	*5 0 0
British Aluminium Ord.	10	10	1 1/16	—	9 8 2
British Insulated Ord.	12½	15	1 1/16	—	7 14 8
Callenders	25	—	8	— ½	7 16 8
,, 6½ Pref.	6½	6½	4½	—	6 16 10
Chatner-Kellner	20	—	4	—	—
Crompton Ord.	10	—	22/-	—	9 1 10
Edison-Swan, "A"	10	—	1½	—	8 17 10
do. do. 5 per cent. Deb.	5	5	79½	—	6 5 9
Electric Construction	10	—	23/-	+1/9	8 18 10
Gen. Elec. Pref.	6½	6½	18/6	—	7 0 6
do. Ord.	10	—	1½	— ½	*6 3 1
Henley	25	15	2½	—	7 1 2
do. 4½ Pref.	4½	4½	3½	—	6 8 7
India-Rubber	10	—	13½	—	*7 11 0
Met.-Vickers Pref.	—	8	2 1/16	—	6 11 2
Siemens Ord.	10	10	27/-	—6d.	*7 8 2
Telegraph Con.	20	20	23½	—½	*5 2 0

* Dividends paid free of Income Tax.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Tuesday, May 4th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Oxalic	per lb.	2/10	...
a Ammoniac Sal	per ton	£100	...
a Ammonia, Muriate (large crystal)	,,	£92	...
a Bisulphide of Carbon	,,		...
a Borax	,,	£42	...
a Copper Sulphate	,,	£62	...
a Potash, Chlorate	per lb.	1/-	...
a ,, Perchlorate	,,	1/3	...
a Shellac	per cwt.	£28	...
a Sulphate of Magnesia	per ton	£18	...
a Sulphur, Sublimed Flowers	,,	£28	...
a ,, Lump	,,	£25	...
a Soda, Chlorate	per lb.	6d.	...
a ,, Crystals	per ton	£12	...
a Sodium Bichromate, casks	per lb.	...	...
METALS, &c.			
g Babbitt's Metal Ingots	per ton	£118 to £345	...
c Brass (rolled metal 2" to 12" basis)	per lb.	1/8½	...
c ,, Tubes (solid drawn)	,,	1/6½ to 1/6½	½d. inc.
c ,, Wire, basis	,,	1/8½	...
c Copper Tubes (solid drawn)	,,	1/8½	½d. inc.
g ,, Bars (best selected)	per ton	£163	...
g ,, Sheet	,,	£163	...
g ,, Rod	,,	£163	...
d ,, (Electrolytic) Bars	,,	£114	£1 inc.
d ,, ,, Sheets	,,	£156	...
d ,, ,, Wire Rods	,,	£129	£1 inc.
d ,, ,, H.C. Wire	per lb.	1/4½	...
f Ebonite Rod	,,	8/-	...
f ,, Sheet	,,	2/6	...
n German Silver Wire	,,	3/-	...
h Gutta-percha, fine	,,	18/-	...
h India-rubber, Para fine	,,	2/3	½d. dec.
i Iron Pig (Cleveland Warrants)	per ton	Nom.	...
l ,, Wire, galv. No. 8, P.O. qual.	,,	£57	...
g Lead, English Pig	,,	£41	10/- inc.
g Mercury	per bot.	£24 to £24 10/-	10/- to 20/- dec.
e Mica (in original cases) small	per lb.	6d. to 4/6	...
e ,, ,, medium	,,	5/- to 10/-	...
e ,, ,, large	,,	12/6 to 25/- & up	...
g Phosphor Bronze, plain castings	,,	1/7 to 1/11	...
g ,, ,, rolled bars and rods	,,	2/2 to 2/6	...
g ,, ,, rolled strip & sheet	,,	2/3 to 2/9	...
d Silicium Bronze Wire	per lb.	1/11½	...
r Steel, Magnet, in bars	,,	1/8	...
g Tin, Block (English)	per ton	£321 to £322	£22 dec.
n ,, Wire, Nos. 1 to 16	per lb.	5/3	...
White Anti-friction Metals	per ton	£90 to £345	...

Quotations supplied by—

a G. Boor & Co.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
r W. F. Dennis & Co.

Industrial Christian Fellowship.—We are asked to announce that the annual meeting in connection with the Industrial Christian Fellowship will be held on Wednesday, May 12th, at 3 p.m., in the Large Hall of the Church House, Westminster. The chair is to be taken by the Right Hon. Lord Colwyn, who will be supported by the Lord Bishop of Lichfield, Miss Knight-Bruce, the Right Hon. William Adamson, M.P. (leader of the Labour Party in the House of Commons), and Mr. W. C. Bridgman, M.P.

The Industrial Christian Fellowship has lately joined forces with the Christian Social Union, and their united object is to minister spiritually and socially to all engaged in the industrial world:—

1. To appeal to them to confess their faith in Christ and to seek to unite all classes in a bond of Christian fellowship and prayer.
2. To claim for the Christian law the ultimate authority to rule the whole life of humanity, and to study in common from an international standpoint how to apply the moral truths and principles of Christianity to the social, economic, and industrial system of the world.
3. To present Christ in practical life as the living Master and King, the enemy of wrong and selfishness, the power of righteousness and love.

The Industrial Christian Fellowship holds that there can be no solution of the present unrest unless those who make, or resist, demands for a new order test their attitude before taking action by the standard and teaching of Christ. If class warfare continues, catastrophe is imminent, and the Church can prevent it by strong, definite leadership now.

Early application should be made for tickets, which can be had from the headquarters of the Industrial Christian Fellowship, Church House, Westminster.

Wireless Torpedoes.—An invention by a French wireless engineer, M. Dunoyer, according to the daily Press, consists of what he calls an "electric safety lock." The mechanism to direct the course of a torpedo and secure its explosion against an enemy warship can be worked not only by wireless waves of the right length, but also by a proper sequence of Morse signals. Any error in the right sequence of dots and dashes would run the mechanism down to zero again and render the torpedo harmless. Each torpedo launched would have its own key sequence of dots and dashes, and so the enemy would be unable to tamper with it.

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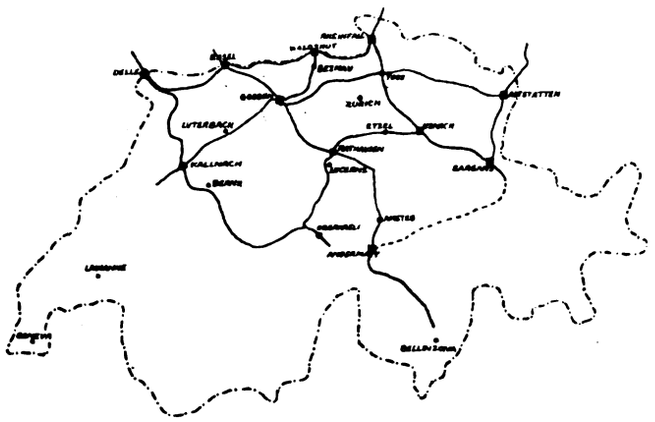
THE EXPORT OF ELECTRICAL ENERGY.

The export of electrical energy is an obvious and rational development of the super-station and super-transmission schemes now in more or less active operation or construction in all civilised countries. For generations past, energy has been exported in the form of coal, the latent energy of which is associated—(1) with mass and volume which occupy railway and shipping space, and entail an expenditure of energy equivalent to quite a serious percentage of the energy in the coal itself; (2) with anything from 2 to 20 per cent. of ash, which is dead material, and represents waste at every stage of its career from pit to ash-heap; and (3) with the bases of innumerable by-products which should never be allowed to remain in coal, since most of them have no fuel value, but have, on the other hand, a total value (when separated for specific applications) comparable with, or exceeding, that of the coal itself.

Electricity as a form of energy for export is subject to none of these disadvantages. It is energy itself, and has neither mass nor volume, so that it makes no demand upon the roads, railways, and shipping which are essential to the transport of material products. Transmission lines are required, it is true, but these act also as distribution lines without impairing the efficiency of "through traffic." Also, the rapid increase in the pressure at which electrical energy can be transmitted, has reduced the investment on lines and poles to a remarkably small sum per KW.-year. There can be no question that the overland export of electrical energy —and possibly its submarine export over moderate distances—compares far more favourably than is yet generally realised, with the cost of transporting and distributing coal. Electricity is the only form in which energy as such can be transmitted over any considerable distance, and in



Map of Swiss Power Transmission Lines.

view of the world-wide coal crisis, and the established position to which electricity has attained in respect of bulk production and distribution, it is reasonable to anticipate that the export of electrical energy will become an important factor in national economics within the next decade.

It is now several years since 3½ miles of 25,000-volt three-phase cable was laid under the sea between Palajo (Sweden) and Marienlyst (Denmark). Here the question of exporting electrical energy was involved, but this aspect of the case was rather obscured by the interest attached to installing a high-tension submarine cable for power service. The clear-cut issue of electricity-export as a means of utilising natural wealth and improving the over-all efficiency of electricity works in the exporting country, is raised by the foundation of the Schweizerische Kraftübertragung A.G. This company was established in 1918 by the North-East Swiss Power Co. (in which the cantons of Aargau, Schaffhausen, and Zug are interested), and the Berne Power Co. (most of the shares in which are owned by the canton and municipality of Berne). Whilst retaining the commercial incentives of a trading company, the new concern has a semi-State character which will secure public interests. As explained by Dr. Bruno Bauer in the *Bulletin* of the Swiss Electrotechnical Association, the fundamental aim of the new company is to ensure that the best use is made of all Swiss power stations. This will ensure maximum prosperity to the latter, and at the same time will provide Swiss industries with abundant cheap power. The means by which these results are to be attained, are:—(1) The encouragement of new industries, particularly those capable of adjustment to suit the seasonal variations of hydro-electric power; (2) the improvement of hydraulic storage on a broad basis adapted to the best advantage of all the power stations; (3) the provision of extra high-tension bus lines, not so much to equalise the load and output between stations, as to provide for the efficient export of electrical energy surplus to the requirements of the country. It is considered that a number of the large power stations proposed in Switzerland are only justified if full use is to be made of their possible output by exporting energy. There is not much room for improvement in the way of interchanging energy between stations, the latter being subject to closely similar variations in demand and to similar variations in capacity, since the nature of the load and of the water power is much the same in each case. Also, groups of existing stations are already interlinked sufficiently for load-equalising purposes. Electricity for export is the broad policy for major developments.

The provision of "100,000-volt bus lines from Geneva to Lake Constance, to which all stations would be connected," would not in itself constitute a rational solution to the problem. Nothing is to be gained by duplicating or replacing existing connecting and distributing lines. Use should be made, wherever possible, of existing lines, and a high-power, high-voltage network, with a few feeding points at the main centres of energy distribution, should be used for such energy interchange and balancing as is possible between existing networks, the main function of the new network being, however, to carry energy for export. The total capacity of hydroelectric stations likely to be developed in Switzerland during the next five or ten years will probably far exceed the power requirements of the country, even allowing for a large increase therein. The export of electrical energy should, therefore, become an important industry and a source of considerable national wealth.

In the conveyance of energy to the frontier export points, the Schweizerische Kraftübertragung A.G., working with the support of the individual electricity undertakings, should be able to overcome technical and economic problems which would be almost prohibitive to a less comprehensive organisation. Provisional schemes for the network to be owned or leased by the S.-K. Co. provide for the lines indicated on the attached map. For mere interchange of energy between existing stations or networks, a line pressure of 45,000 to 50,000 volts would be sufficient, but for the main transmission lines carrying energy to new bulk consumers in the country and to the frontier stations, a pressure of 120,000 to 150,000 volts should be employed. The main feeder, or collecting points, would then be equipped as transformer sub-stations for, say, 135 KV./50 KV., interconnecting local networks with the extra high-tension system. For the latter yet higher pressures may ultimately be employed, 220,000 volts being already contemplated in the United States for long-distance work.

Control of the output of some dozens of power stations feeding the super-network will naturally be on the "load-dispatcher" system which has already proved necessary and satisfactory in a number of American installations. Wireless telegraphy or telephony is suggested for intercommunication between the load dispatcher and the individual stations, and frequent conferences between the engineers of all the undertakings concerned will, of course, be required in order to allow properly for the individual circumstances and requirements of each concern, and to deal with the innumerable points which must receive attention if so widespread a system is to be operated and maintained successfully. The financial details will demand much attention, particularly in view of the necessarily different costs in individual stations, but it appears to be certain that reasonably uniform selling prices must be established throughout the system. At any rate, there must be no financial inducement for con-

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sumers to seek connection at points or in manners inimical to the efficiency of the system as a whole. Penalisation of low power factor by a tariff taking power factor into account, cannot logically be omitted, since there is no valid reason why consumers should operate at low net power factor.

The first section to be built in the contemplated Swiss network is the Gösgen-Lüterbach line which will at first serve to interchange energy between Lüterbach in the Berne Power Co.'s system and the Olten-Gösgen and Beznau line. The line will be operated at 50,000 volts for about two years, the pressure then being increased to 80 KV., and finally to 135 KV. or higher, the line then being extended to Kallnach. In order to provide for these developments, the line is laid out with two sets of three aluminium cables of 191 sq. mm. section, and an earth wire. The normal span is 240 m., and to allow for the softness of aluminium, the breaking stress is taken as 16·5 kg. per sq. mm. Chains of eight suspension insulators are to be used, and the clearances are sufficient for working at 150 KV.

A 50-KV. line from the traction station at Omsteg to Lucerne is proposed to deal with surplus energy available from the former, and this line would then connect with the Gösgen-Kallnach line over the Central Swiss Co.'s Lucerne-Gösgen line. The Rathausen-Etzel-Uznach line (probably at 50 KV.) would be undertaken if a large surplus of energy became available in Central Switzerland. Further developments, concerning which it is yet too early to speak definitely, would be the extension of the western E.H.T. line to Toss, and the completion of the Oberhasli project. Plans for the requisite transformer and switching stations, which will embody a number of interesting features, are at present under consideration. The policy adopted and the progress already made indicate that the export of electrical energy is a phase of international economics of immediate importance.

AUTOMATIC PROTECTIVE DEVICES FOR A.C. SYSTEMS.

By A. E. McCOLL, A.M.I.E.E.

(*Abstract of paper read before the* INSTITUTION OF ELECTRICAL ENGINEERS.)

THE purpose of this paper is to deal with some recent developments in protective apparatus for A.C. systems, and to describe a number of devices which have been omitted from recent papers on the subject. Core balance or leakage protective devices are usually dependent for their inactive condition on a summing up of the currents in a circuit, which may be obtained in several ways. Devices of this type form a simple, cheap, and efficient means of protecting many parts of a system. The author then discusses the magnetic balance relay as a leakage protective device applicable to cases where three transformers on a polyphase system are available; the Ferraris disk employed as a mechanically-balanced leakage protective device, also capable of protecting against unsymmetrical loading; and other applications of the biased principle to core-balancing devices.

Parallel feeder protection is next discussed. An advance in the art of parallel feeder protection takes advantage of the principle that, normally, parallel feeders of the same length and cross section will share substantially in the distribution of the load current. A breakdown on one feeder, however, will alter the relative current values, so that usually the faulty feeder carries the heavier current. A number of interesting and useful devices have been developed which take advantage of this condition. These devices are normally balanced against one another, but immediately operate to select the more heavily loaded of two or more parallel feeders. In the future, devices of this nature will find a larger field of application. The majority of interlocked relay devices operate on the balanced principle; a few systems have been developed, however, which employ the bias. The biased principle as applied to parallel feeder protection was first proposed by Mr. Wedmore, and engineers generally have been slow to recognise the good features inherent in devices operating on this principle. With biased systems of protection, a definite measure of stability is obtained and smaller fault settings are thereby obtainable. This particularly applies to the larger power schemes where the ratio of possible short-circuit current to the normal rating of the parallel feeders is large.

Parallel feeder protection and discriminating relay protection with biased reactive type relays are then considered.

In the past a number of causes have contributed to unsatisfactory operation of the reverse power relay when associated with the end protection of parallel feeders. First, severe fault conditions between phases near the feeder end in most cases result in the potential being extinguished. Secondly, if the connection for the potential coil is taken from the star potential of the circuit, and the current in the potential and current coils is substantially in phase, there is a shift of 90 degrees in the phase of the potential coil. This happens if the voltage triangle collapses on one side due to a short-circuit between two phases. If the current at the fault point is lagging, there is a further shift in the relation of the potential and current coils.

A connection which has recently been employed with a fair measure of success utilises the current, say, in phase 1 and the delta potential across phases 2 and 3. The respective vectors for current and potential are normally 90 degrees apart. These are pulled into their proper phase relation, in either the induction or reactive types of relay, by employing the requisite proportion of resistance or reactance in the potential winding. In the event of a short circuit of magnitude sufficient to distort the voltage triangle, it will be found that the potential and current vectors retain their relative positions. Any further shift in phase relation due to low power factor at the fault point will not be sufficient to rotate the respective vectors beyond their proper operating quarters, although the relay may still remain unresponsive to the most severe conditions.

Fig. 1 shows a general scheme for the protection of parallel feeders wherein mechanically balanced relays are employed at the end adjacent to the source of supply and reverse relays at the remote end. The mechanically balanced discriminating relays, including their respective transformers, are all connected for circulating current.

Equipotential points on the various relays are connected together by a balancing lead. If the symmetrical loading of the loop is altered by one feeder becoming faulty, the transformer carrying the larger current diverts its excess current through the operating coil of its particular relay and by way

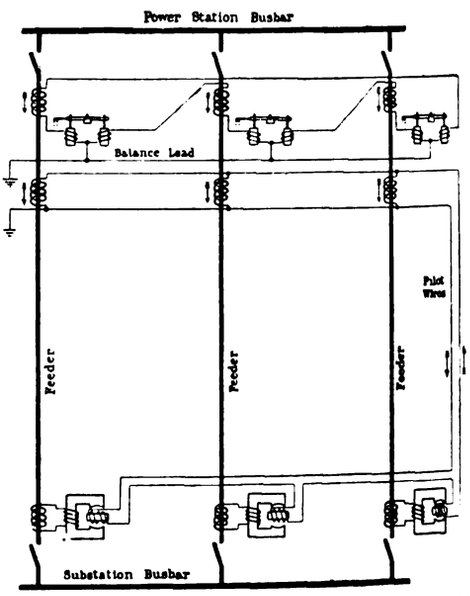

FIG. 1.—PARALLEL FEEDER PROTECTION WITH DISCRIMINATING AND REVERSE-CURRENT RELAYS.

of the balancing lead through the restraining coil of another relay. The impedance of the relay and transformer of the disconnected feeder may be cut out either by contacts mounted on the relay itself or by auxiliary switches operated by the feeder oil-break switch.

At the remote end of the feeders there is reverse-current relay protection, but differing from that usually associated with this type of relay. Instead of being dependent on the potential of the circuit to give the determinating action to the relay, a sample of current is taken from the parallel-connected series of transformers at the source end by means of pilot wires. As consequent polarity will always be obtained in the relays at the remote end immaterial of the direction of current flow, the scheme is obviously unaffected by surges. The scheme has the further advantage that the heavier the fault the more definite is the action of the reverse relays.

In the past, protective gear on generating and transforming

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plant has been looked upon more from the point of view of preserving the continuity of supply than of saving the faulty plant from destruction. As power systems grow in capacity and with them the output of individual units, it has come to be realised that it is not only essential to preserve the continuity of the service, but also absolutely necessary to save the generating plant.

Generating and transforming plant is subject to three classes of fault conditions, these conditions comprising leakage to earth on individual phases, short circuit between phases, and breakdown between turns of the same phase. Generating plant is subject to further conditions such as accident to the prime mover and loss of field. The development of the differential system has permitted of the first two conditions being satisfactorily dealt with, and particularly where the neutral is earthed through a limiting resistance. The third condition can only be taken care of by the reverse power relay or some form of split winding. The majority of fault conditions comprise those of the first mentioned class, consequently, the more satisfactory protection is given by the differential system which has the further advantage that it operates equally well with only one unit on the bars.

The circulating current system which has been described elsewhere is inherently a sensitive protective means. Full advantage may not be taken of this, however, owing to the general unstable tendency of the series transformers under severe emergency conditions. This unstable tendency has resulted in the adoption of higher fault settings, these averaging about 30 per cent.

With large generating units a 30 per cent. setting is too high. With a 30,000-kw. generator this setting might represent a very large amount of energy spent in continual destruction of the windings without operation of the relay. Generators may suffer from mechanical damage close up to the star-point end of the windings, and ultimately break down to earth electrically and, where the neutral point is earthed through a resistance, there may be insufficient potential above earth to permit of the necessary current passing to operate the 30 per cent. relay setting. Destruction of the windings may here take place due to the heat caused by the prolonged arcing.

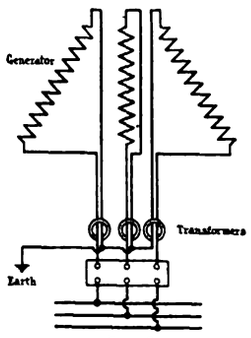

Fig. 2.

Fig. 2.—Generator Protection (Beard's System).

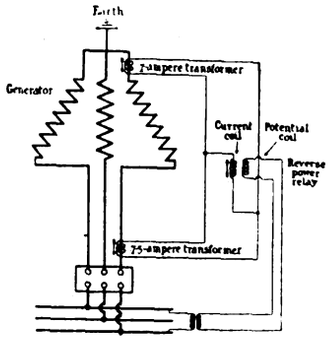

Fig. 3.

Fig. 3.—Generator Protected by Combined Differential and Reverse-current Relay.

It should be borne in mind that the lower fault settings may mean all the difference between a lengthy and costly repair and merely a damaged coil which only requires the disablement of the unit for a comparatively short period.

Protective systems have recently been developed which have for their object a stability under severe emergency conditions and a possible fault-setting not obtainable with the balanced current system. One such system, due to Mr. J. R. Beard, is shown in fig. 2. We have here a device which is unaffected by these unbalancing troubles, and the lowest possible fault settings may therefore be adopted. In this system the input and output of each phase winding is directly compared, and any resulting difference due to faults between phases or leakages to earth appears in the secondary of the core-balance transformer. This system may likewise be employed for transformer protection, and readily lends itself for this application.

Developments of the circulating-current system as applied both to transformers and generators are then explained.

The various arrangements, while capable of dealing effectively with leakages to earth and faults between phases, are ineffective with a breakdown between turns of the same phase which does not develop into either of the preceding forms of fault. One solution of the problem of uniting in one relay a means of dealing with all the fault conditions, is shown in fig. 3. In this arrangement the unbalanced circulating-current system is employed. The unbalance may be obtained either by inserting resistance in the circuit or, preferably, by increasing the current capacity of No. 2 transformer, a local current contributed by this transformer thereby flowing through the moving coil of the relay. This current, in relation to the flow in the fixed element energised from the potential of the system, gives the necessary bias.

With the development of leakage to earth or between phases the increase in current in No. 1 transformer balances the circuit, and ultimately spills through the moving coil in the reverse direction operating the relay, while normal delivery of power continues to the busbars.

A reversed flow into the windings due to, say, a breakdown between turns of the same phase will reverse the whole current in the circulating-current system and, likewise, the local current flowing through the moving coil which previously gave normal bias. The relay will, therefore, swing over to the operating side and disconnect the generator.

The standard arrangement provides for No. 1 transformer having a full-load secondary current of 7 amperes. No. 2 transformer at the other end of the winding has a secondary current at full load of 7.5 amperes. The difference current of ½ ampere normally circulates through the current element of the relay, the direction of this current relative to the potential of the circuit being such that the relay is held strongly in the off position. The current element is wound to carry continuously this ½ ampere of unbalanced current, and the general proportions of the coil are such that the usual characteristics of the typical reverse-power relay are obtained.

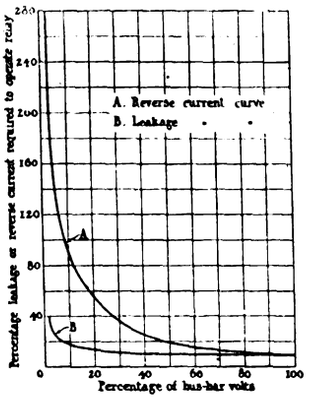

Fig. 4.

Fig. 5.

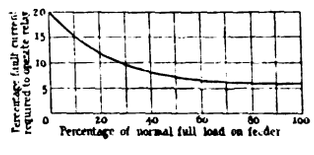

Fig. 6.

Fig. 4.—Operating Characteristics of Combined Differential and Reverse-current Relay. (Without Auxiliary Coil.)

Fig. 5.—Feeder Protected by Lever Biased Relays and Circulating-current System.

Fig. 6.—Percentage Fault Current required to Operate Relay with Varying Load Current. Lever Biased Relay with 5 per cent. True Bias.

Now, if we have a reversed flow into the generator due to, say, an accident to the prime mover, the whole current in the circulating current system reverses, including the ½ ampere of unbalanced current which traverses the moving coil. The relay operates in a manner similar to the usual arrangements of the reverse current relay.

Dealing with the other classes of fault which give rise to differential currents in the generator winding, a leak to earth or between phases will increase the current in No. 1 transformer. The effect of this increase is to balance the relay circuit and finally to extinguish the ½ ampere of unbalanced current. To produce this result it is necessary for the fault current to reach a value sufficient to give 7.5 amperes in the secondary of No. 1 transformer. The percentage fault current required will be $(0.5/7)\times100=7.1$ per cent. Immediately the fault current exceeds 7.1 per cent., there is a reversed flow through the current element which brings the relay to the operating point. Fig. 4 shows the characteristics of this scheme obtained with an induction-type relay.

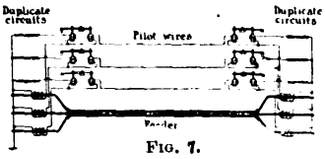

Fig. 7.

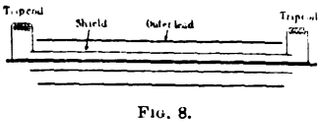

Fig. 8.

Fig. 7.—Circulating-current System with Biased Relays. Three-phase Feeder.

Fig. 8.—Whitaker Protective Cable.

Of the various differential systems applied to feeder protection the arrangements proposed by Merz & Price have been most extensively used. Developments and extensions of the principle are next dealt with by the authors.

The substitution of the mechanically biased relay with the same circuit arrangements is shown in fig. 5. In this scheme also, in the single-phase application, the resistance of each duplicate circuit corresponds to that of one pilot wire. Under healthy conditions the output of each transformer distributes itself equally between the duplicate and pilot-wire circuits. The operating and restraining coils of each relay comprise a similar number of turns. The desired degree of stability is obtained by biasing the relay. This may be accomplished in a number of ways. The usual method provides for the leverage from the fulcrum to the restraining coil being increased by perhaps 10 per cent. over that accorded to the operating

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coil. Alternative methods may consist in increasing the resistance of each duplicate circuit by, say, 10 per cent. over the resistance of the corresponding pilot wire. The effect of this is to divert a larger share of the transformer output through the restraining coil of each relay. The same result may be obtained by adding the requisite number of additional turns to the restraining coils. In the case where a fault develops on a dead-ended cable, that is to say, where no reverse flow will ensue at the remote end, the fault component of the transformer current divides and flows through the operating and restraining coils in the ratio of 3 to 1. Should the feeding arrangements be such that a reverse current may flow from the remote end, the transformers oppose one another and divert their whole output into the duplicate circuits at each end of the feeder. This current flows entirely in the operating coils of the relays.

Of the two circuits which each transformer supplies it is apparent that only in one of these can capacity current flow. This refers to the pilot wires, the capacity current of which will traverse the restraining coil of each relay. Abnormal current flow, which may raise the potential of the series transformers to high values and give rise to considerable capacity current in the pilot wires, has no other effect than to increase the stability of the relay. Fig. 6 shows the operating characteristics of this scheme employing relays which have a mechanical or lever bias of 10 per cent. or a true bias of 5 per cent. In a relay of the mechanically balanced type having open-circuit plunger-type coils the pull on the cores increases as the square of the ampere-turns. In this case the normal load current flowing in the coils of the relay produces a high state of magnetisation in the cores, the relay becoming immediately sensitive to the addition of a small amount of leakage current to the operating coil.

Fig. 7 indicates the manner in which the scheme would be applied to a three-phase feeder.

A number of special cable designs have been developed which in themselves partially function as protective devices. Mr. Whitaker's scheme which employs the shield-surrounded core is illustrated in fig. 8. The trip coil in this scheme is connected between the core and the shield, and, consequently, has to be insulated for the full-line potential. In the author's opinion the shield is employed to better advantage than in the Hochstadter cable, as a greater thickness of dielectric exists between the outer lead and the shield. Extraneous influences, therefore, will not be so likely to nullify the protection should the outer or lead sheath be damaged.

Discussion in London.

Dr. C. C. Garrard, in opening the discussion, said that Mr. E. B. Wedmore had developed many devices on the lines discussed by the author, and he should receive credit for his pioneer work. The author's diagrams, and his thorough treatment of the subject might frighten some readers, but the systems outlined were nevertheless simple ones. In the speaker's opinion it was preferable to obtain adjustment of bias mechanically than by the use of different current transformers. The relays did not require to be ultra sensitive, they were practically small motors, and rough hand adjustment could be allowed without fear of disaster. Another advantageous feature was that standard transformers with iron cores could be employed, special ones with air gaps were not necessary. Further, standard switches could be used, they did not require split-contact switches. A disadvantage of using a pilot wire was that in the event of it breaking the cable would be cut out. It was his opinion that engineers had now reached the stage when they must of necessity consider some such system of protection as had been discussed by the author.

Major K. Edgcumbe objected to the author's nomenclature; it was confusing, and he would have done better had he kept to more standard terms. For instance, the word reactive was objectionable in connection with relays. The paper contained numerous diagrams, and described many devices, but the author gave no indication of which were the best or the ones he would recommend. With regard to parallel feeder protection no scheme was outlined in the paper which did not employ pilot wires, except one where twin cables were protected by biased reactive-type relays, but the scheme would cut out both feeders, and, therefore, afforded no advantage. A further disadvantage was that the author's scheme would require very exact adjustment of resistance, &c., and in practice it was not possible to maintain such accurate adjustment. He did not favour the promiscuous introduction of fuses in protective gear; fuses were erratic things in operation, and they introduced a time lag element. With regard to the author's fig. 6, showing parallel feeder protection by discriminating relays, he thought that the wrong feeder would be cut out. However, he was glad to hear the author emphasise the question of bias, but he did not favour the policy of balancing transformers; it was very difficult to obtain a proper balance in that way.

Mr. J. R. Cowie suggested that the devices described could be used as stabilisers on old systems which had not been made as good as they should have been. With regard to the pilot wires being used for telephone signals, &c., could they not use the main telephone cable? Would there be any interference? He had knowledge of four-figure earth currents, and in one instance the earth current had reached a value of 2,000 amperes. Such conditions imposed an altogether unnecessary strain on the plant. Concerning generator protection, he agreed that the field switch should be broken. He thought that Beard's system, fig. 2, was the best, but he would like to see also a system carried out which employed biased beam relays. In his opinion, there was a large field for the author's devices in connection with generator protection. Pilot wires were expensive, and their use meant additional capital expenditure. It was very desirable that the problem should be brought to finality, and he hoped eventually to see the use of series transformers and ordinary switches.

Mr. E. B. Wedmore complained that although the author described a variety of devices, he gave no indication of which he would recommend or his reasons for doing so. He agreed with most of what the previous speaker had said, but thought they would hear more of the Merz-Price system, which had been side tracked by other schemes. There were two types of fault, leakage to earth and shorts between phases, and he thought they should discriminate between them. The object of the paper was to describe the protective systems developed by the author, but he had been too modest to say so. He had shown much skill in developing in generator protective systems, and that shown in fig. 2 was, the speaker thought, the best. It was well designed, had been tested out, and deserved to stay. With regard to the differential system applied to feeder protection, the sheathed pilot wire employed with the balanced-voltage system to neutralise the effect of capacity current in the pilot wire was much too expensive to come into favour. Whitaker's protective cable, fig. 8, had not, he thought, hitherto received publicity, but even the author had given no particulars of the scheme.

Mr. H. W. Clothier also complained of the absence of standard terms and requirements in the subject under discussion. It was very desirable to pick out by some means or other information contained in such papers that constituted a real advance in the subject with a view to developing the devices in question. For instance, what was meant by a "sensitive" relay, what volt-amperage was required to operate it? In the recent Kelvin lecture an extremely sensitive device had been mentioned, and it would be interesting to know what they were working to to-day. He had not yet heard of the necessity to employ unbalanced phases, and he was sceptical about a 15 per cent. fault setting for long lines. With regard to generator and transformer protection, the self-balance system shown by the author's fig. 5 was the simplest, and as it had proved to be effective in practice, there was little room for improvement by the introduction of the additional parts and connections which would be required for the biased system which the author illustrated in the following diagrams. The system of "current balance" protection with biased beam relays had the disadvantage of an intricate relay and connections, whereas the self-balance dispensed with the factors which created the need for the bias. The arrangement shown in fig. 3, whilst providing for additional protection, had the disadvantage of introducing the potential element into the relay. A fault between turns had not nearly so serious an effect on the system as a fault between phases and to earth. Therefore, it was not so essential to cut it out instantly, and it might be left for the short time which it required to develop in to an earth when it would be isolated so quickly as to avoid much damage. The failing prime mover gave sufficient warning for hand isolation. The system (fig. 3) to be complete, must have instantaneous release for the faults between phases and to earth, and time limit to avoid premature operation on momentary reversals. The essential feature in restricting damage to generators, and this applied also to transformers, was the rapidity of the isolation of the fault between phases and to earth, and the simultaneous destroying of the main field. The rapidity of operation was of greater moment than highly sensitive fault settings. It would be very helpful if they could have a panel of experts to consider the whole subject.

Mr. H. Brazil emphasised what had been said by previous speakers about the paper containing descriptions of a variety of apparatus without indicating which devices were most suitable for use. He spoke from the users' point of view, and wanted to know whether the devices described worked as well in practice as they did on paper. He thought that they were cutting things too fine with respect to discrimination; would a relay with a 5 or 6 per cent. setting really not trip when it was not required to do so? There was other apparatus which was not perhaps so good as, but it was more reliable than, some of the newer devices. He objected to the word "leakage," would the 2,000 amp. earth current mentioned by a previous speaker be called a leak? The term obviously required defining. He would like the author to give an indication of which devices he had tried and found to work well in practice.

Mr. Wilson said that the schemes outlined by the author were simple, and apparently sound. A feature was that ordinary types of transformers, &c., could be used, and also a very fine adjustment was not necessary. Personally, he liked the system of generator protection by means of biased beam relays, because it was particularly simple, and the system employing a combined differential and reverse-current relay on account of the completeness of protection afforded.

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The method of feeder protection shown in fig. 5 was very simple, and that shown in fig. 7 was not really complicated, but it looked so because it was drawn to show all three phases. He suggested a method of simplifying the device shown in the author's fig. 3, and submitted a sketch for publication in the Institution *Journal*.

Mr. MARSHALL objected to some of the terms used by the author, and thought that only one device described in the paper was of any real value. In his opinion, it was equally difficult to obtain a good unbalance as it was to get a balance on a system.

Mr. RICHARDS explained that their object should not be to protect a feeder itself, but the whole system from the shock that followed as the result of a short circuit.

Mr. ROGER T. SMITH, the president, referring to several of the speakers' remarks on the nomenclature used by the author, said that if standardisation was required it was the Institution Council's place to put the matter before the Engineering Standards Committee. If one or two members, say, Messrs. Edgcumbe, Wedmore, and Clothier, would write to the secretary of the Institution, setting out what was required, the Council would pass it on to the committee for consideration.

Mr. A. E. MCCOLL, in reply, said that figs. 5 and 7 showed the most practicable schemes of feeder protection; a 5 per cent. bias was employed in the tests on those systems. Mr. Wedmore, to whom much credit was due, had dealt fully with his own devices in a paper in 1915. With overhead transmission trouble was not so much due to capacity as to induced currents in the pilot wires. In the schemes illustrated in figs. 5 and 7 it was not necessary to consider induced currents when setting the relays. With regard to voltage collapse, a scheme he had recently suggested was to split the busbars and to insert a 5 per cent. resistance across which transformers were connected. In this way the voltage would never collapse; under the worst conditions there would always be 5 per cent. of the voltage available to operate the relays.

PRODUCER & BLAST FURNACE GASES.

AT Birmingham, on March 31st, the paper by Mr. S. H. FOWLES, and also that by Mr. W. H. PATCHELL, abstracts of which appeared in our issues of March 19th and 26th respectively, were read and discussed before the SOUTH MIDLAND CENTRE of the INSTITUTION OF ELECTRICAL ENGINEERS.

Opening the discussion on the first paper, Mr. F. FORREST said that the utilisation of blast furnace gas which was now going to waste in many places would undoubtedly receive close attention from those responsible for the electric power supply in this country, but it was unlikely that any large proportion of the national power supply would be made dependent upon the utilisation of waste heat from any commercial manufacturing process which was likely to be influenced by strikes of workmen or fluctuations in trade. The production of gas by the blast furnace plant was a fairly continuous process whilst the furnaces were in operation, whereas the load on an electric generating station would fluctuate between wide limits during the 24 hours. The cost of storing an adequate quantity of heat energy in the shape of blast furnace gas of only 98 therms per cubic foot would be an extremely expensive matter, and if storage was not resorted to a great deal of gas would continue to be lost.

Mr. H. BENTHAM said the fact that practically 3,000 KW. of power from blast furnaces was going to waste under the old methods of working fully warranted the writing of the excellent paper. Mr. Bentham asked for further information on a number of points.

Mr. FORREST, dealing with the second paper, said the author stated that the first installation put up by him at Messrs. Hoffmann's works consisted of two 360-KW. generating sets, which cost £40.98 per KW., or £29,506 altogether. The second installation consisted of four similar sets, which were put in at a cost of £50 per KW., or £72,000 for the four sets, making the total expenditure for the generating station £101,506. The average cost per KW. of the 2,160 KW. installed, therefore, amounted to £47, and not £45.49 as given in the table. The capital charges per unit were given as .207d. per unit. The capital charges were taken at 10 per cent. per annum. If based on the total cost given above, this would be £10,150 per annum, or £5,075 for the six months' period dealt with. Dividing this sum by the number of units delivered during that period, the cost per unit amounted to 0.665d.

There was no mention in the table of cost of water, which must be fairly heavy in the plant, especially as most of it went through the Paterson water softener. The fact that the Premier gas engines took about 64 per cent. of their full load consumption when running light or with any load up to half load would point to the absolute necessity of obtaining always a very high running plant load factor. With the variations of the works load, this would point to the necessity of installing a large number of comparatively small sets, which could be started up or shut down as the load varied, in order to maintain the desirable high plant load factor. The putting in of six sets seemed to indicate that this was just what the author had in mind, but the effect on the cost of electricity was reflected in the high capital cost per unit. The very low-grade fuels now being efficiently burned by many of the largest generating stations was a type of material which could not be satisfactorily dealt with in a producer gas plant of the type described. Much of this fuel was below 9,000 therms per lb. with a large percentage of ash. Producer gas firing of boilers mentioned by the author could only be justified if it could be shown that the extra capital cost due to the producer plant, together with the heat losses incurred in operating the plant were more than offset by the improved boiler-house efficiency, due to gas firing, plus the revenue derived from the sale of the by-products. With producer gas containing 45 per cent. of inert nitrogen, which was likely to give a low flame temperature, and with the very heavy cost of storing such lean gas, its use for boiler firing was not likely to prove a success.

Mr. W. WILSON said he had come into contact in the past with a number of producer plants, very similar to that described, with the sole exception that the recovery of the by-products was not attempted. These plants were situated in a Colonial possession, and were partly for the supply of electricity to moderate-sized municipalities, and partly for industrial purposes. An interesting feature in connection with many of the Colonial plants referred to was the use of lignite, which was successfully employed by Mr. Fraser, of the Waihi Gold Mining Co., as far back as 1907 for the supply of power to what was then the third biggest gold mine in the world. The engines were not quite as large as those mentioned in the paper, the biggest being four-cylinder horizontal Crossley machines, of about 368 H.P. The Crossley type of producer was employed, and the difficulties of gasifying the lignite were successfully overcome. The cleaning apparatus was in the main that described by Mr. Patchell, and reliance was chiefly placed upon sawdust scrubbers, and upon centrifugal extractors, very nearly as described in the paper. Plenty of water was employed in the latter machines, and the serious tar problem was thus effectively coped with. It was interesting to note that the comparative cost of energy by gas and by carefully operated steam engines, employed side by side with the gas engines, was in 1910 about £9 10s. per H.P. per annum for gas and about £19 10s. for steam. Another type of plant that was successfully developed in this colony, overcame the tar difficulty by means of a locally designed down-draught producer, in which air was admitted to the incandescent fuel at various stages during its descent in the producer, special valves being fitted for the purpose. This method, however, nullified one of the principal objects that the designer of Mr. Patchell's system had in view, namely, the recovery of the by-products. Nevertheless, this method had reached such a degree of perfection that small producers were fitted to vessels of the fishing-boat and coastal class for the operation of their existing oil engines. This they did, using the same lignite fuel, without requiring any other cleaning than that afforded by a single washer, consisting of a tank filled with coke through which sea water was allowed to drip. The author had mentioned the shortening of the working week, and expressed a fear that it would have a disturbing effect upon the load factor. The present working week was approximately that to which he had always been accustomed, and it was worth recording that the load-factor at the power house supplying the city of Christchurch, New Zealand, was 45 per cent. when he last saw the official figures, in October, 1915. By paying attention to opportunities for suitable loads, as had been done in this case, the reduction of the working hours should not cause any anxiety.

Mr. H. BENTHAM said the author had spoiled an otherwise excellent paper by trying to compare a one-shift private plant with a public supply undertaking operating under ordinary conditions, much to the disadvantage of the latter. Such comparisons might result in many misleading conclusions. The results shown in the tables were good, but they were not ordinary working conditions. Load factors of 73.6 per cent., and 102 per cent., and 84 per cent., were not attainable in any plant which operated continuously. It would be interesting to know whether the results would be equally satisfactory under fluctuating load conditions. The load factor of most industrial electric supply undertakings was in the neighbourhood of 30 per cent., and if the results given were corrected to this load factor he estimated the total costs at 1.75d. instead of 0.72d. per unit, a very material difference. Applying a similar revision to the plant under discussion in connection with the Coal Controller's figures, the thermal efficiency of the gas plant would be 8.15 per cent., a figure somewhat less than that for the steam stations.

Strike of Railway Workshop Men in India.—Most of the 5,000 employés in the locomotive workshops of the Northern-Western Railway of India have joined the railway power house employés who are on strike.—*The Times.*

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NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

Tubular Earths for Lightning Conductors.

The Killingworth Hedges patent tubular earths for lightning conductors were illustrated in the ELECTRICAL REVIEW of May 3rd, 1918. Since that date they have been extensively adopted by the Admiralty for the earthing of airship sheds and other buildings which have to be specially protected. Fig. 1 shows a new cheapened design of the casting, in which the electrical connection is made between the tape conductor and driven tube. There are two sockets, so that two conductors can be led into the same tube; the loose washer A is first slid up to allow free access. In dry ground the carbon in the tube which surrounds the tape is watered either by hand by means of the pipe, which is generally enclosed in a stop-cock box, or by attaching a funnel-shaped top to collect the surface rainfall. One of the advantages claimed for the tubular earth is that the resistance tends to decrease; this is shown by the following tests of a Hedges earth sunk at one of H.M. Dockyards:—

Date of test.	R. ohms.	Date of test.	R. ohms.
December 3rd, 1917 ...	2·1	June 6th, 1918 ...	1·68
December 12th, 1917...	1·78	October 18th, 1918 ...	1·63
March 8th, 1918 ...	1·73	April 10th, 1920 ...	1·4

MESSRS. R. C. CUTTING & Co., of 56, Ludgate Hill, E.C., are licensed manufacturers under Mr. Hedges' patents.

The Transportation of Radium.

A recent issue of *Archives d'Electricité Médicale* gives a description of a protective case to facilitate the transportation of radium. The four points to be considered in the design of such a case are (1) The radium must be enclosed in a thick bed of lead to arrest the α and β rays and to reduce the strength of the γ rays. (2) To arrest the secondary rays emitted by the lead when penetrated by the γ rays by means of an envelope of metal of a lesser density. (3) To dispose the action of the radium in such a manner that the rays in the direction of the hand of the person carrying the case shall be reduced as much as possible, and (4) To suitably fix the handle for carrying the apparatus. Fig. 2 shows these precautions put into practice in the form of a carrier combining safety with good design. This consists of a lead cylinder (*Pb*) enclosed in a copper envelope (*Cu*) 2 mm. thick. In the centre of the lead is a cavity (C) having a conical top into which is fitted a lead cone (T) provided with a nickelled copper button. The cylindrical cavity is capable of holding from 50 to 90 mgr. of radium—six tubes 3 mm. in diameter and 39 mm. long. The thickness of the lead is then 25 mm. laterally and 30 mm. in the direction of the handle. A copper cover (B) is provided fitted with a handle, and the whole apparatus can then be put into a leather cover with a fairly long loop to carry it by.

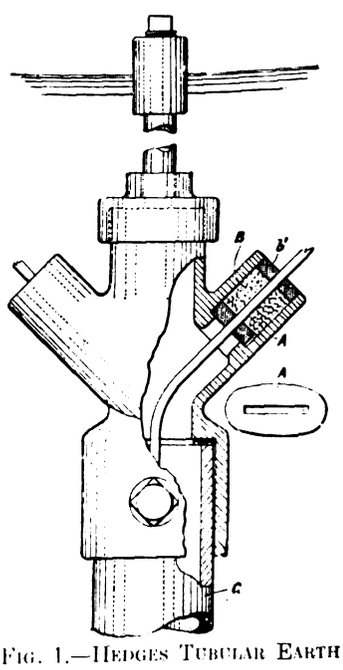

FIG. 1.—HEDGES TUBULAR EARTH.

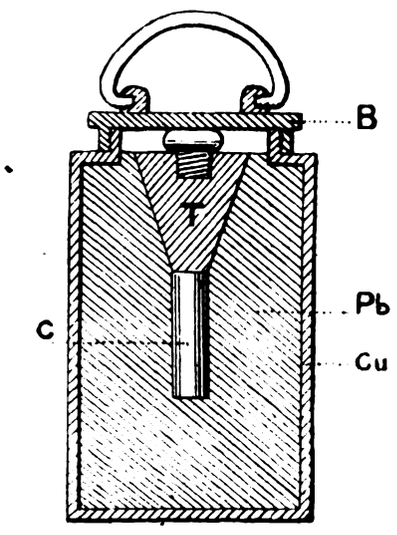

FIG. 2.—CASE FOR THE TRANSPORTATION OF RADIUM.

Electric Helm Indicator.

MESSRS. SIEMENS BROS. & Co., LTD., Palace Place Mansions, Kensington Court, W. 8, send us particulars of a device to indicate the angle of a ship's rudder.

It is operated by its own separate battery of one dry cell, thus being entirely independent of the ordinary electric supply on board ship. The amount of current consumed is so small that under normal conditions the battery should not need renewal more than once yearly.

The angle of the rudder or helm is indicated positively each 5 deg., absolutely without backlash, so that the usual trouble experienced with gear operated by chains and wire ropes is entirely absent.

The gear, which is very simple and strong, consists of a switch, an indicator (fig. 3), and a battery.

The switch is contained in a watertight case, and may be placed either in the steering gear house or between decks near to the rudder post. The angular movements of the rudder are communicated to the switch by means of levers and links which are connected to the rudder post on the one hand and to the spindle projecting from the switch case on the other.

The indicator is mounted in a watertight gun-metal case and is usually placed in the wheel house or on the navigating bridge. It is provided internally with an electric lamp for illuminating the dial at night, the lamp being fed by separate wires from the ship's mains.

The electric connection between the transmitter switch and the indicator, and between the latter and the battery, is by means of two-core cables. The battery may be placed either in the wheelhouse or in the chart room. Should the cable be broken, or should the current supply to the indicator be interrupted from any other cause, the pointer of the indicator disappears from sight, so that a wrong indication cannot be given.

FIG. 3.—ELECTRIC HELM INDICATOR.

The "Lyto" Dry Cell.

MESSRS. T. E. SLAUGHTER & Co., of 172, Church Road, London, S.W., have put on the market the "Lyto" dry cell, for which high qualities are claimed, as the result of long experience and the use of the best materials. The cell is of the sack type, with the maker's improved gelatinous paste, which contains a larger percentage of moisture and active materials than a blotting-paper or plaster lining, and therefore does not tend to dry up so quickly; the well-known advantages of the sack type, enabling the cell to give a long efficient life, render it cheaper in the long run than the less expensive types. Besides the round type (which is fitted with brass terminals on both poles), the company makes pocket-lamp batteries in a large variety of sizes. A sample cell of the round type which we have received gave a short-circuit current well over 15 amperes—the highest range at our command at the moment—the pointer going up against the stop.

An Electric-arc Soldering Iron.

Most electric soldering irons are constructed so that they are heated by the current passing through a resistance coil enclosed in a tube attached to the top of the iron.

Fig. 4 shows an electric soldering iron heated by an electric arc in the iron itself. A hole is bored in the centre of the iron, having a diameter equal to the outside diameter of the tube of a battery bushing, down to where the iron begins to taper. A standard battery porcelain bushing B is placed

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in the hole and a ½-in. arc-lamp carbon C is placed in the bushing, and allowed to come down into contact with the bottom of the hole, then the carbon is withdrawn about ¼ in. to establish the arc. The iron should be connected to a 110-volt circuit and resistance enough connected in series to keep the current down to between two and three amperes

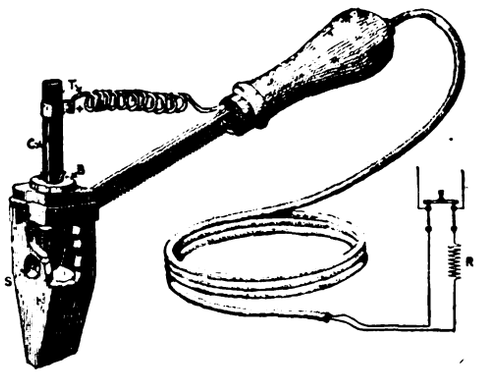

FIG. 4.—ELECTRIC-ARC SOLDERING IRON.

as at R in the figure. The soldering iron is connected to the circuit with the positive terminal on the carbon, as shown at T.

The carbon is held in place in the bushing by small metal wedges, and adjustment of the carbon is made by tapping it down to give the desired length of arc. A second hole S is bored at right angles to the first, so as to allow the arc to be cleaned of the nitrate that forms around it.—*Power.*

REVIEWS.

Essentials of Alternating Currents. By W. H. Timbie and H. H. Higbie. Pp. viii + 374; figs. 223. London: Chapman & Hall, Ltd. Price 8s. 6d. net.

This book is written as the result of teaching trade courses for electric wiremen, and aims at including the essentials that a workman who handles alternating appliances should know.

Having in view the probable educational deficiencies of those for whom it is written, it avoids the use of algebra and trigonometry.

To have written a book on alternating currents of the size and scope of the present volume, without the use of algebra and trigonometry, is certainly an achievement which must have required very careful consideration. At the same time, one is inclined to doubt how many students who are incapable of mastering the elements of these branches of mathematics will show themselves willing to follow the lengthy and close reasoning which replaces in many places what might have been a simple mathematical relation. The reviewer believes that a non-mathematical book for the use of working wiremen and men of similar type would have been more useful if it had been less ambitious in its scope, and had been more purely descriptive and didactic, without such comprehensive reasoned explanations, which appear so laboured, and demand so much concentration in order to follow them.

This is, however, a matter of opinion, and, taking the book as it stands, it must be said at once that it is clearly and capably worked out, as was only to be expected from its authors.

The elementary method of approach to relatively complicated problems involves—almost necessarily it would appear—some steps which are not logical and may be confusing. One point of this nature occurs in the first statements regarding the ratio of transformation of a transformer, where the student is told that "If one volt is impressed on one turn of the primary coil" certain voltages will be developed in the secondary windings, depending on the number of secondary turns. This statement and the reasoning based upon it are really meaningless until some explanation of the back E.M.F. induced in the primary winding has been given. Without this, the student cannot understand how you can "impress one volt" on a turn of a winding without a short-circuit resulting. Reactance and self-induction are not considered until the next chapter, and no attempt is made to explain the absence of a short-circuit in connection with the statement referred to

In explaining the ratio of currents in the primary and secondary windings of the loaded transformer it would probably have been simpler, and have given a clearer idea of the actual and practical conditions (bearing in mind the type of student for which the book is written) if it had been stated definitely that the no-load currents are negligible in comparison with the load currents, and that the primary and secondary ampere-turns are always equal. In this way a page and a half of difficult reasoning would have been saved, and the point of practical importance would have been given greater prominence.

Many suggestions of this kind naturally occur to the reader who has his own pet ways of envisaging the various problems dealt with, and it would be a thankless task to continue to put forward alternative methods of treatment in a book which is, on the whole, excellently clear and accurate within the limits marked out.

Vector diagrams—or, rather, diagrams of a somewhat more primitive type—are freely used, while the diagrams of circuits, and the connections of apparatus are admirably clear.

Each chapter concludes with a brief summary of the subject-matter and the results arrived at, followed by a set of problems to be worked by the student.

Probably enough has been said to give a fair idea of the treatment and method adopted in the book, and it only remains to enumerate some of the main subjects included in it, so as to indicate its scope. This scope, as will be seen, is considerably wider than would usually be expected in a completely non-mathematical work intended only for the use of trade students.

After a general outline of the arrangement and purpose of the machinery and apparatus to be found in a typical power-transmission system, there follow chapters on transformers, impedance, power and power-factor. After this, the current and voltage relations in series and parallel circuits, and the relation between impedance, resistance, and reactance are considered.

Then come polyphase circuits and the calculation of sizes of wires for various distributing systems. A good deal of ingenuity has been used in dealing with these matters without using the symbols of trigonometry—whether this has really made the subject easier or more difficult to follow is open to question.

The next chapter deals with synchronous and asynchronous motors, under which are included polyphase and single-phase induction motors, repulsion and repulsion-induction motors and series alternating current motors. In this case, the authors adopt a more descriptive style, and are content to forgo a good deal of explanation as to the reasons underlying the phenomena described.

In the final chapter, converters and rectifiers are dealt with. Considerable space is given to mercury-arc rectifiers, electrolytic rectifiers, and vibrating rectifiers, on account of the more extensive use of these types of apparatus in America.

An appendix gives a number of useful tables, some of which contain figures of an approximate nature which may perhaps lead to inaccurate assumptions in the hands of inexperienced users, although their general utility is not questioned.

C. F. S.

Alternating Current Work: An Outline for Students of Wireless Telegraphy. By A. Shore, A.M.I.E.E. London: Wireless Press, Ltd. Pp. ix+163. 1919. Price 3s. 6d. net.

A full knowledge of the elements of alternating current work is a *sine qua non* to the student of wireless telegraphy. Especially in the case of transmitting stations, the operator should have a good understanding of the reasons for the various adjustments which he carries out, and this can only be acquired by a study of the general theory of alternating currents. From the point of view of the operator, however, there is usually a considerable amount of unnecessary detail in many text-books on alternating current. Moreover, there is no special emphasis laid on those sections of the subject which immediately concern the man who is to use alternating current for the generating of oscillations. There has consequently been a need for some text-book which would instruct the student and operator in the theory of transformers, chokes, alternators, motor-generators, resonance, power, and all other phases of alternating current work which concern wireless transmitting sets. The volume under review adequately fills the gap. It is written by a wireless engineer who knows not only his subject, but how to teach it. The style of writing and the presentation of the subject, if not altogether original, are undoubtedly very effective. Not a sentence is wasted. Problems of considerable difficulty to the beginner are treated in such a manner as to rob them of most of their complexity.

Chapter I is a general account of alternating currents. The reader is introduced to sine curves, current curves, R.M.S. values, and form and amplitude factors. Chapter II deals with alternating current generators including rotating field, mono-coil and multi-coil alternators. Armature, ring, and drum windings are also discussed. Chapters III deals with rotary converters, the voltage and current ratios, and a few brief considerations. Chapter IV brings the reader to the subject of the power in an alternating current circuit. The effect of the phase relationship of currents and E.M.F., the power equation, the power factor, and other comparable matters are discussed. Chapter V deals with self-induction, Lenz's law, angle of lag, coefficient of self-induction, reactance and impedance, choking coils, eddy currents, measurement of inductance, and air-core inductances. In Chapter VI the author discusses the condenser from the usual simple points of view. Chapter VII deals with the somewhat intricate problem of resonance. Transformers next claim attention in chapter VIII and one only regrets that a few more pages were not devoted to this important subject. High-frequency resistance forms the subject of chapter IX. The next two chapters deal effectively with electrical measuring instruments, and

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various up-to-date devices are described. The whole concludes with several pages of useful mathematical tables.

The volume, as a whole, deals essentially with the *theory* of alternating currents, and the author, except in the case of measuring instruments, has studiously avoided applying his theories to particular apparatus. There is, for example, no description given of any form of rotary converter, condenser, or transformer. Nothing is said about the method of using transformers in series or parallel, although this is an important matter in commercial wireless sets. The alternating current motor is not described, nor methods of starting up rotary converters.

The subject dealt with by the author covers a very wide field, and in a book of this size he has undoubtedly been compelled to say less than he would have liked about many of the aspects of alternating current work as applied to wireless telegraphy.

The book is one confidently to be recommended to the student entering for his P.M.G. examination, and to those who are interested in that branch of wireless telegraphy with transmitting gear.—JOHN SCOTT-TAGGART.

NEW PATENTS APPLIED FOR, 1920.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by MESSRS. SEFTON-JONES, O'DELL AND STEPHENS, Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

10,775. "Electro-pneumatic solo and harmony device for organs." G. E. MORLEY. April 19th.

10,802. "Commutators for electric motors." E. HORNBY. April 19th.

10,824. "Explosive-mixture ionising apparatus and spark plug." F. TAVANI. April 19th.

10,831. "Electrically-heated apparatus." V. F. H. COLLEDGE and E. R. LEE. April 19th.

10,835. "Tungsten alloy." BRITISH THOMSON-HOUSTON CO. (General Electric Co., U.S.A.) April 19th.

10,836. "Electric protective devices." BRITISH THOMSON-HOUSTON CO. (General Electric Co., U.S.A.) April 19th.

10,867. "Ignition devices for internal-combustion engines." R. BOSCH AKT. GES. April 19th. (Germany, January 6th, 1917.)

10,872. "Electro-magnetic generators and motors." Sir W. G. ARMSTRONG WHITWORTH & CO., R. LACON, H. W. LEE and F. L. ROBERTSON. April 19th.

10,893. "Electrical fuse-boards." F. W. COTTON. April 20th.

10,898. "Advertising index cards for recording telephone calls, &c." J. A. CREWE. April 20th.

10,902. "Electric furnace covers." W. C. FOX. April 20th.

10,903. "Machines for exhausting electric lamps." E. H. WESTON. April 20th.

10,905. "Electric conduit fittings." H. LOWNIE and MIDDLESBROUGH STEEL TUBE & CONDUIT CO. April 20th.

10,915. "Sparking plug." E. B. MORGAN. April 20th.

10,931. "Multiple-acting switch controls." J. S. HOLMES. April 20th.

10,939. "Terminals for electric conductors." A. GREENWOOD. April 20th.

10,943. "Electrical signalling systems." WESTERN ELECTRIC CO. April 20th. (United States, December 31st, 1919.)

10,944. "Electron discharge devices." BRITISH THOMSON-HOUSTON CO. (General Electric Co., U.S.A.) April 20th.

10,951. "Dynamo-electric machines." H. A. COPE. (E. Haefely et Cie.) April 20th.

10,961. "Arc welders." LINCOLN ELECTRIC CO. April 20th. (United States, February 26th, 1915.)

10,979. "Starting rotary internal-combustion engines." R. BOSCH AKT. GES. April 20th. (Germany, September 30th, 1918.)

10,980. "Ignition devices for starting internal-combustion engines." R. BOSCH AKT. GES. April 20th. (Germany, September 2nd, 1918.)

10,996. "Intercommunication, &c., telephones." H. J. PALMER and TELEPHONE MANUFACTURING CO. April 20th.

11,016. "Electric oil-break switches." R. T. NORTON. April 21st.

11,018. "Railway signalling apparatus." AUTOMATIC TELEPHONE MANUFACTURING CO. April 21st.

11,039. "Telephone indicators." C. JENNER. April 21st.

11,045. "Electric light switch." F. E. HALLAHAN. April 21st.

11,066. "Electric wave filters." WESTERN ELECTRIC CO. April 21st. (United States, July 15th, 1915.)

11,078. "Storage batteries." J. A. LAW (A. P. Smith). April 21st.

11,080. "Electric relays." F. BERGMANN and IGRANIC ELECTRIC CO. April 21st.

11,105. "Electrical apparatus indicating value of quantities subjected to variations." C. M. P. DE NEUTER. April 21st.

11,111. "Duplex telegraphy, &c." H. W. SULLIVAN. April 21st.

11,117. "Means for electro-magnetically fixing work-pieces." J. ZEHNDER & SOHNE. April 21st. (Switzerland, April 22nd, 1919.)

11,135. "Sparking plug." R. H. A. SEARLE. April 22nd.

11,150. "Terminal electrical connections for sparking plugs." M. L. WILLIAMS. April 22nd.

11,161. "Electrical fog-signalling apparatus for railways." N. M. LINDLEY. April 22nd.

11,165. "Electro-magnets." J. NEALE. April 22nd.

11,182. "Magneto-electric machines." BRITISH THOMSON-HOUSTON CO., H. W. H. WARREN and A. P. YOUNG. April 22nd.

11,183. "Electric signalling devices." BRITISH THOMSON-HOUSTON CO. and A. P. YOUNG. April 22nd.

11,184. "Systems of electric ship propulsion." BRITISH THOMSON-HOUSTON CO., F. H. CLOUGH and J. MARTIN. April 22nd.

11,191. "Dynamo-electric machines." S. A. M. ROSE. April 22nd.

11,198. "Secondary batteries or accumulators." E. H. NAYLOR and RUSHMORES, LTD. April 22nd.

11,204. "Apparatus for testing magnetos and sparking plugs." W. H. SPIERS. April 22nd.

11,239. "Utilising an electric current to produce a modified current, or correspondingly modified magnetic flux." IGRANIC ELECTRIC CO. (Cutler-Hammer Manufacturing Co.). April 22nd.

11,240. "Apparatus for utilising an alternating current of a given frequency to produce an alternating current of magnetic flux of a different frequency." IGRANIC ELECTRIC CO. (Cutler-Hammer Manufacturing Co.). April 22nd.

11,241. "Electrical discharge." IGRANIC ELECTRIC CO. (Cutler-Hammer Manufacturing Co.). April 22nd.

11,242. "Electro-ionic relays." IGRANIC ELECTRIC CO. (Cutler-Hammer Manufacturing Co.). April 22nd.

11,243. "Vapour arc devices." IGRANIC ELECTRIC CO. (Cutler-Hammer Manufacturing Co.). April 22nd.

11,255. "Electrical double-pole switching plug." H. C. SANDERS. April 23rd.

11,277. "Telephone sets." DICTOGRAPH PRODUCTS CORPORATION. April 23rd. (United States, August 21st, 1917.)

11,278. "Radio-navigational systems." H. L. CROWTHER, G. P. GRENFELL, J. ERSKINE-MURRAY and J. ROBINSON. April 23rd.

11,311. "Wireless direction-finding apparatus." C. K. CHANDLER. April 23rd.

11,312/3. "Electro-magnetic wave-receiving systems." H. L. CROWTHER and J. ROBINSON. April 23rd.

11,345. "Systems for supplying energy to electrical circuits." J. F. P. JAUBERT. April 23rd. (France, March 7th, 1919.)

11,392. "Electrically-operated riveting, pressing, stamping, &c., machines." E. ADAMSON. April 24th.

11,401. "Electric protective devices." BRITISH THOMSON-HOUSTON CO. (General Electric Co., U.S.A.). April 24th.

11,413. "Machine for winding and shaping armature coils." J. EVANS. April 24th.

11,436. "Duplex, &c., telegraphic systems." H. W. SULLIVAN. April 24th.

11,443. "Ignition-testing devices." F. C. HARVEY. April 24th.

11,445. "Apparatus for remagnetising magnetos." J. HAGUE, T. HOLT and S. WOOD. April 24th.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1916.

16,248. SPARKING PLUGS. Clerget, Blin et Cie. November 13th, 1915. (102,260.)

1918.

10,997. TREATMENT OF METALS AND REFRACTORY MATERIALS AND OF TOOLS OR CRUCIBLES MADE THEREOF, AND THE ELECTRIC FURNACES USED THEREFOR. G. Marsh. July 4th, 1918. (140,835.)

13,014. ELECTRICAL SYSTEMS OF POWER TRANSMISSION. British Thomson-Houston Co. (General Electric Co.) May 23rd, 1919. (140,656.)

15,863. APPARATUS FOR ELECTRICALLY CONTROLLING RAILWAY TRAINS OR VEHICLES THROUGH THE TRACK. A. R. Angus. October 10th, 1917. (119,868.)

19,785. APPARATUS FOR CONVERTING ALTERNATING CURRENTS TO DIRECT CURRENTS AND VICE VERSA. J. E. Calverley and W. E. Highfield. November 29th, 1918. (140,853.)

21,813. ELECTRIC CLOCKS. Coventry Electric Clock Co. and T. Rushton. December 30th, 1918. (140,856.)

1919.

1,315. TRACKER DEVICES FOR ELECTRIC PIANO-PLAYERS. M. Compare and E. Pizzi. January 18th, 1919. (140,864.)

1,738. ELECTRIC HEATING APPARATUS. M. Arese. January 23rd, 1919. (140,868.)

7,034. IGNITION DISTRIBUTING AND TIMING APPARATUS FOR INTERNAL-COMBUSTION ENGINES AND THE LIKE. Dayton Engineering Laboratories Co. March 23rd, 1918. (124,745.)

7,795. SPARKING PLUGS FOR INTERNAL-COMBUSTION ENGINES. J. H. Terry & Sons and A. V. Terry. March 28th, 1919. (140,900.)

8,128. ELECTRIC LIGHTING SYSTEMS AS USED ON MOTOR VEHICLES. E. Morris. April 1st, 1919. (140,903.)

10,063. CURRENT-COLLECTING DEVICES FOR DYNAMO-ELECTRIC MACHINES. W. H. Scott and A. A. Pollock. April 22nd, 1919. (140,913.)

14,071. IMPROVED BRUSH-HOLDER FOR ELECTRIC MACHINES. W. S. Bulpitt and W. J. Denholm. June 4th, 1919. (140,936.)

16,652. SPARK-GAP DEVICE. G. R. Meissner. July 3rd, 1919. (140,949.)

20,188. DEVICE FOR THE PREVENTION OF UNAUTHORISED TAKING-OFF OF CURRENT FROM ELECTRIC CONDUCTORS. R. D. Giacomi. February 18th, 1919. (139,146.)

21,897. AUTOMATIC ELECTRIC COUPLINGS. R. Belfield. September 5th, 1919. (140,970.)

23,590. HOLDERS FOR INCANDESCENT ELECTRIC LAMPS. Fullers' United Electric Works, Ltd., and W. S. Gilbert. September 25th, 1919. (140,975.)

25,485. BALANCING MEANS FOR POLYPHASE ELECTRIC CURRENT SYSTEMS. Metropolitan-Vickers Electrical Co. October 17th, 1918. (133,970.)

27,134. MEANS FOR OBTAINING ELECTRICAL ENERGY FROM THE ATMOSPHERE. W. Dunn. November 4th, 1919. (140,986.)

32,658. APPARATUS FOR ELECTRICALLY CONTROLLING RAILWAY TRAINS OR VEHICLES THROUGH THE TRACK. A. R. Angus. October 10th, 1917. (Divided application on 119,868.)

1920.

8,063. APPARATUS FOR ELECTRICALLY CONTROLLING RAILWAY TRAINS OR VEHICLES THROUGH THE TRACK. A. R. Angus. October 10th, 1917. (Divided application on 119,868.)

Zinc Ore Smelting Works in Norway.—It is expected that the smelting of zinc ore will begin this month at the works of the A.S. Elektrodrift at Glomfjord, the erection of which was first commenced as far back as 1912. The hydroelectric plant already available consists of two turbine sets each of 27,000 H.P., although the full capacity of the works will comprise 6 to 7 sets, for which adequate water power is on hand for constant working. A total expenditure of £1,648,000 has already been incurred, of which about £988,000 applies to the hydroelectric plant. Stocks of zinc ore are already on the spot, and the company is said to have assured itself of further supplies for a long time forward. The ore, which costs from £50 to £60 per ton, contains about 40 per cent. of zinc, and the by-products are sulphuric acid and lead, together with some silver. It is calculated that the first parcels of zinc bars will be ready for export in June. The electrical plant has been obtained from the United States.

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THE

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THE INDUSTRIAL SITUATION.

CHAIRMEN of large manufacturing companies have better opportunities than some other people for judging the development of industrial relations. There have been signs during the past few months that here and there the good sense of the workers was gaining ascendancy over the extremists, but there are so many demands for higher wages following fleet of foot upon each other, and so many evidences that the cost of living appears to be rising on the whole, notwithstanding falls in certain commodities, that we cannot pretend to believe that stable conditions have yet been reached. In pessimistic mood one wonders whether they ever will be. Yet when chairmen of great engineering manufacturing concerns express satisfaction with the rate of progress toward tolerable harmony, we are encouraged to hope that, if things continue no worse than they are at present, industry in our own department will be able to carry on without very serious anxiety for a time. We say for a time advisedly, for none of us can see far ahead, and it might be unwise to be deluded by what may be only a temporary lull. There are disquieting factors in the situation, as everybody knows, and it remains to be seen how far the movement of one trade after the other in the pursuit of advances can be pursued without our heading for disaster. In the electrical industry there is, of course, an abundance of work waiting for everybody at present, but several straws have shown during the last few weeks which way the wind is blowing even here. We have recorded in these pages several instances of electrical schemes having to be technically revised, and new tenders invited, owing to the price being regarded as prohibitive; and in one case a scheme has been abandoned. We have not searched for these developments; we refer to matters which have come more or less casually under our notice. We have good reason for believing that many more decisions of the same kind could be produced were we to search for them. But these alone are sufficient to form a warning regarding the sure and certain tread of Nemesis in the wake of high wages and other costs. Railway electrification developments are hardly likely to be proceeded with on any extensive scale until the present uncertainty as to the question of future ownership has been removed. There are other industries of which we know a good deal, that might have been engaging in great new enterprises giving employment to thousands of additional men if the wage rate had become steady, and if the entry of new labour had been freer from restrictions, enabling plans to be proceeded with with reasonable prospects of success.

Manufacturing interests were last week given to understand that the Chancellor of the Exchequer must have that 60 per cent. Excess Profits tax in order to secure substantial revenues from industry during a period when it is expected to enjoy great prosperity. The alternatives are either a

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levy on increased war wealth or a flat rate of from 5s. to 7s. 6d. in the £ upon profits, in place of the new Corporation Tax. Everybody must be in sympathy with the Chancellor's determination to make great inroads into the indebtedness of the country during the next few years. It is suggested, and the suggestion is very significant, and needs no elaboration, that in the mind of the Government there are very strong social as well as economic reasons why industry should bear a substantial burden at the present time. It is clear then that industry has to bear heavy burdens; it is as well to know where we stand—if we do stand. Sir Tom Callender is reported as stating that nothing would settle unrest more promptly and thoroughly than some means of taxing war wealth, and also that the working classes are strongly up against what they consider to be undue profits. Manufacturers at a special meeting held last week to consider the Chancellor's reply desired time to consider his alternatives, but they, with full justification, urged that energetic action should be taken to amend the worst features of the Excess Profits Duty, especially in respect of the hardships inflicted upon new enterprises, small businesses and increases of capital. They further declared that the Chancellor's advisers were seriously over-estimating the probable revenue to be obtained from any taxation on industry in view of the indications of decreasing prosperity and diminishing trade in many industries.

In a speech delivered in the House of Commons on Tuesday Mr. Austin Chamberlain showed a very definite leaning toward the alternative of a levy on war wealth increases, to produce 500 millions, enabling him to revise the Excess Profits Tax at once. It could thus be reduced to 40 per cent., and extinguished altogether by a couple of later stages.

Incessant wage demands and heavy tax demands alike are becoming something of a nightmare to those who are anxious for British industry to prosper in the interests of all sections of the community. There is a heavy drag on enterprise at present, and we hope that the signs of slackening trade, which are showing themselves on both sides of the Atlantic, will dissolve. There are still many thousands of demobilised officers and men awaiting positions, and in the interests of these in particular, industry should be assisted to expand.

Whitley Councils.

The question whether Whitley Councils will eventually be granted statutory powers to make their decisions binding upon the industries which they respectively represent has been debated from time to time; whether it will be found advisable to confer upon them this large measure of authority is as yet a matter of conjecture—that they are still too young and inexperienced for the experiment to be tried will be agreed by all, but they are doing their best to justify their existence in the face of extreme difficulties, and we believe the prospect of their ultimate success is decidedly a bright one.

In the meantime, they are called upon to grapple with problems of great perplexity, one of the most important of which is that of bringing their constituents into line. Unless the undertakings for which they act abide loyally by their decisions, the Councils will soon become mere talking-shops, doomed to early extinction. The unfortunate tendency of the members of the Trade Unions to repudiate agreements arrived at in their name by their own chosen representatives has in the past been one of the most troublesome stumbling-blocks in the way of industrial harmony, but it certainly has not attained prominence in connection with the Whitley Council scheme. On the other hand, the employers' side has not shown to advantage in this respect, in the electrical field at any rate. How many of the electricity supply undertakings of the country are still holding out against the official award in favour of members of the E.P.E.A.? That question, it is true, is not directly connected with the Whitley scheme, but it is of a very similar order. An instance which is free from such objection is given elsewhere in this issue, namely, that of the Home Counties Industrial Council (No. 9 area), which finds that some of the undertakings which it represents on the employers' side have not complied with its award of March 31st, while one of them (Gillingham Corporation) has definitely refused to adopt the recommendation in question. This has led the Industrial Council to pass a resolution "that this Council supports any action that the Trade Union side of the Council decides to take in order to bring defaulting undertakings into line . . . . since by the action of such undertakings . . . . the matter of fixing basic rates is being delayed, and further, the antagonistic attitude thus indicated disturbs the whole of the relations between employers and employed."

We whole-heartedly endorse the action of the Council in this matter. Already the Trade Unions are complaining of the burden of expense laid upon them by their representation on the Councils; their claims have not been uniformly conceded, but so far they have generally accepted the decisions of the Councils. If, however, they find that the employers ignore awards that they do not like, the unionists will lose confidence in the system, and will naturally conclude that they cannot expect justice, fair play, and loyalty from its operation. And that will be the end of the Whitley Councils.

It is with the sincere desire to avert that misfortune that we protest against such action as that of the Gillingham Corporation. Undertakings which do not loyally carry out the Industrial Councils' awards are wreckers of industrial peace, and while we abhor strikes in general, and hope none will take place in this case, we cordially approve of the action of the employers' representatives on the Industrial Council, whose hand is plainly visible in the resolution.

Belgian Railway Conversion.

It is of some interest to hear what the directors of a large company in Belgium have had to say concerning the question of the electrification of the railways in that country. Addressing the shareholders at the recent general meeting of the Ateliers de Constructions Electriques de Charleroi, the chairman is reported to have stated that the company was perfectly equipped for eventually dealing with orders for plant for the conversion of the national railways, and in this connection the company had supplied first-class plant to its subsidiary at Jeumont for the electric lines of the Midi railway in France. Nevertheless, the directors estimated that the moment was not opportune to think of the electrification of the Belgian system, and the excessively high expenditure which such a conversion would demand would be imprudent at the present time when the Belgian works were devoting their activity to the reconstruction of the country, and could with difficulty bear this overload of production. On the other hand, as it was scarcely probable that the Belgian Government would be disposed to place orders abroad which would fatally affect the exchange, it seemed preferable, before thinking really of the transformation, to wait until Belgian industry was able to undertake it without prejudice to the reconstruction of the country. There were certain trunk lines which called for electrification, as, for instance, that between Brussels and Antwerp, which had been under discussion for 20 years; but the idea of a general scheme of conversion was not yet ripe.

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THE KING'S CROSS KINEMA THEATRE.

Recently we had the pleasure of paying a visit of inspection to a new and up-to-date kinematograph theatre that was opened to the public a few days ago at King's Cross. The theatre, which is designed to afford seating accommodation for 1,500 people, is well arranged and comfortably fitted out, the scheme of decoration being pleasing to the eye. A feature of the building is that ample room has been provided both for seating accommodation and in the operators' rooms, &c., a point that is often neglected, to the detriment of all concerned.

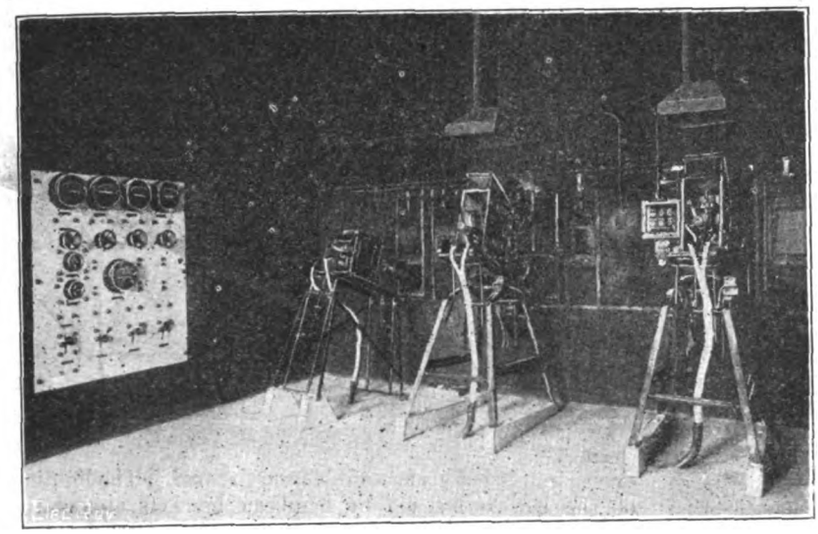

Fig. 1.—Projectors and Control Switchboard.

The whole of the electrical installation for lighting and power, as well as the engineering plant provided for heating and ventilation, was carried out to the specification and under the direction of Mr. W. C. C. Hawtayne, M.I.E.E., consulting engineer, and is considered to be one of the most up-to-date systems for buildings of this nature in the country. As far as we could see, nothing from the electrical engineer's point of view, at least, that goes to make the operation of a kinema theatre safe, simple, and satisfactory, has been overlooked. The whole of the installation complies throughout with the London County Council regulations.

The operating room, fig. 1, contains one stationary picture lantern and two projectors of Mr. Will Day's "Daynish" type. They are composed of all steel moving parts, including the intermittent sprocket which, in this instance, is specially hardened to withstand the heavy strain and hard wear to which this part of the projector mechanism is subjected. The gates of the projectors are fitted with a special fireproof attachment which eliminates nearly all danger, as even in the event of the film becoming ignited in the gate itself, the flame from the small portion in the open aperture cannot spread through either the top or the bottom of the gate. The picture delivery is very steady, and the machines, which are fitted with spool boxes of sufficient capacity to hold 2,000 ft. of film, are electrically operated. Motors are fitted to each projector and a perfectly level drive is obtained.

The operating room contains nothing but the projectors and a switchboard which controls the projectors, lights in the hall, and the motor-generators. All arc resistances, &c., are placed in a separate room so that the operators are not obstructed in any way. Further, the duplicate motor-generators are installed in a third separate room, fig. 2. These machines are quite free from vibration, as shown by the fact that they are not bolted or fixed to their foundations in any way; they simply stand on cocoa-nut matting placed on top of the foundation beds.

The electric supply is taken direct from the mains of the St. Pancras Borough Council, and enters the building at the north and south ends; it is on the three-wire system at a pressure of 440 and 220 volts. Each intake is fed from a different portion of the Council's supply network. The south intake supplies energy for power at 440 volts for the ventilating fans, vacuum cleaner, and circulating pump motors. A sub-main is also taken to a change-over switch in the north intake room to feed the motor-generators supplying power to the projectors, in the event of failure of the mains feeding that intake. The general lighting of the basement, south tower, balcony exit stairs, orchestra lighting, and outside brackets is also fed from this intake.

From the north intake a power supply is taken to the top terminals of a D.P. C.O. switch, and from there to the motor-generators which are installed on the balcony level immediately below the operating room, the power for these machines being normally taken from this end of the building; a duplicate pair of mains is, however, brought from the south intake to the bottom terminals of the change-over switch to provide a stand-by supply. The general lighting of the hall, &c., is also fed from this service.

Taking the power service first, there are two 10-H.P. motor-driven blowers supplying fresh air to the building,

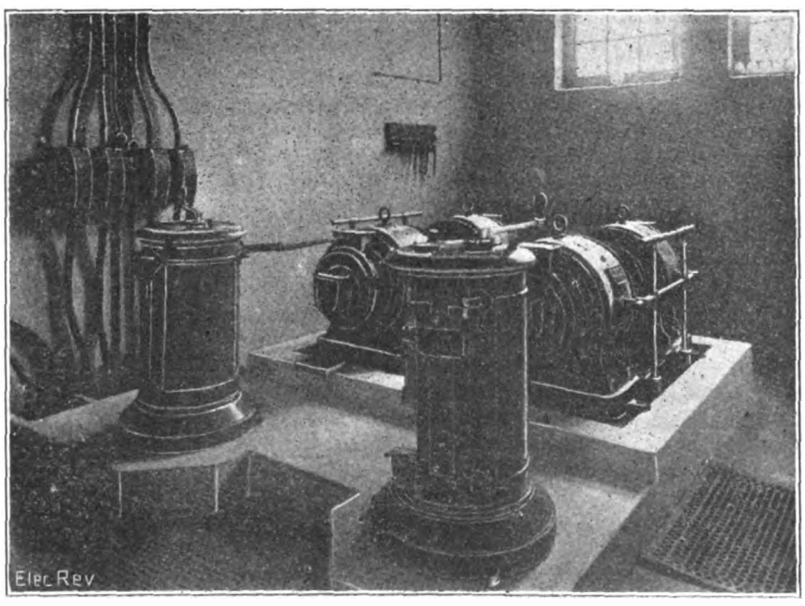

Fig. 2.—Vickers Motor Generators.

four exhaust fans, and two accelerator pumps, for the water supply to the heating system and coils for warming the air. There is also an 8-H.P. motor driving the vacuum cleaner plant, and last, but not least, a duplicate set of motor-generators for the projectors.

The mains supplying the motor-generators are taken up to a three-way main fuseboard fixed on the wall of the generator room, one way to each generator, and the third way is left spare for a service to a stand-by resistance, which

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is to be provided later, so that power for the projector arcs can be taken direct from the supply mains in case of the failure of both motor generators.

The motor-generators are by Messrs. Vickers, and each consists of a dynamo having an output of 115 amperes at 70 to 100 volts, coupled by means of a flexible coupling to a 14-H.P. 440-volt motor mounted on the same bedplate. The service to each motor is taken through a D.P. switch and fuses to one of Messrs. Vickers's drum-type starting pillars, the shunt leads being taken up to the operator's board above. The mains from the generators are taken

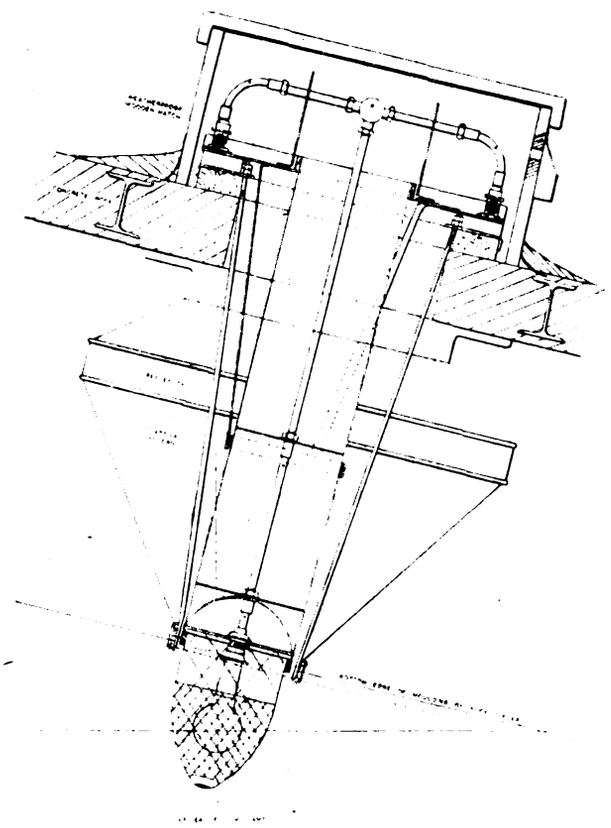

FIG. 3.—DETAILS OF CEILING LAMP.

direct to a D.P. C.O. switch on the main switchboard in the operating room; the centre terminals of this switch feed direct on to busbars from which the supply is taken through D.P. switches to the two projectors and the lantern.

The main switchboard deserves special mention. It consists of a white marble panel built into the wall of the operating room, the whole of the control gear being mounted on the back of the board in a separate room, being operated by handles passing through the panel. On the face of the board there are mounted a voltmeter reading the busbar volts, an ammeter for each projector arc and one for the lantern; there is also a check ammeter connected between the main change-over switch and the busbars. On the back of the board are switches and fuses for each projector and the lantern, a tandem resistance for the projectors operated by a handwheel with index plates on the front of the board, and a separate resistance for the lantern arc; the two shunt regulators for the generators are also mounted on the back of the board, and operated in a similar manner. On this switchboard there is also mounted a metallic dimmer for the lights in the auditorium. This makes a specially neat arrangement, as none of the cables, with the exception of the leads to the projectors which are run under the floor, enter the operating room.

The general illumination of the theatre is worthy of note; it is specially effective. The lighting of the entrance hall, crush hall, and foyer and auditorium, is carried out on the semi-direct principle by means of half-watt lamps in bowl fittings. The lighting of the auditorium is on the semi-direct and direct principles, that portion of the hall below the balcony being lighted by half-watt lamps in bowl fittings placed close to the underside of the balcony. The main ceiling lighting is direct, the arrangement of the fittings being novel. They consist, figs. 3 and 4, of special octagonal lanterns built into the roof, the main lighting being carried out by means of a tubular half-watt fitting terminating in an obscured bowl in the centre of the lantern: the red lights are arranged around this fitting, but inside the lantern proper, being so placed as to cast a red glow through the latticed openings which form the sides. There are none of the usual raising and lowering gear, plugs, or loose flexible wire. The conduit is carried right up to the lamp socket and

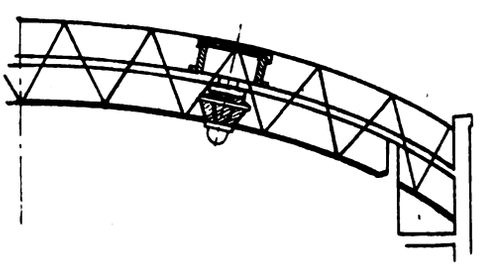

FIG. 4.—CEILING LAMP.

every lamp is readily accessible from the roof. The lighting of the hall is assisted by flambeau brackets around the walls. The local lighting of exits, &c., is carried out in the ordinary way with metal-filament lamps.

The orchestra lighting has received special attention, and is carried out in a most workmanlike manner. It is arranged generally as follows:—A light tubular structure carrying the music stands, fig. 5, also contains the whole of the wiring, ironclad plugs being built into the structure itself, adjacent to each music stand; the whole of the plugs are controlled by switches mounted in an iron box adjacent to the conductor. This arrangement was designed to do away with the tangle of flexible cord usually present, and it has entirely fulfilled expectations, only about four and a-half yards of cab-tire flex being used in the whole orchestra.

The installation generally is carried out on modern principles, the whole of the tubing being galvanised, and so arranged as to be really continuous from the supply terminals to the farthest lamp, all the switches being of the ironclad type; the fuses, however, are mounted in teak cases, to comply with the supply authority's requirements, bonding of conduits being secured by screwing the tubes into metal bands passing round the cases. Gas brackets are installed in addition to the electric lighting. All the

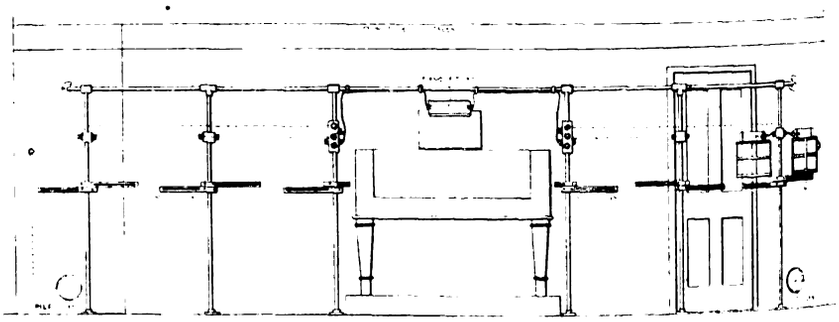

FIG. 5.—ORCHESTRA LIGHTING AND MUSIC FITTINGS.

wiring for lighting and power and switchgear was supplied and installed by Messrs. Pinching & Walton.

An intercommunication telephone service on the central-battery system, supplied by the Sterling Telephone and Electric Co., Ltd., has also been installed to all parts of the house, besides a system of control-signalling by means of bells and indicators between the operator and the back of the auditorium. Illuminated signs indicating the amount

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of accommodation available are also exhibited over each pay-box.

The cleansing of the theatre is provided for by the installation of a turbine vacuum plant supplied by the Sturtevant Engineering Co., Ltd. Adapter plugs are placed at frequent intervals throughout the building to which the cleaning tools are easily attached.

The heating apparatus is of the low-pressure hot-water type, with accelerated circulation, so that the temperature of the air in the theatre can be raised or lowered quickly, as may be required to meet the fluctuating atmospheric conditions. The entrance lobbies, vestibule, corridors, &c., are also heated by means of direct hot-water radiators, so as to prevent cold draughts blowing in through the open doors, to the discomfort of the audience sitting in close proximity to the entrance.

For ventilating the building, a hot-water battery has been installed, through which fresh air is passed, and driven into the building by powerful centrifugal electrically-driven fans. These fans will give an air interchange throughout the building four times per hour, and the inlets of the fresh-air supplies have been so arranged to ensure at all and every point an equable supply and distribution, thus ensuring that the atmosphere is kept perfectly clear from smoke or fog, and the light rays from the operating chamber are not obstructed or distorted when playing on the screen. The air, when being drawn into the battery chamber, is thoroughly cleansed of all impurities, it being passed over a patent glass screen and washed by water sprays playing over the screen. This also enables the air to be humidified as may be required in very dry weather, and cooled in the summer.

The exhaust, or vitiated, air is extracted through openings in the ceiling by means of volume fans, four in number, also electrically driven, fixed above the roof; the vitiated air is so discharged that it cannot possibly be drawn into the theatre again through the fresh-air supply duct. The plant has been arranged in duplicate, so that in case of a breakdown the stand-by plant can be brought into operation.

All the heating and ventilating apparatus was supplied and installed by Messrs. G. N. Haden & Sons, Ltd.

In conclusion, our thanks are due to Mr. Hawtayne for affording us an opportunity of visiting the theatre, and to his managing engineer, Mr. A. G. Dixon, under whose supervision the work was carried out, for supplying drawings, from which some of our illustrations were reproduced.

BUSINESS CONDITIONS IN SOUTHERN EUROPE.

By E. P. BENNETT.

To anyone having pre-war experience of general business conditions in the southern countries of Europe, the conditions of to-day revealed by an actual visit over the old ground will come as a decided shock, at once establishing the necessity of forming new ideas and adopting methods suitable for post-war requirements if a successful business campaign in the interests of British manufacturers is to be undertaken. This applies equally to any Continental enterprise by private concerns or the new Government Trade Departments. Perhaps it requires but little effort to realise the full significance of the changes that have taken place during the war in the countries under review. These countries could be named in the following order:—

France, Switzerland, Italy, Spain and Portugal, three of which have been waging war and organised for the purpose of producing materials and securing men. The latter point it is important to keep in mind, as the absence of men from industry has been responsible for the initiation of women into this sphere of usefulness—a sphere almost new to female labour with the possible exception of some specialised trades and agriculture.

Switzerland, though neutral, has been fully mobilised, while Spain, if enjoying greater immunity for geographical or other reasons has been affected to a large degree, resulting in a keen revival of industial ambition and a stock-taking of the mineral, coal, and water wealth of the country.

On the outbreak of war, supplies of all the cheap manufactured necessities and many of the luxury items hitherto imported almost exclusively from Germany naturally stopped, and upon the sale or consumption of the purchased and consignment stocks of these commodities, the utter dependence upon Germany was shown to such an extent that the war construction programme was largely planned with a view to subsequent manufacture of these goods in the countries affected, when conditions again became normal, and if the inspection of some of the home-made goods gives ample opportunity for criticism, the effort is not without its significance, and in our future commercial relationship will require to be taken very carefully into consideration.

These notes have been written with a view to assisting home manufacturers who may be contemplating activities on the Continent and who have no established organisation abroad to supply them with up-to-date information, and have been collected from actual contact with the various markets covered personally during the past few months. I would also point out that the conditions are constantly varying, the tendencies undeniably being in the direction of easier trading facilities, although the actual time taken between the official publication of new edicts, and their active operation by executive departments is a longer process than we are used to in this country. This delay is often responsible for costly complications and irritating trading difficulties, which conditions, however, must be faced with patience if the British manufacturer is to secure a good proportion of the business to be obtained from these countries. It must also be realised that until intensive, or at least more energetic sales methods are adopted by the local wholesale and retail establishments, "price" is the ruling factor in many negotiations for supplies in quantities, a few points variation in the Exchange will often be a deciding feature in the direction in which indents are placed, and this, unfortunately, irrespective of the merits of the material offered.

Preparation for an extensive business tour through the part of Europe covered by these notes will of necessity require considerable thought and time. The known channels for information relating to business houses on the Continent are, to-day, of very little use, nor is it advisable to rely upon the names of concerns that may have been collected from past correspondence? Many of the pre-war firms are no longer in existence. This probably applies more to the commission agent who may have had a sound pre-war business connection, although quite a large number of the old-established houses have undergone a considerable change in personnel, and many of their trading titles have been revised. It is more advantageous to carefully work out the details of the tour and route, leaving the compiling of a new Continental business index till after the completion of the actual tour, as by adopting this method the concerns which have come rapidly to the front under the strenuous war conditions will have been located and their relative importance to other concerns established.

It is a noticeable feature of any visit to these countries that many of the hitherto solely retail houses have already, or are contemplating, purely wholesale departments, which departments to the British manufacturer are of more importance than the retail side of the business, which may only operate in a defined area.

During a visit to these countries, the pre-war conception of business methods will be, as indicated in my opening

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remarks, very speedily dispelled, and valuable information obtained about the new methods necessary to conduct successful Continental business operations.

It will be found that many of the war-time factories are now producing materials hitherto imported. This has an important bearing on price and the conditions of supply, as the concerns in question seem to be sufficiently well financed to make local purchase conditions very favourable for the buyer, and it certainly establishes a means of comparing the price between local manufactures and similar apparatus which have hitherto been imported from other countries.

The idea that orders will be placed for any reasons of war sentiment is quite erroneous, for even at this early date the meaning of the word "Allies" has been largely forgotten, and is now substituted by the old title of "foreigner." This substitution is aided by many patriotic societies which have sprung up in these countries for the protection of the "*enfant*" industries and for recognised effort to exclude the importation of any material which can possibly be manufactured locally. This condition of affairs, added to the unhealthy state of the exchange and foreign finance generally, will at once indicate the enormous difficulties with which the importer is faced. Fortunately for the British manufacturer who has in the past built up a very sound credit, this credit applies more particularly to the quality of goods supplied, and the fulfilling of all conditions of the contract entered into at the time of purchase. This credit is certainly far above that of any other country which has done in the past, or is now attempting to do, business in this part of Europe.

It is difficult to refrain from some reference to Germany and Germany's methods of trading, but perhaps it will be sufficient to give a reminder that the easy conditions of supply create a very strong temptation for the Continental buyer to take a very keen interest in the possibilities of the early resumption of business with Germany. The local evidence points very strongly to the fact that Germany has already attempted to resume the old relationship, and the offers made through the medium of correspondence, are to-day as tempting to the buyers in these countries as any offers that have been made in the past by Germany.

Another obstacle in the way of successful business being initiated by the concerns new to the Continental conditions, is the attitude of practically all the business houses endeavouring to secure exclusive agencies. These agencies, if entered into, usually tie up the interests of a manufacturing concern to one firm, and unless the firm secured under an arrangement of this sort is actually operating in all parts of the country covered by the agency agreement, the interests of that concern are likely to suffer for a considerable period. I have seen records of one comparatively small firm holding as many as 60 exclusive agencies covering all classes of electrical and other material. This firm would probably have no more than two men on the sales side operating for the whole country, the 60 agencies so arranged, but the revenue automatically received from the commissions derived from various direct orders placed with that country, would be sufficient to maintain quite a considerable establishment, and provide a very lucrative position for the promoters.

During the business visit, inquiries should be instituted regarding means of transport for merchandise sold, port regulations, Government restrictions and Customs. Information is also required in connection with the permits for payment, which in some of these countries can only be secured after considerable difficulty, and cover goods absolutely necessary to the development of the local industries.

It would be difficult to give any indication of the duration of a visit to the various countries owing to the uncertainty of one's reception and the disappointment over interviews. This point is more noticeable in the countries furthest south.

To secure the best results the visits should not be timed for any particular dates.

It is interesting to note the American method of lightning tours, and it is to be hoped that they will continue by this way to endeavour to open up European markets for American manufactures, as, owing to the short duration of the visit, it is very rarely that the American finds the best buyer, or negotiates with a house in the premier position to promote his interests.

By far the best method is to treat each country independently; in fact, the circular tour should be eliminated in favour of an extended visit to each country, and time given in all the principal cities to interview every concern for handling electrical material, not devoting the entire energies to the wholesale house, but visiting in turn the principal contractors.

Certain information can be obtained from the various Chambers of Commerce or Commercial Attachés of the Embassies abroad, but unfortunately the method usually adopted in securing information by the Chambers of Commerce or the Commercial Departments of the Embassies is not such that gives the home manufacturer the name or standing of the best concerns. These departments will go so far as compiling and sending a schedule of traders' names covering certain trades to the manufacturer applying for them. These schedules, however, often omit the establishments of the best standing, as the lists are usually compiled from replies sent to the departments in response to a circular letter or printed notice. This means that the list of names will contain a higher proportion of "the least desirable" agent-seeking concerns than the older established houses, which are in a position to purchase stocks.

The only method of securing reliable information and compiling serviceable lists is by a personal canvass by representatives of the departments named.

At the present time the demand for all classes of electrical material is particularly urgent, and manufacturers of the following goods would have no difficulty, if offering at the right price and conditions of supply, in securing large contracts:—

Domestic generating sets, motors, generators, switchgear, accumulators, high and low-tension porcelains, insulators and accessories of all descriptions made to Continental standards, cable and flexible supplies, electric hair dryers, vibrators, electric novelties, pocket lamps and torches, glass shades, M.F. lamps (to compete in price with Phillips and the Continental "Z"), and half-watt lamps.

Orders for these materials would be placed at once, but stipulations would be made in connection with delivery.

These demands are likely to be maintained for a considerable period, owing to the efforts to generate electricity by water-power, for all purposes, to reduce coal consumption.

The Americans are keenly alive to all these possibilities; many American concerns, having important concessions for a supply of electricity, keep the American manufacturer well informed concerning the local demands.

There are also a number of important German manufacturing concerns which have large and well-equipped establishments in the countries that were neutral during the war. If "British financed" concerns are to be found in these countries, they appear to lack the prominence of their German and American competitors, and now would be the time to take advantage of the good feeling prevailing towards Britain and British-made goods.

The distribution of all English catalogues throughout these countries is of very little use in promoting business. The temperament of the buyer abroad is not one which enables him laboriously to study the catalogue of an English manufacturer; to convert our technical terms to the relative meaning in his own language; to struggle with our currency or, to him, the intricate dimensions.

In compiling catalogues, the translation should certainly be given into the hands of men specialising in this work in the country for which the catalogues are intended.

The next best instruction aid would consist of points of salesmanship neatly compiled and in the correct language, and distributed broadcast to the trade throughout the countries, backed up by the visits of men capable of explaining in the language of the country, the advantages of energetic sales efforts. These men must be prepared for an active campaign against the price ruling conditions, and the general inertia prevailing almost universally in these countries. This would be no easy undertaking for any pioneer, however capable, owing largely to the apathy of the actual trades, and in turn to the prejudices and temperaments of the actual buyer. The aim, however, should be on the lines of general educational propaganda, and the ultimate result—the establishment of British trade predominance in Southern Europe.

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SOUTH STAFFORDSHIRE ELECTRICITY SUPPLY.

An exhaustive inquiry is being conducted at Birmingham by a Government Committee, over which Sir Richard Redmayne, K.C.B., is presiding, into the threatened submersion by water of the whole of the South Staffordshire coalfield, and in considering this problem evidence was taken at the sittings last week of several well-known electrical engineers with a view to finding out whether, having regard to the supply of water, South Staffordshire would be a suitable place for one of the proposed super-stations, or for smaller generating plants. Among the witnesses who dealt with this aspect of the question were Mr. S. T. Allen, M.I.E.E., borough electrical engineer of Wolverhampton, and Mr. G. R. J. Parkinson, M.I.E.E., the chief engineer to the Midland Electric Corporation for Power Distribution, Ltd. The former said that electric supply authorities in that district had set up a conference and a committee of electrical engineers to inquire into and report upon future requirements. A scheme of electricity supply by means of joint working had been devised which included the erection of a new power station having a capacity of 230,000 kw. The requirements of the Black Country had been estimated at 150,000 kw. The water supply was important, but it was vitally necessary that the supply should be a regular one, and if possible of increasing quantity. Water from the pumping of mines could not be of use for the purpose of new electric power stations, as it diminished in quantity, and would perhaps cease altogether. The only mine water that would be of use was that from continuous drainage. Electricity generating stations using steam turbines required water principally for circulating through condensers. Mine drainage water could be used for this purpose provided it did not contain an excess of corrosive or scale-forming compound in solution. The working capacity of the generating stations contemplated was of the order of 100,000 kw., and for a station of this capacity the amount of cold water for direct circulation, if such a load were maintained, would be 200,000,000 gallons per day. He understood that the quantity from the mines under investigation would only be 12½ million gallons per day, and to be of use for generating electricity it would be necessary to deliver it at one place. The amount of 12½ million gallons would be sufficient for direct circulation in condensers connected with a plant of 6,000 kw. capacity only. He was of opinion that this quantity of water would not warrant the erection of a special power station. Supposing they took a 50,000-kw. station, allowing less than half the load for the 24 hours the cost for the circulating and for the cooling towers would be about £60,000 more than the cost of generating on the Severn without allowing a penny for the cost of the water. The area of the proposed new scheme was approximately 2,500 sq. miles. The scheme had been provisionally agreed upon, and was at present before the Electricity Commissioners. What the cost of generating power under the new scheme would be was not known owing to the rising of labour and coal costs. Assuming a normal selling price of coal at 15s. a ton, he thought they would be able to sell power at a halfpenny per unit. In saying that he was relying on the quality of the coal being good; nowadays it was a question of calorific value, although they might pay five times as much for the coal. If pumping was to continue in South Staffordshire, he thought they could supply current from the new station for the pumps at the figure he had mentioned. There was already 1,000 h.p. available for this purpose. Witness then dealt with the quality of the coal they had to use for generation, and he advocated washing, for which he thought they would be willing to pay 5 per cent. more.

Mr. Parkinson said his company had an area in South Staffordshire of about 70 sq. miles, and there was one generating station at Ocker Hill, which was in the Tipton mines area. At the present time there was a large and growing demand for electric power in the Black Country, and although they had room for extensions, they were faced with the difficulty that there was not sufficient cooling water available from the canal for dealing with any large extension of plant. In view of this difficulty electrical supply authorities in the district were, at the suggestion of the Electricity Commissioners, considering the advisability of building a large generating station to which Mr. Allen had referred, but witness considered that, although it might be necessary eventually to adopt such a course, owing to the high cost of transmission lines, and the losses involved in transmitting a large amount of power such a long distance, it was advisable to defer the proposition as long as possible. If sufficient cooling water could be obtained at a reasonable cost to operate a generating station of 20,000-kw. capacity, the larger scheme could be put off for a number of years. A generating station of 20,000-kw. capacity, if supplied with cold water without the use of cooling towers, would require about 1,800,000 gallons of water per hour. This water would be raised in temperature about 15 or 20 deg. F., and would be discharged without any appreciable loss. On the other hand, by the utilisation of cooling towers, this same station would be operated with a fresh supply of cold water of 450,000 gallons per hour. The loss in the cooling towers would be about 10 per cent. of this water, and the balance of, say, 400,000 gallons would be discharged at a temperature of about 90 to 100 deg. F. If, therefore, it was found practicable to continuously pump large quantities of cold water from the mines and supply this at a suitable spot for a generating station, the water could be utilised for condensing, or for any other purposes, and then discharged into the canal without serious loss of water. There was no intention, he said, to have one generating station for the new area; it would probably be divided into two, one being erected at Rugeley on the Trent, and the other at Ironbridge on the Severn. The question of water supply from mines had a very important bearing upon new electricity schemes.

A number of other experts on this and other aspects of the question are to be called. The inquiry stands adjourned until the 26th inst.

A.W.P. ARC WELDING FOR STRUCTURAL STEEL WORK.

In view of the interest taken in their structural steel-work exhibits at the Building Exhibition, Messrs. Alloy Welding Processes, Ltd., gave a demonstration of their system on Monday last at Brixton, where the first example of welded truss work on a practical scale in this country is being carried out on the "A.W.P." system by the Welded Construction Co., for Messrs. Stelfast Wheels, Ltd. The factory is a modern brick building, arranged on one floor and covering an area of about 22,000 sq. ft. The roof is of the north light type, with 93 steel trusses of 19 ft. span, supported on H-section stanchions and joists. The whole of these trusses are being assembled by "A.W.P." welding, and without the use of either rivets or bolts. Fig. 1 shows the arrangement of a finished welded truss.

In addition, the cap and base plates are welded to the stanchions, the joists are welded to the cap plates, and the completed trusses are welded on to the joists. Cleats are also welded to the top sides of the trusses to carry the timber purlins for the attachment of the roofing and glazing. There is, therefore, an almost complete absence of rivets and bolts in the whole of the steel structure.

The joists are hoisted on to the stanchion cap plates and held in position by clamps while being welded. Steel bars and angles are cut to the correct length on site. Jigs of a simple type are prepared, into which the cut lengths of bars and angles are dropped and held in correct position. The joints are welded up in the jig and gusset plates welded in. The truss is then removed and is ready for erection.

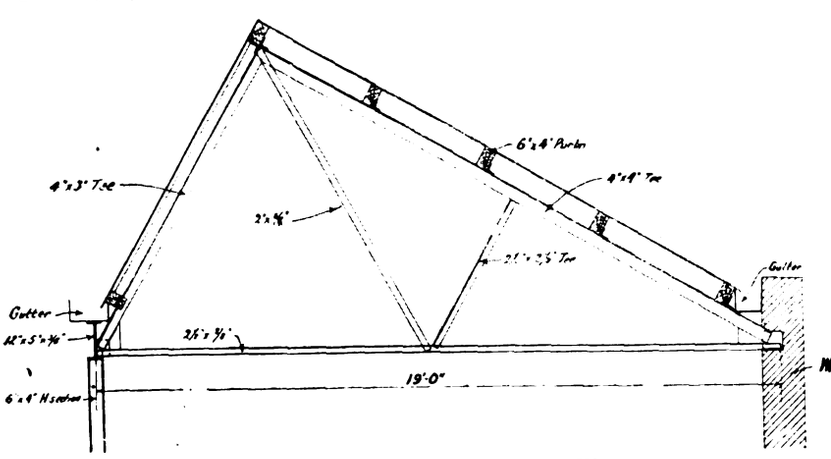

Fig. 1.—Truss Assembled by Electric Welding.

One welder and one labourer, having the material cut to length, can assemble and weld complete one truss in an average total time of 1½ hours (on more than one occasion they have been timed to do this work in 50 minutes) and attain an output of over five complete trusses in one eight-hour day. Allowing for imminent increases in wages, the total cost of one truss works out as follows:—

Labour.—Welder at 2s. 6d. per hour, labourer at 1s. 8d., 6s. 3d.

Material.—Electrodes, 22 in., 2s. 10d.

Energy.—At 2d. the B.O.T. unit, 3d.

Total, 9s. 4d.

Each of these trusses weighs 3 cwt., and the total cost *per ton* for assembling and welding, therefore, amounts to £3 2s. 3d.

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As regards the welding of the cap and base plates to the stanchions, it is found that one welder and one labourer can complete each stanchion in half-an-hour, and the total cost of this work is 2s. 9d. per stanchion. The total weight of the stanchion is 3 cwt., and the cost per ton is therefore 18s. 4d.

Nothing has been allowed in these figures for cutting the material and delivering it adjacent to the welder; the costs of these operations would, of course, refer to either welded or riveted construction, but by eliminating marking-off and drilling, the handling of material is considerably reduced, the material being delivered direct from the rolling mills or stores to the site, and the cutting can take place close to the welding jig.

The present cost of structural steel work, apart from the cost of materials, is £18 to £20 per ton. Taking the most expensive welded work (*i.e.*, comparatively small trusses) at the figures given, allowing £2 per ton for cutting and handling to the welder, plus 100 per cent. overhead charges and profit, a comparative figure is obtained of under £11 per ton, which shows that by the elimination of drilling, bolting, and riveting, and substituting "A.W.P." welding, a saving of 50 per cent. can easily be effected.

In the case of the roof at Brixton a joist can be fixed in position on the cap plate in 15 minutes, and the trusses can be fixed to the joists at both ends by one welder in 30 minutes.

The plant required consists of a standard "A.W.P." welding transformer, with a capacity for two welders, two "A.W.P." reactances for controlling the current at the arc, two switchboards, and two complete sets of welders' equipment; the whole at present prices would cost about £155. This is equivalent to £78 per welder, but in the case of a four or six-welder plant this cost is decreased to about £60 per welder. Such a plant could of course, be used for several contracts, and regarded as capital expenditure would form only a small item at the usual rate of depreciation.

Where no electrical supply was available it would be necessary to install a self-contained welding plant driven by petrol or paraffin; such a plant costs about £300 per welder. Allowing 20 per cent. for depreciation, this is equivalent to £60 per welder per annum. Contractors need not themselves carry out the welding work, but can sublet it to firms associated with Alloy Welding Processes, Ltd., who undertake structural welding contracts, supplying all necessary plant, labour, and material.

On the work described at Brixton only two welding operators are employed. The art of "A.W.P." welding can be acquired by unskilled workmen within four to six weeks, and as the welding involved on structural work is of the simplest type, and can be quickly and thoroughly inspected, there is no difficulty in obtaining and training men to carry out sound work. Alloy Welding Processes, Ltd., are always ready to train men or to recommend suitable operators, of whom they already have a number on their books requiring employment. The advantages of the processes are explained in Bulletin No. 36 issued by the company.

The Welded Construction Co. has also obtained the contract for constructing and erecting a steel building for stabling for the Horse Show to be held at Olympia next month. Two welders and four labourers are turning out ten completed trusses per day. Such work can be done for cost of material plus £10 per ton.

Our impression, after inspecting the work in progress at Brixton, was that the system was exceedingly simple to apply and carry out, and that the economies which it effected rendered it certain of very extended adoption.

Catalogues Wanted for Chile.—The Commercial Secretary to H.M. Legation at Santiago de Chile (Mr. W. F. Vaughan Scott), has written to the Department of Overseas Trade, stating that frequent inquiries are being received by him for the catalogues of United Kingdom manufacturers, and that a useful purpose would be served, if firms prepared to do business in Chile would forward him duplicate copies of any catalogues issued by them. They should be printed in Spanish, if possible, and should be addressed direct to the Commercial Secretary, his Britannic Majesty's Legation, Santiago.

Electric Smelting of Iron Ore.—A scheme has been in progress in Norway for some time past with the object of establishing iron and steel works in Hardanger, and a proposal is now being laid before Parliament in favour of State participation in Sima II Company to the amount of 500,000 kr. The latter is a subsidiary of Sima I Company, which has sought for powers to utilise the Simadals waterfall, and has obtained patents for and the services of experts in the construction and working of electric smelting furnaces. An expert committee appointed last year by the banking connection (Norsk Investment) of Sima I Company has reached the conclusion that the future of the iron and steel problem in Norway can only be solved by electrothermic methods, and it recommends the erection of one furnace as a beginning. It is then proposed to proceed with the construction of a large works at Sima, capable of producing 80 000 tons of iron per annum; Norwegian ores and water-powers being utilised as far as possible.

EXPORTS AND IMPORTS OF ELECTRICAL GOODS FOR APRIL, 1920.

The official returns of electrical exports and imports for April show as regards the exports, totals of £940,014, as compared with £1,102,781 for March, a decrease in values of £182,000, the falling off occurring in submarine cable exports, the figures being £88,278, as against £303,406, for the previous month, the values recorded for the other items of the electrical exports being well maintained. The electrical import values for the past month were £189,597, as against £136,310 for March, an increase of £53,000; the principal increases occurring in electrical goods and apparatus, £20,000, and electrical machinery, £29,000. The re-exports totals of foreign and colonial electrical material show a slight increase (£5,000) on the previous month. The total values being £15,494 for April, as compared with £10,114 for March.

The weight of electrical machinery exported during the month totalled 1,012 tons, as against 746 tons in 1919, and 2,267 tons in 1913.

Values of Electrical Exports and Imports for April, 1920.

	Exports.	Imports.	Re-exports.
Electrical goods and apparatus (unenumerated)	£127,901	£56,545	£9,909
Insulated wire	266,613	6,926	547
Glow lamps	15,315	1,967	27
Arc lamps and parts	1,754	1,862	9
Batteries...	35,382	9,900	—
Meters	36,357	4,264	1,421
Carbons	11,202	6,616	87
Electrical machinery :—			
Railway and tramway motors...	2,034	—	—
Motors and generators	94,507	—	—
Elec. machinery (unenumerated)	86,944	86,321	1,972
Switchboards (not telegraph or telephone)	5,550	17	—
Telegraph and telephone cable and apparatus :—			
Telegraph and telephone wires and cables (not submarine)...	87,727	570	—
Submarine telegraph and telephone cables	88,278	—	—
Telegraph and telephone instruments and apparatus ...	80,450	14,609	1,522
	£940,014	£189,597	£15,494

LEGAL.

Charge of Stealing Electricity.

At Haslingden last week, Horace Kay, electrical contractor, was fined £10 for fraudulently consuming electricity. It was alleged that he made a connection from the Corporation main, and though he had lamps and a radiator, he had no meter. Defendant admitted to the officials that he had obtained the current in this way, and said his father, the Corporation electricity manager, knew nothing about the matter. The defence was that in the rush of business and with a great need for light, defendant made the connection, but he put in a switchboard ready for the meter. Defendant was ordered to pay £9 for electricity consumed, and the Bench hoped he would not take such a false step again.

Factory Act Prosecution.

At the Redcar Police Court, on the 7th inst., Messrs. Dorman, Long & Co., Ltd., ironmasters, were charged under the Factory Acts with a breach regarding the use of electricity by having failed to earth a wire attached to a motor driving a pump at their Warrenby Works. They were also charged that in consequence of their failure to conform with regulations, a boy was killed on February 2nd.

A workman said he saw the boy collapse on the handle of the starter of the pump. The current was cut off and artificial respiration was applied, but without avail.

Cross-examined, the witness said he knew nothing about electricity, and so far as he was aware, the lad might have had a fit.

Elisha Price, an electrician, said he was sent to repair the bushes of a motor-driven pump. He connected it with the starter. There was an earthed wire to the motor, and he never noticed that there was not one connected with the starter. The leakage of current had been caused by metal dust which was blown about. Witness added that on this particular day he had been troubled because his child was very ill.

For the defence, it was stated that the firm were prepared to plead guilty to a technical offence, but they would resist the second and major charge against them.

Mr. S. E. Bennett, factory inspector, said he would withdraw the second charge.

Mr. R. Cohen, for the firm, then urged that defendants, though pleading guilty to a technical offence, were not guilty

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in law. The guilt, he said, obviously rested on one of their employés. It was an unfortunate oversight; the man was sorry; and the firm, instead of sheltering behind him, took the brunt of the matter on themselves. He pointed out that the firm took every precaution, and despite the fact that they had been large users of electricity for over 20 years, they had not had a single case of death by electricity, nor, under the present manager, had they been troubled with a Home Office action. Relatives of the boy, he added, had been generously compensated.

The Bench intimated that there would be no conviction, but that the firm should pay the Court and witnesses' costs.

Giant's Causeway Electric Tramway.

The Water Power Lease.

In the Nisi Prius Court of the High Court of Justice in Ireland, Dublin, on Friday last, before Mr. Justice Moore, an action was brought by William Robert Young, of Galgorm Castle, Co. Antrim; George C. G. Young, of the same address, and Richard Grove Annesley, of Annsgrove, Castletownroche, Co. Cork, against William Acheson Traill, of Porballantrae, Bushmills, Co. Antrim, civil engineer, and the Giant's Causeway, Portrush, and Bush Valley Electric Railway & Tramway Co., in which the plaintiffs claimed possession of premises demised by indenture of lease dated June 23rd, 1883, made between Robert J. Montgomerey of the one part, and Anthony Traill and William Acheson Traill of the other part, for a term of 35 years from November 1st, 1882, which has expired.

The premises in question were the mill and mill premises of Walkmills, together with the water power belonging to the mill, and the right of way to the high road. The plaintiffs were trustees of a term of a thousand years created by the will, dated April, 1903, of Sir Francis Macnaughten, deceased. The defendants were, and had been since the expiration of the lease, in possession of the premises, and had withheld possession from the plaintiffs. The plaintiffs claimed, in addition, £500 for mesne profits. The defendants in their defence stated that they did not admit that the plaintiffs were entitled to the reversion in the premises expectant on the expiry of the term in the statement of claim. The defendants also pleaded that if the plaintiffs recovered possession the working of the Portrush and Giant's Causeway Railway, which depended upon the supply of electricity derived from the water power demised by the lease, would cease, and thus cause great inconvenience to the public. The defendants were at all times ready to take a renewal of the lease upon reasonable terms, or to purchase the premises and the water rights.

When the case was called, Mr. Andrews, K.C., for the plaintiffs, said he and counsel for the defendants had agreed on terms, which were that a decree for possession should be given, with a stay until November 1st next. It was further agreed, he continued, that for a period of six months —May 1st to November 1st—a sum of £50 for mesne rates should be paid for occupation of the premises, and that, in regard to the mesne rates which were the subject of the claim, they should be settled by payment by defendants of a sum of £125, covering them from the expiration of the lease in 1917 down to May 1st this year. Defendants had agreed to pay the costs of the action. It was hoped that the parties would be able to come to terms during the interval in regard to the extension of the lease, and thus enable matters to be satisfactorily adjusted.

Mr. Jellett, K.C., M.P., for defendants, said the matter had been very reasonably dealt with. The subject matter of the action was the water power of the River Bush, which for 40 years had supplied motive power for the tramway. The continuance of that water power was vital not only to the tramway company, but to the people of the district. They had no defence in law, but he thought that they all recognised that there was more at issue in the action than a mere fight between plaintiffs and defendants, and that they must take a broad view of the situation. In his view, Sir Malcolm Macnaughten recognised that it was in nobody's interest that the Tramway Co. should come to an end.

Mr. Justice Moore said he trusted the negotiations would not fall through. If they did possession should be given by October 31st.

Mr. Jellett said the tramway was being worked under Government control.

A consultation led to a statement on behalf of the defendants that they could not undertake to give up possession, and that they preferred that judgment should be marked on the expiration of six months.

Mr. Justice Moore said in those circumstances the costs would have to be taxed.

Carmarthen Electric Light Co. v. Thomas.

His Honour Judge Lloyd Morgan, K.C., at Carmarthen County Court on May 5th, gave his reserved judgment in an action in which plaintiff company claimed from defendant, a solicitor, £1 1s. 6d. for electric current supplied to him from September 29th, 1919, to December 24th, 1919, at the rate of 9d. per unit. Mr. Thomas had paid at the rate of 7d. per unit, and disputed the company's right to charge 9d. per unit for this period, for they did not receive the consent of the corporation to increase the price from 7d. to 9d. until January 8th, 1920.

The Judge said that on September 29th, 1919, the Board of Trade, under the Statutory Undertakings Temporary Increase of Charges Act, 1918, made an Order authorising plaintiffs to charge a sum not exceeding 9d. per unit, and on October 27th plaintiffs gave defendant notice that the price would be increased from 7d. to 9d. as from September 29th. On the same day plaintiffs applied to the corporation for their consent to increase the charge to 9d., but this consent was not given until January 8th, 1920. The Judge said that, in his view, plaintiffs were not entitled to charge ordinary customers more than 7d. until they obtained the consent of the corporation. A fair construction of the resolution of the council on January 8th, 1920, was that they gave the company consent to charge the corporation for public lighting as from September 29th, but the resolution did not give consent to charge private customers from September 29th. He did not think the council had power to date it back. His Honour gave judgment for defendant, and allowed leave to appeal.—*Western Mail.*

Charge Dismissed.

At Burnley Police Court, on May 5th, Bernard Birtwistle (27), of Skipton, was summoned on a charge of having stolen certain parts of a desk fan while a servant of Burnley Components, Ltd. It was stated that defendant was engaged by Burnley Components, Ltd., as an armature winder, and his wages were £4 5s. per week, plus bonus. One of the articles in which the company specialised was a desk fan, and defendant had charge of the department in which certain parts were kept. It came to the knowledge of the company that defendant was sending out certain parts of the fans to persons with whom Components, Ltd., dealt, and asking for quotations for their manufacture. He was also making inquiries from customers as to whether they could find him a market for desk fans in considerable quantities.

Mr. Mossop contended the man had no right whatever to take any of the parts off the firm's premises.

Mr. Arthur Charles, managing director of the firm, admitted defendant had written an apology, and had said he had no intention of injuring the company.

Mr. Harry Ogden, another director, said defendant admitted that he and another man were in partnership together for the manufacture of the fans. "There are no complaints about his work while in the employ of the company," added Mr. Ogden, "and the prosecution have no desire to be vindictive, and have only brought the case as a deterrent."

For the defence, it was stated the parts were only sent away for the purpose of obtaining quotations, and these would be returned.

The Bench held that whilst defendant had done wrong, they did not think he had any felonious intention.

The case was dismissed.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

The Electrification of Canals.

The resolution moved by the Birmingham Chamber of Commerce and passed unanimously by the Association of Chambers of Commerce on the 20th of last month is a sign that the business community throughout the country is fully alive to the canal situation, and the necessity for a development of this national asset.

It is generally felt (supposing it were impossible at the present time to carry out all the recommendations of the Canal Commission of 1906) that the main arteries of the canal system are deserving of the Transport Ministry's close attention, if only for the purpose of being used as auxiliary to the congested railways.

The Association of Chambers of Commerce, together with the Waterways Association, for which Mr. Neville Chamberlain, the chairman, and Mr. Frank Impey, the secretary, have done such good work, would no doubt be satisfied with a less ambitious programme than that originally planned, and they would be considerably heartened by some tangible commencement in the way of dredging, electrification, or other improvements which might be looked upon as an earnest of the Ministry's future intentions.

Birmingham, for instance, from its position in relation to the seaboard, would enjoy some benefits from a modernised system of canals similar to those which Manchester now has from its Ship Canal. Particularly would this be the case in relation to the ports on the Severn estuary.

The meagre amount of literature available on this subject seems to be quite in keeping with the decadent condition of canals generally in this country, and as no practical examples appear to exist at the moment, any electrification scheme will be in the nature of pioneer work. Numerous examples of towing by locomotive (either steam or electric) are in

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existence, but no serious attempt has so far been made to find the best or most facile system to suit the circumstances in this country.

I venture to submit that you would serve a most useful purpose were you to collate particulars of canal electrification in countries where water transport has been more fully developed. It would serve to encourage a form of enterprise which would be of great value to the electrical industry.

Whatever method may be adopted, the type of electrification must be the same through to the coast, and the parties most nearly concerned or affected by the traffic along the canals must have a voice in this important question.

Canals.

London.
May 6th, 1920.

[We have always advocated the development and electrification of our canals, and for years past have published particulars of electrification schemes that have been carried out abroad. Unfortunately, the pressure on our limited space under present conditions precludes the possibility of accepting our correspondent's suggestion.—Eds. Elec. Rev.]

Electrical Japanning Ovens.

I have read the letter on japanning ovens contained in the Electrical Review for the 23rd ultimo, and I think the statements made should be supported by fuller details. Will Mr. Rider kindly answer the following questions:—

1. Were the gas-heated ovens internally or externally heated?
2. What temperature were the ovens worked at?
3. What size flue nozzles were used for carrying off the products of combustion?
4. What was the hourly gas consumption?
5. What time was allowed for stoving?
6. Were the gas ovens loaded to the full capacity?
7. Why is the control of heat easier with electrically-heated ovens?
8. What form of heater is used for the electric oven?
9. What is the quantity of electricity used per oven per hour?
10. What is the working temperature of the electric oven?

The case is worth careful examination, as it is obviously impossible for four electrically-heated ovens to do the work of nine gas-heated ovens of the same size heated to the same degree of heat. There must, therefore, have been something radically wrong with the gas installation, which answers to the foregoing would probably make it possible to detect. So much success has attended other gas installations for such work that I am quite certain there was a "nigger" somewhere in the case quoted by Mr. Rider.

W. M. Mason,
Secretary.
The British Commercial Gas Association.

London, S.W.
May 3rd, 1920.

The I.E.E. Building.

It is a good idea of, I think, Mr. Wordingham and others, to try and close the electrical profession, but it is not yet, I fancy.

Can any of your readers tell me when we are, if ever, going back to the Institution building? Personally, I think this building is a mistake, for several reasons, and ought to be sold, if possible.

If the I.E.E. had a smaller building, fitted out more like a club, in Westminster, it would be better in every way.

D. R. Broadbent.

London, S.W.

The Cost of Living in India.

In your issue of March 26th last a correspondent signing herself "Western India" draws attention to the inadequacy of pre-war salaries paid to engineers in view of the increased cost of living under present-day conditions. It is perfectly true that the cost of living has risen considerably, but it only confuses the issue if criticisms are made upon salaries which carry with them the perquisite of free quarters, when figures are quoted giving the rentals of houses, flats, and rooms in hotels. Obviously, when free quarters are granted, the cost of rentals in hotels, &c., has no bearing upon the subject whatever, and the letter may lead many young men to refuse appointments which, seeing that free quarters are given, are adequately remunerated, and carry with them good prospects of further advancement.

Your correspondent also implies that all merchants' assistants who draw less than Rs. 1,000 per month, plus allowances, are few and far between, badly off, and dissatisfied. I have just returned from a visit to India, and can state with confidence that many young men of public school and university education willingly go out as assistants in merchants' offices on salaries one-half of that mentioned, where there are good prospects, and that, too, where free quarters are not provided. A single young mechanic, therefore, who is fortunate enough to start on Rs. 450 per month with free quarters may consider himself very well paid indeed. The rise in the exchange value of the rupee is already having its effect on prices of commodities grown or produced in India, and the cost of living should gradually become somewhat less. The rentals of living accommodation are still very high, and are not likely to fall, but engineers who may legitimately expect the valuable perquisite of free quarters remain unaffected thereby.

I consider that there are at the present time many openings in India for engineers and mechanics, and I should be sorry if young men are deterred from taking their chances by the confused manner in which your previous correspondent has stated her case.

It should also be borne in mind that a determined effort is being made to train young Indians as engineers, and if Englishmen insist on excessive salaries, they will find their placed filled by others.

A. H. Dykes.

London, S.W.
May 7th, 1920.

Battery Symbols.

"W.S.B." (Electrical Review, May 7th) has inquired which is right: + ▮ | ▮ | ▮ | −, or + | ▮ | ▮ | ▮ | −?

May I supplement your Editorial footnote? This rightly informs "W.S.B." that "the correct form is a long thin line for positive and a short thick line for negative." You, Sir, have here rightly assumed that, in customary circuit nomenclature, the signs "+" and "−" refer to battery *poles* outside the electrolyte, and not to battery *elements* within the electrolyte.

The reverse, however, would have been right, had it been a question concerning battery *elements*.

This is, I think, where the authorities of various nationalities consulted by "W.S.B." have appeared to contradict one another. Some, when referring to the subject, had *poles* in their minds, and some *elements*.

Clearly: *Zinc* = + element, = − pole. Symbol: short thick line.

Carbon or *Copper* = − element, = + pole. Symbol: long thin line.

Of course, "+" and "−" are purely arbitrary terms, and are merely convenient modes of expression for describing two *converse* electrical states or conditions.

Lord Kelvin always adhered to the names Vitreous (= +) and Resinous (= −).

E. R. B.

[Our correspondent, of course, is perfectly correct. But our experience has been that, unless one is addressing men who are thoroughly conversant with the subject, it is dangerous to introduce the distinction between pole and element—confusion is almost certain to arise. By adhering to the usual convention, the signs + and − can be applied to all sources of unidirectional electricity, dynamos, batteries, &c., without risk of error.—Eds. Elec. Rev.]

I always teach students to memorise the above by describing the Leclanché cell—the zinc is a short thick rod (negative) and the carbon in porous pot, a longer thin plate (positive).

Earlier in the same lesson I lead them to remember which is the negative (zinc) as the element having no standing being attacked by the electrolyte, and the positive (carbon) remaining *in statu quo*.

Eau Delun.

Bromsgrove.
May 8th, 1920.

The L.C.C. and the Awards.

We note that the L.C.C. tramways are never very slow at the raising of fares, but the last always to pay the awards; no wonder discontent is bred amongst the workers. Being a constant reader and a mechanic, as I have informed you before, I believe in a straight deal both with employers and men—not shuffle, dilly and dally—a fair day's work and a fair day's pay, with less officialdom, trying every subterfuge to delay and excuse. Why do they do this?—to keep officials? They should act like contractors, or be made to; what they demand of them they fail to do themselves. Just like the present Government—muddle and waste.

A Worker.

London, *May 10th*, 1920.

The Street Passenger Transport of London.

I have now the pleasure of sending you a copy of the paper on this subject which I read before the Royal Society of Arts on March 17th, and upon which you commented on the 9th ult.

With the complete paper before you, you will perhaps see that Parliament had reasons for rejecting the London County Council Tramways Bill for tramway extensions. These reasons were at some length dwelt upon in the House of Commons on the 22nd ult., as reported in the official report No. 46 of that date.

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They appear to support your remarks when you say: "To put the matter briefly, we look upon the motor 'bus as a luxury, the tramcar as a necessity." Not only did the House agree with this, but the London public will unhesitatingly accept it. The difference between you and the House seems to be that while the House accepted your eulogy of the 'bus as a luxury, its members did not wish to have any further "necessity" forced upon the street passengers of London.

Parliament no doubt recognises the past usefulness of the London tramways, and would probably encourage some expenditure in the reinstatement of many of the existing tramways, but it does not see in that past usefulness any reason for perpetuating a past necessity or for creating a new one.

With you Parliament agrees that the London tramways are "weighed down with enormous capital charges due to the adoption of the 'conduit system,'" and so fully does it agree, that it will not give its assent to an extension of that system, or it may be expected, to any other.

Being deficient in daring, it is with trepidation that I tell you that you are, with a good many others, mistaken when you suggest that the motor 'bus does not pay anything for the use of the roads. It pays heavily, and hence one of the causes of the recent deficiency, and if, as you suggest, "their proper function is to ply on routes where there are no tramways," the loss of financial aid to the cost of the maintenance of roads would not only be heavy, but millions of passengers would be left in the streets many hours, for the 'buses on popular tramcar and 'bus routes carry twice as many passengers as the tramcars, and at crush hours in the morning, between 8 and 9, carry within 3 per cent. as many as the tramcars, or between 8 and 10 a.m. they carry the greater number, and nearly the same proportion obtains in the evening crush hours, and peak load times. These facts are shown by diagrams by one of the L.C.C. officers. I meekly remind you of these figures, because the public seem to look upon the omnibus, not only as a luxury, but as a thing that is necessary to their avocations.

The help given by Parliament, to which you refer as giving the tramways power to increase their fares, and as "enabling the omnibuses on competitive routes to raise their fares also" is apparently wanted by the tramways only, for the 'buses seem to be unmindful of this help.

You have, Sir, charged me with eulogy of the omnibus *ad nauseam*. You have published an article on "London Transport," and you have mentioned that I had read a paper before the Royal Society of Arts. In that article you have not controverted a single one of the facts given in that paper or any of the conclusions based on those facts, but you have defended and eulogised the tramways of London, and have not allowed yourself to "seek a just and true perception" of the nature of the problem of mechanical transport and of the means of its solution.

Considering recent events, the exposition of the wishes of all the highway authorities except the L.C.C. and the decision of Parliament, it would seem that when tramway extensions are extolled the public agree again with you and say, "Really we cannot help laughing."

W. Worby Beaumont.

Outer Temple,
Strand, London.
May 4th, 1920.

[Mr. Beaumont makes great play with the proceedings of the House of Commons in connection with the L.C.C. Tramway Bill: but this is a red herring which he draws across the track. The question before the House was whether "Standing Order 22 be dispensed with in respect of the Bill, with a view to the consideration of the proposals thereof." That is to say, the question was whether the veto of other local authorities should be suspended on this occasion. The opposition to the motion, led by Sir Herbert Nield, was based on the ground that the veto ought not to be dispensed with until a London Traffic Board had been brought into existence. The Ministry of Transport urged the House to suspend the Standing Order and allow the Bill to be considered, it being a matter of urgency, whereas years might pass before the Central Traffic Board could be got into working order.

The House of Commons declined to suspend the veto, and thus the Bill did not come, and cannot come, under consideration.

To claim this incident as the deliberate verdict of Parliament on the subject of tramway extensions is to insult the intelligence of our readers.

Mr. Beaumont again states that the motor 'bus pays heavily for the use of the roads. Will he tell us what contribution the London borough councils received from the omnibus company last year? The L.C.C. tramways not only pay for the maintenance of the roadway (£184,000 a year), but are also rated on the track (£77,723 in 1918-19), a total of more than £260,000 a year. If Mr. Beaumont is referring to the 6d. tax on petrol, how much of the product is paid to the London road authorities?

With regard to raising fares, our correspondent is trifling with the question. He knows that the 'bus fares are not subject to any statutory limit, but it is only practicable to increase them if railway and tramway fares are also increased. The present attempt of the London Underground Railways to obtain sanction to increase fares is due to the fact that the 'buses have landed them in a mess. "The inclusion of the 'buses has the effect of converting the net income . . . from £833,500 to a deficit of £177,695" (Report of the Ministry of Transport to the Advisory Committee on London Traffic). In other words, the omnibus undertaking is to the railways like the old man of the sea to Sindbad the Sailor. And the 'buses are "unmindful"!

Whether we have controverted any of Mr. Beaumont's facts we leave to the judgment of our readers. In the discussion on his paper Mr. Henry Ward said the author had not written a paper on the Transport of London, but had given a contribution which praised omnibuses and did not mention a single one of their defects, and which from end to end damned the tramways; and Mr. G. H. Hume said everything had been said that could have been said in favour of the omnibuses, and nothing at all had been said in favour of the tramways. That is the substance of our criticism; the author assumed a judicial attitude, but his paper was intensely partisan.—EDS. ELEC. REV.]

City of York Advertisements.

One reads with pleasure the spirited letters in the current issue of the REVIEW, in reference to the City of York Corporation's advertisement for a mains superintendent at a salary of £90 per annum, plus the E.P.E.A. award.

To those intimate with the York undertaking, the salary is even more disgraceful than appears to readers of the advertisement, for the distribution system is by no means a small and unimportant one; it comprises E.H.T. 3-phase, and H.T. 3-phase cables, and O.H. lines to outlying areas, rotary and static sub-stations, &c., whilst there is also a 3-wire D.C. network (L. and P.), and public lighting and tramway cables, not to mention miles of tramway O.H. work.

Mr. J. H. Parker's letter is delightful reading, and one wonders that any self-respecting chief (and member of the I.M.E.A.!) would append his name to such an advertisement in an important journal like the ELECTRICAL REVIEW.

The salary offered seems rather paradoxical, too, in view of the fact that York is a strong labour centre, and the City Council is in favour of paying adequate living wages to its employés.

However, York will get its mains "superintendent," and it is practically certain that the (say) £100 p.a. saved on salary will be far more than compensated for by lack of experience, knowledge, tact, and ability, &c., and the world will still roll round.

The great moral lesson of it all is to see that we engineers stand back to back until our profession is placed on a proper foundation like the medical and legal professions, and then plumbers and gasfitters will not be "electrical engineers," and trained engineers will receive salaries instead of existence money.

If engineers would hasten that day, let them support with enthusiasm the E.P.E.A. in particular, and the I.E.E. in general, in their efforts for the betterment of the profession, and then, and *only then*, shall we see the last of such advertisements as that of the York Corporation and its engineer and manager.

An ex-Member of the Staff.

May 9th, 1920.

Turbine Explosion. — The April 20th issue of *Power* gives minute details of a turbine explosion causing the death of two men and injuring ten others which happened at the Waterbury station of the Connecticut Light and Power Co. The machine, which had a normal speed of 1,800 R.P.M., was directly connected to a 3,000-KW. generator. The main shaft was 13 in. in diameter, turned down to 7 in. at the governor end, and six 48 in. wheels were keyed to it. These wheels carried two rows of buckets on an outer face 5½ in. wide. The turbine was equipped with a centrifugal type governor, actuating ten steam valves through a connecting-rod, and an emergency stop arranged to operate at about 8 per cent. above the normal speed was also provided. The latter consisted of an unbalanced ring mounted on the shaft, and at normal speed was held in a concentric position with the shaft by means of springs. If the speed became excessive the spring tension would be overcome by the unbalanced weight acting centrifugally, and the 8 in. main throttle valve would be closed. The accident caused the shaft to break in two parts, the bolts of the generator coupling were torn out of place and the bucket wheels were cast about in all directions, resulting in the total destruction of the machine. The cause of the trouble is, of course, the centre of much discussion, and various theories have been put forward. The most feasible conjecture is that the exciters on all the generators in working (there were four running at the time) suddenly lost their excitation, resulting in a loss of load on the turbines. Three of the four machines were shut down upon the sudden increase of speed by their emergency stops, but the steam valve of the wrecked turbine was found after the accident to be not quite closed, and it is thought that something upon the valve seat prevented its closing and cutting off the supply. It is stated that the valve was in proper working order, having been tested only a short time before the disaster occurred.

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BUSINESS NOTES.

Deed of Assignment.—E. W. F. HEATH (Heath, Wingfield & Co.), electrical engineer, 6, Hans Road, Brompton Road, S.W. Particulars of claims, &c., must be sent to the Trustee, Mr. A. J. Osborne, Balfour House, Finsbury Pavement, E.C., by May 24th.

Ellison's Athletic Club: A Challenge.—At the close of the war, the employés of Messrs. George Ellison, of Birmingham, showed a desire for recreation and sports. The head of the firm was heartily in sympathy with them, and fostered the movement. The workpeople were encouraged to form football, hockey, cricket, swimming, and other sections of a comprehensive athletic and recreation club. This took shape, and we are pleased to learn that it is now a vigorous institution controlled by committees elected by the workers. The football section has won laurels, its records being as follows:—

Season 1918-19.—Champions of the 5th Division of Birmingham and District Works League, winners of Mitton Challenge Cup, and winners of Cadbury Challenge Shield.

Season 1919-1920.—Finalists for Aston Villa Challenge Cup, Semi-Finalists for Prudential Victory Cup, and winners of Vernon-Austin Challenge Cup. In this last competition the club had a stiff struggle with Harper Son & Bean's men, drawing two games before beating them decisively by 2 goals to none. The club have only suffered one defeat in the Works League 1st Division, to which it had been promoted, and but for the F.A. ruling that all fixtures must be played by May 1st, Ellison's men would probably have been the League Champions.

In addition to this team, the section successfully ran a second men's football team and a boys' team. The boys are the probable champions of the Welfare League, but a point is in dispute. They have won 20 out of 22 games, and scored 164 goals against 31. They are considered to be the most finished boys' football team in the Midland district.

We are informed by Mr. Geo. Swales, the secretary of Ellison's Athletic and Recreation Club, that the senior team is willing to play a match against an amateur side from any electrical works in London or the provinces, and we have pleasure in passing on the challenge. If the secretary of such a club accepts this challenge, and will write to Mr. Swales at Messrs. Ellison's works at Perry Barr, Birmingham, a game could be arranged during this month.

High-Pressure Transmission Lines in Japan.—According to "Commerce Reports," the proposed extension of hydro-electric projects in Japan will involve the building of about 1,000 miles of high-pressure transmission lines within the next two years; most of the construction will probably be of the steel-tower type. Aluminium is being considered by the Japanese hydroelectric plants to replace copper in their heavy transmission cables. Copper has been used exclusively for this purpose heretofore, but even with a 25 per cent. duty, aluminium can compete successfully on the basis of price.

U.S. Foreign Electrical Trade Outlook.—Figures furnished by the United States Bureau of Foreign and Domestic Commerce show a slight falling off in the average of electrical goods exported during January, and manufacturers say that incoming orders from the foreign trade have shown a decrease since November. Export shipments have held close to the record rate established last fall, but they are beginning to reflect the slight slump in bookings. This decrease is by no means regarded as a lasting condition. Japan is considered a big prospective purchaser, and it is believed that large orders for manufacturing and water-power equipment will be received from that country during the spring and summer. The impossibility of obtaining a sufficient supply of coal is forcing Japan to an immediate development of her unused water-power. Practically all of this equipment will be purchased in the United States. Very little equipment is being exported to Europe, due to the fact that the larger electrical companies have an important interest in almost all of the European electrical plants. Execution of any of the numerous plans for the electrification of European railways would mean some large orders for the leading American companies, but none of these plans has so far been completed. Italy plans eventually to electrify 6,000 km. of railway, and a dozen or more projects are said to be under consideration in France. Orders received from South America compare favourably with the high rate reached last fall. Improvement in the industrial situation in Buenos Ayres is expected to be reflected in an immediate increase in bookings. The conclusions to be drawn from this information are that electrical exports will soon be on the increase, with the possibility of approaching figures never before attained.—*Electrical Review*, Chicago, April 17th.

New French Company.—La Société Le Moteur Electrique is the name of a new undertaking which has lately been formed in Lyons with a capital of 1,000,000 fr.

An Australian Inquiry.—The D.O.T. has received from the Office of H.M. Senior Trade Commissioner in Australia a communication to the effect that a firm of electrical apparatus manufacturers in Melbourne wish to get into touch with United Kingdom firms who are in a position to supply core stampings for armatures, field magnets, stators and rotors; also commutators for D.C. motors from ¼ to 5 H.P., and for A.C. motors up to 10 H.P. Particulars as to the name and address, &c., can be obtained on application to the D.O.T. in London.

Copper Prices.—MESSRS. F. SMITH & Co. report, May 12th: No change in electrolytic. MESSRS. JAMES & SHAKESPEARE report, May 12th: Copper bars (best selected), sheets and rods, £165, and increase of £2. English pig lead, £40, a decrease of £1 on the week.

Liverpool Commercial Library.—We have received from the Chief Librarian, Liverpool, a copy of the official "Handbook to the Commercial Reference Library" which is in existence there at Exchange Buildings. Two full-page photographic views are given, and the several sections are as follows:—Alphabetical Index to Commercial Subjects; Classified Catalogue of Books in the Library; Alphabetical List of British and Foreign Directories; Index to Periodicals, including trade journals, trade reports, &c.; and Commercial, Railway, and other Maps. From a study of the catalogue we feel justified in congratulating those responsible for the organisation upon having brought together a very representative and useful collection of literature relating to trade and industry.

Electrical Plant for China.—There has recently been in the United States the representative of a large flour-milling company of China, who was arranging for the purchase of a quantity of machinery, and for an electric generating plant, for which over a million dollars will be spent.—*Commerce Reports.*

Orders for Resistances.—Among the orders recently received by the ELECTRO-MECHANICAL BRAKE CO., LTD., of West Bromwich, for "E.M.B." unbreakable and jointless resistances, "Maley's Patent," are the following:—

Vigo Tramways (per English Electric Co.), Midland Railway Co., Bournemouth Corporation Tramways (per B.T.H. Co.), Yorkshire (Woollen District) Tramways (per British Electric Federation), County Borough of Stockport, Oldham Corporation Tramways, Sheffield Corporation Tramways, Dunfermline Corporation Tramways, Manchester Corporation Tramways, Dover Corporation Tramways.

Glasgow Exhibition.—*Gas and Oil Power* states that the Corporation of Glasgow is promoting an Electrical, Engineering, Shipbuilding, and Motor-boat Exhibition, which is to be held at the Kelvin Hall, Glasgow, from November 8th to December 4th.

Catalogues and Lists.—MESSRS. CALLENDER'S CABLE AND CONSTRUCTION CO., LTD., Hamilton House, Victoria Embankment, E.C.4.—Booklet (24 pp.) illustrating and describing the component parts and accessories of the "Kaleeco" wiring system, giving photographs of installations. Booklet (8 pp.) showing boxes and wires for the above system finished in various art shades to harmonise with interior decorations; and a priced catalogue (18 pp.) setting forth the different grades and applications of "Kalanite" insulating material.

MESSRS. WILLIAM SANDERS & Co., Falcon Electrical Works, Wednesbury.—New illustrated and priced catalogue (20 pp.) of ironclad switch and fuse gear, to meet all voltages up to 600.

STERLING TELEPHONE AND ELECTRIC CO., LTD., 210-212, Tottenham Court Road, W.1.—Publication No. 278 a 4-page priced leaflet illustrating the "Equipoise" flexible telephone arm.

STURTEVANT ENGINEERING CO., LTD., 147, Queen Victoria Street, E.C.4.—Catalogue No. 1,072 (32 pp.). A well-illustrated description of the "Sturtevant" mechanical draught and its various industrial applications.

MESSRS. ALLDAYS & ONIONS, LTD., Great Western Works, Birmingham.—Catalogue No. 464, a 4-page leaflet describing a system of oil-firing for boilers. Priced and illustrated.

MESSRS. VAN HADEN & Co., LTD., Great Heath, Coventry.—This business was purchased by Mr. R. Rankin, B.Sc., M.I.E.E., some time ago, and has been completely re-organised and equipped for the rapid production and delivery of accumulators. Five pamphlets recently to hand, give complete descriptions of the firm's manufactures, including the special "Looped Grid" type of plate. These pamphlets are fully priced and well illustrated.

ALLOY WELDING PROCESSES, LTD., 14-16, Cockspur Street, S.W.1.—Folder (8 pp.) describing the structural steel work at Stelfast Works, Brixton, welded by the "A.W.P." process. Also 4-page leaflet describing the all-welded steel stabling for Olympia Horse Show.

BLACKMAN EXPORT CO., LTD., 374, Euston Road, N.W.1.—Leaflet (April, 1920) illustrating and describing the "Blackman" CO_2 tester. Priced.

MESSRS. DYER & YOUNG, Empire Works, Stansted, Essex.—Catalogue of spare parts for electric traction motors, including armature and field coils, commutators, and contacts. Also eight sheets illustrating various standard types of controller fingers, 16 in. × 24 in., brass bound for hanging on wall.

Plant for Sale.—Manchester County Asylum authorities have for disposal two steam dynamo sets by Mather & Platt; Stockton-on-Tees Electricity Department invites offers for one 150-KW. Brush "Universal" vertical reciprocating engine, direct-coupled to one 460-volt Brush "Universal" shunt dynamo. Shoreditch Borough Council Electricity Department invites offers for one 800-KW. generating set (marine-type compound engine), complete with condenser pumps, &c.; also one Davis-Perrett type electro-mechanical oil separator, &c. For particulars see our advertisement pages to-day.

American Railway Company's Profit-sharing Scheme.—The *Electrical News* (Canada) gives particulars of a profit-sharing scheme which has been prepared by the Pittsburg, Butler, and Harmony Consolidated Railway and Power Co. (U.S.A.). The employés will be given $1,000,000 worth of stock by the company, and will select three of their number to represent them on the board. About 400 employés are involved in the plan, which will be tried for five years. It is hoped to put the plan into operation at an early date. The fund which will result from the dividends accruing on the $1,000,000 stock is to be divided equally among the employés.

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Book Notices.—The Marconi International Code Co., Ltd., has published the Marconi Dictionary, containing upwards of 38,000 leading English words. Included in the volume is a glossary of about 3,000 technical words used in connection with wireless telegraphy and telephony. This has been compiled by Mr. Sidney H. Nayler, lecturer and demonstrator in wireless telegraphy at Marconi House and King's College, London. This volume, every word of which is numbered and defined, has been published for three purposes: first, to serve as an auxiliary to the Marconi International Code; secondly, to be used, if desired, as a verbatim code by which cable charges may be reduced; and, thirdly, to supply the need for a modern dictionary.

"Steam-Boiler Construction. Rules of the National Boiler and General Insurance Co., Ltd." Second edition. 208 pp. By Edward G. Hiller, B.Sc. Manchester: Bethell & Co. Price 3s. 6d. net. —Divided into 15 sections, this work deals with all classes of boiler-work in a very complete manner.

"Vickers News." Vol. II. No. 15. 20 pp. London: Vickers, Ltd.—Contains a number of interesting contributions and good photographs. The articles include descriptions of the dry dock recently launched at Barrow, cleaning machinery for grain and seed, and notes on the Contraflo condenser, &c., and a report of the fifty-third annual general meeting of Vickers, Ltd.

"The *Journal* of the Röntgen Society." Vol. XVI. No. 63. April, 1920. 40 pp. London: Percy Lund, Humphries & Co. 5s. net.—Includes articles on "The Action of Induction Coils," by Prof. E. Taylor Jones, D.Sc., illustrated by oscillograph records; "Some Aspects of Radiology," by Major G. W. C. Kaye, O.B.E., M.A., D.Sc.; and "A Timing Device for Rapid Radiographic Exposures," by E. E. Burnside.

"The Metropolitan Vickers Gazette." Vol. V. No. 85. April, 1920. 22 pp. 7d. post free.—Includes articles on "The Modern Cane Sugar Mill," by L. Millar, and a description of an electric-battery locomotive built by Metropolitan-Vickers, Ltd.

"Aluminium." By G. Mortimer. Pp. viii + 152; 51 figs. London: Sir I. Pitman & Sons. 2s. 6d. net.

"*Proceedings* of the Rugby Engineering Society." Vol. III. Session 1918-19. Rugby: The Society.—This volume sets out the rules of the Society, and gives a list of members and officers. The papers included are "The Decimal System," by G. Moores, B.Sc.; "Polyphase A.C. Commutator Motors," by N. Shuttleworth, M.Sc.; and the "Tool Room," by E. Hayes. A large amount of space is devoted to a record of the discussions upon the above papers.

Trade Announcements.—Messrs. Buckley, Saunders and Co., Ltd. (E. A. Chantler), have secured the agencies for South America for the Wild-Barfield electric furnaces, and also for the Argentine for the A.I. Manufacturing Co.'s electric welding machines. Demonstration plants are already in operation at the works in Buenos Aires, and can be inspected by applying at the offices, 314, Bme Mitre. A demonstration Wild-Barfield electric furnace will also be in operation shortly in Rio de Janeiro.

The Overseas Engineering Co., Ltd., has removed to 163-165, Great Portland Street, London, W. 1, where it will shortly open a showroom.

The business of the late Mr. W. Rigden, electrical engineer, of Princes Road, Ramsgate, has been purchased by Messrs. H. W. Booth & C. H. Bottomley.

The Economic Electric Co. have opened new works at Latchford Without, Warrington.

Foreign Trade.—April Figures.—The following are the values of imports and exports of electrical goods and machinery in April:—

	April, 1920.	*Inc. or dec.*	*4 months*, 1920 *Inc. or dec.*
Imports.	£	£	£
Electrical goods, &c. ...	103 276	— 29,388	— 106,982
Machinery	1,883,162	+ 789,474	+ 583,510
Exports.			
Electrical goods, &c. ...	756,529	+ 392 407	+1 810,944
Machinery	4,051,663	+2,115,937	+7,003,485
Re-exports.			
Electrical goods, &c. ...	13 522	+ 8 864	+ 16 881
Machinery	123,023	+ 75,698	+ 255,339

British Empire Exhibition.—It is stated in the Press that the President of the Board of Trade is shortly to introduce a Bill for authority to contribute £100,000 to the guarantee fund of the forthcoming British Empire Exhibition to be held in London. It is understood that the Lord Mayor will shortly convene a public meeting at the Mansion House, at which an appeal will be made for contributions to the guarantee fund.

Lead.—In their report dated May 8th, Messrs. G. Cawson & Co. stated that there was an ample supply of lead for all requirements. The general demand, except for electrical purposes, was exceedingly slack, and did not look like improving.

Messrs. James Forster & Co. reported under the same date:—

On the 6th inst. a report reached London that some of the smaller Unions in Australia had decided to accept the terms offered by the mine owners, but that the majority of the miners still held out. This was, however, considered in some quarters to indicate that a settlement of the prolonged strike was at last in sight, and some fairly heavy realising for speculative account followed. On 7th inst the market closed at the lowest, the final quotations being: £36 May, £36 10s. June, £37 July, £37 5s. August, and £37 10s. September. The turnover for the week is approximately 7,000 tons.

Should it prove to be the case that work on the mines in the Broken Hill district be renewed at an early date, we may look for a renewal of the normal rate of supply from this quarter next year, but in the meantime available stocks must be getting short, and this scarcity will probably make itself felt about next July-August.

Manufacture of Electrical Porcelain in Japan.—In the course of a report on the commercial pottery of Japan, the United States Commercial Attaché at Tokio remarks that one of the newer developments is the manufacture of electrical accessories in connection with the rapidly expanding electrical industry in Japan. The large high-tension insulators demanded by hydroelectric development are made both in large factories, such as the great Morimura plant at Nagoya, and also by small individual workshops (on sub-contracts) in villages. The large pole insulators are thrown on an ordinary wheel which usually is motor driven. When shaped they are passed to a second man who turns them to size with a tool. Finally they are carefully finished by hand before drying. They are glazed in the clay and fired once. One man carrying through all the processes will throw, turn, and finish 400 insulators in a day, for which he gets about 1.70 yen (including a rice stipend). Smaller white porcelain goods, insulators, cleats, rosettes, &c., are for the most part manufactured in Japan in the households alongside of dolls and teapots. They are moulded in plaster of Paris moulds, with a lavish expenditure of time and energy, from clay purchased ready for working, and are then fired in community kilns. With practically no overhead charges, such small manufacturers are able to compete successfully with modern factories. In fact, one large establishment which put in an insulator factory has been underent in price by the small independent potters to such an extent that it has almost ceased to do business. Prices at the factory in October, 1919, for various items were as follows: Two-piece ceiling rosette, 2½ in. screw thread, 7½ to 8½ sen; cleats, 1.4 sen a pair; solid knob No. 5, 1.20 to 1.30 yen per 100 (an advance of 60 per cent. over 1918); solid knob No. 3, 2.50 yen per 100; split knobs, 1.60 yen per 100.

[N.B.—Yen = 100; Sen = 2.0¼.]

Auction Sale.—By direction of the Disposals Board Ministry of Munitions, Messrs. King & King will sell by auction on May 26th and 27th, at H.M. Dockyard, Portsmouth, machine tools, plant, and electrical equipment. On May 28th, at Portishead and Portbury, Mr. C. D. Phillips will sell by auction the plant, machine tools, electric motors, generating sets, &c., of the national shipyards, Beachley, Portishead and Portbury. (Place of sale notified in catalogue.) Mr. M. Matthews will sell by auction at the R.A.O. Depôt, Georgetown, Glasgow, on May 19th, machinery and plant in stores, including many electrical items. For particulars see our advertisement pages.

Training Engineering Pupils.—Messrs. W. H. Allen, Sons & Co., Ltd., of Bedford, have sent us a copy of their prospectus of the engineering course which has been recently revised. The fee has been reduced to £150, and wages are paid to the students. The course is intended only for those who will either proceed to a university or technical college upon completion of the course, or who have already obtained a degree or diploma. A typical four years' course is outlined in the prospectus, and the time (four years) is distributed as follows:—Forge, pattern shop, and foundries, six months; machine shops, six months; fitting shops, nine months; dynamo shop, three months; test bays and outdoor work, nine months; drawing offices, nine months; and administrative offices, six months.

Catalogues Wanted for Chile.—The D.O.T. has received notice from the Commercial Secretary to H.M. Legation at Santiago de Chile (Mr. W. F. Vaughan Scott) that the Chilean Association of Electric Light Companies are desirous of obtaining complete sets in Spanish of the catalogues of United Kingdom manufacturers of electrical machinery and accessories, lamps, &c. Catalogues in triplicate should be sent direct to the Commercial Secretary, H.B.M. Legation, Santiago, Chile.

Telephone Directory.—We have received from Messrs. Swarren, Lld., of 9-11, Phœnix Place, W.C. 1, one of the handy desk telephone directories which they are distributing to their friends. Since reorganising their staff and acquiring new works in Holborn, where they undertake repairs to electrical machinery (including rewindings, A.C. and D.C., in which they specialise) up to 200 H.P. their business has rapidly extended; amongst recent contracts for power and lighting which they have obtained is that of Cassidy's Distillery in Ireland.

Corrosion Research Committee.—We have received a copy of a circular letter which is being sent to users of tubes and condensers by the above Committee. In accordance with the opinion of the Department of Scientific and Industrial Research users of tubes, &c., which are the subject of the Committee's labours, should be ready to contribute to the cost of the work, and an appeal is being made for aid. The Government has agreed to contribute an equal amount to that received from users, which latter class includes shipbuilders and shipowners, and, in addition to these, insurers of ships are directly concerned. The letter states that £1,000 per annum is being received from manufacturers who are interested in the research work of the Committee, and it is hoped that at least this amount will be forthcoming from the users. The letter is accompanied by a summary of the Fifth Corrosion Report, and the full report will be sent to subscribers. The secretary to the Committee states that Messrs. Ellerman Lines, Ltd., have contributed £100, and many others have responded to the appeal.

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Liquidations and Dissolutions.—UNELMA, LTD., electrical goods manufacturers, 18, Christopher Street, London, E.C.—A meeting of the creditors of the above was held on May 4th, at Anderton's Hotel, E.C., under the presidency of Mr. F. T. Shearcroft, who had been appointed to act as liquidator in the voluntary liquidation. The statement of affairs presented by the liquidator showed liabilities of £20,888, made up as follows:—Share capital, £3,027; debentures, £3,100; cash creditors, £865; bank overdraft, £991; and trade creditors, £12,905. The assets were estimated to realise £4,100, or a deficiency of £16,788. The assets consisted of:—Machinery and tools, £3,211, estimated to realise £2,000; fixtures and fittings, £1,552, expected to produce £500; stock in trade, £1,500; and book debts, £938, valued at £100. The company was registered on July 29th of last year, and took over the business which had previously been carried on by Mr. B. Pordes. The cash creditors were Mr. B. Pordes and his two sons. A portion of the fixtures and fittings were sold when the lease of the premises was disposed of. The lease was sold in February of the present year for £10,000 payable in cash, and it was understood that the money was used to pay pressing creditors whilst the other creditors received 20 per cent. of the amount due to them. The lease had about 18 years to run. Complaint was made by creditors that plant was ordered as recently as February 20th, and that goods were ordered on March 19th last. The solicitor to the company said that Mr. Pordes had been made a bankrupt, and but for that a prosperous business would still be in existence. When the company was formed, it took over the liabilities of Mr. Pordes, who was substantially the only person in the company. The latter was formed in order to obtain further capital, and about £5,000 was secured. Mr. E. H. Hawkins said that when the company was formed, it acquired machinery and tools valued at £3,622, and stock of the value of about £9,000, while the liabilities transferred were only in the neighbourhood of £7,000. In other words, the company started with solid assets of £12,000, a sum of £3,000 was obtained on debentures, while the lease was sold for £10,000. That made a total of £25,000, and the creditors wanted to know where the money had gone. The solicitor said that a loss of about £10,000 had been sustained in connection with the manufacture of certain batteries. Mr. Hawkins also pointed out that he had been appointed to act as the trustee in the bankruptcy of Mr. Pordes, and the accounts prepared showed that the business had been making a profit of at least £1,500 per annum. It appeared that the company had only discharged £3,000 of the liabilities, which it took over at its formation.

Dissatisfaction was expressed at the position disclosed, and it was decided that an application should be made to the Court for the appointment of Mr. E. H. Hawkins, I.A., of Messrs. Poppleton, Appleby & Hawkins, 4, Charterhouse Square, E.C., as the liquidator of the company. A committee of inspection was also nominated, consisting of Mr. W. Osborn (Messrs. Coleman & Appleby); Mr. Simon Biheller (Messrs. Weiss & Biheller); Mr. T. A. Pullen; Mr. E. Funk (Messrs. Duffield & Funk); and Mr. R. W. Vining (R. W. Vining, Ltd.).

D. HULETT & CO., LTD.—Particulars of claims must be sent to the liquidator, Mr. J. D. Broad, 1, Walbrook, E.C., by June 7th.

WORSSAM & EDWARDS, electrical engineers and contractors, 302, Upper Richmond Road, East Sheen, and Newman Passage, Newman Street, London, W.—Messrs. P. Worssam, W. D. Edwards, and S. N. Fordyce have dissolved partnership. Messrs. Edwards and Fordyce will attend to debts, &c., and continue to trade only at 302, Upper Richmond Road, East Sheen.

THACKER, BELL & CO., LTD.—Mr. F. H. Agar, of Pinner's Hall, Austin Friars, E.C., has been appointed an additional liquidator by an order of the Court.

BRITISH ELECTRICAL ACCESSORIES, LTD.—Winding up voluntarily. Liquidator, Mr. W. A. Judge, 72, Market Street, Bradford.

PETO & RADFORD, LTD.—A meeting of members is called for June 15th at 50, Grosvenor Gardens, London, S.W., to hear an account of the winding up from the liquidator, Mr. F. G. Hart.

NEW PETO & RADFORD ACCUMULATOR CO., LTD.—Meeting of members is called for June 15th at 50, Grosvenor Gardens, S.W., to hear an account of the winding up from the liquidator, Mr. F. G. Hart.

SINCLAIR, PAGET & CO., electrical engineers and manufacturers, 8, New Inn Yard, Shoreditch.—Mr. W. P. St. John and Mr. H. Ashdown have dissolved partnership. Mr. W. P. St. John will attend to debts.

CAMAROFF & HARRIS, electrical engineers, 11A, Cross Stamford Street, Leeds.—Mr. J. Camaroff and Mr. L. Harris have dissolved partnership. Mr. J. Camaroff will attend to debts and continue the business in his own name at the same address.

Bankruptcy Proceedings.—G. F. KIVERON, electrical engineer, Sheffield.—Receiving order made May 7th on debtor's own petition.

Office Equipment.—There is now running at the Royal Agricultural Hall—it closes to-morrow, May 15th—a Business Exhibition, where a great variety of office furniture and equipment is effectively on view. The exhibits include roll-top and other desks, filing cabinets, card-index systems, type-writing, time-checking, tabulating, calculating, addressing, duplicating, and other machines and devices, stationary and printing, publicity and advertising literature, &c., also illuminated signs and telephones. The exhibitors of telephone equipments, include the Relay Automatic Telephone Co., Ltd., the Telephone Manufacturing Co., Ltd. (West Dulwich), and the Reliance Telephone Co., Ltd. Rawlplug outfits are shown by the Rawlplug Co., Ltd.; the Lazilite Co. show extending brackets for telephones and electric lighting; the Phonotas Co., Ltd., exhibit their telephone cleansing and sterilising service; the Marconi International Code Co. are present with their coding system; the "Dictaphone" Co., Ltd., exhibit their time-saving system and apparatus; and the "Dictograph" apparatus is demonstrated by the Dictograph Telephones, Ltd. The Gledhill Brook time recorders, and the Magneto electric time systems, are also in evidence. Quite a number of the machines referred to are driven by very small electric motors.

Electrical Exports to Guatemala.—The Department of Overseas Trade has received a cablegram from H.M. Consul at Guatemala stating that all restrictions on imports have been withdrawn by the new Government. Manufacturers of electrical appliances are now informed that export may be made to Guatemala without difficulty being made by the authorities in their clearance at Customs House, as has hitherto been the case. There is great demand for telephone instruments.

Solidite Switchboards.—In view of the difficulty experienced in obtaining slate, porcelain, and marble, the IMPROVED SOLIDITE CO., LTD., of Advance Works, Jews Road, London, S.W. 18, inform us that they are making a speciality of supplying all sizes of slabs for fuses, switchboards, &c. There are many advantages in using this material where large quantities are required, there being no drilling to be done, as the company are able to mould the holes into their material. Solidite is an excellent insulator, and is non-hygroscopic.

Whitley Councils.—HOME COUNTIES INDUSTRIAL COUNCIL (No. 9 AREA).—In view of the fact that certain undertakings were not carrying out the recommendations of the Joint Council, the Council viewed the situation with much concern, and felt that it was incumbent upon it to take further action, and the following special resolution was therefore passed:—

"Resolved that this Council supports any action that the Trade Union side of the Council decides to take in order to bring defaulting undertakings into line in conforming with the resolution of the Council dated March 31st, to the effect that an advance of 3s. per week be paid to all employés by electricity supply undertakings in the Home Counties (No. 9) Area, as from April 1st, 1920, since by the action of such undertakings in not carrying out the recommendations of the Council the matter of fixing basic rates is being delayed, and, further, the antagonistic attitude thus indicated disturbs the whole of the relations between employers and employed."

It being reported that the Gillingham Corporation had resolved not to follow such recommendations of the Industrial Council, a special letter was addressed to the town clerk requesting him to draw the Council's immediate attention to the above resolution.

Strike.—The labour dispute at the Enfield Ediswan Cable Works has been settled, and the men returned to work on Wednesday last.

LIGHTING AND POWER NOTES.

Aberdeen.—NEW BOILER PLANT.—The Electricity Committee has approved the electrical engineer's proposal to purchase additional boilers and accessories, at a cost of £8,250.

Batley.—LOAN.—On the recommendation of the Electricity Committee, the Corporation is applying for sanction to borrow £10,000 for a rotary converter and switchgear, and £4,600 for mains extensions and services.

Barnstaple.—NEW PLANT AND PRICE INCREASE.—Mr. J. S. Highfield, the expert engaged by the Town Council to report and advise on the electricity works, recommends the installation of two 500-KW. steam turbines and two boilers and engine sets, at an estimated cost of £39,000, and an application for the maximum price of energy to be increased from 8d. to 1s. 2d. per unit.

Belfast.—NEW PLANT.—It was announced at a recent meeting of the Council that Lord Pirrie had placed a hall at the Council's disposal for the installation of a 6,000-KW. generator, and had also offered to provide the necessary boiler-power. This will enable the Council to supply the additional power required by Messrs. Harland & Wolff and the general public by November next.

Bideford (Devon).—ELECTRICITY SUPPLY.—A survey of the town has been made by Messrs. Crompton & Co., Ltd., with a view to forming a company to provide electricity before next winter.

Birkenhead.—ADDITIONAL LOAN.—The Town Council has decided to apply for sanction to borrow an additional sum of £16,701 for the provision of high-pressure electricity plant, mains, &c., to supplement the amount sanctioned on April 13th last.

Bristol.—DISTRIBUTION COSTS.—The Corporation has informed the Warmley Rural District Council that charges for electricity supplied to outside areas cannot be reduced to the same level as those in force within the city, owing to the extra cost of distribution. It is pointed out that the Corporation has spent several thousands of pounds on mains extensions in the Warmley area.

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Blackburn.—New Power Station.—The foundation stone of Blackburn's new electricity generating station at Whitebirk is being laid to-morrow. The enterprise will cost about half a million sterling. The undertaking is being constructed under the Electricity Supply Act to serve not only Blackburn, but a wider area outside. The engineer-in-chief is Mr. P. P. Wheelwright, M.I.E.E. The general work has been placed with the English Electric Co., Ltd., of Kingsway, London. The works have the advantage of the close proximity of railway and canal. The construction of the buildings and part of the foundation work has been placed in the hands of the Consolidated Construction Co. The foundation work is of reinforced concrete on the Hennebique system, designed to give an evenly-distributed load over the whole area. There are over 450 tons of steel reinforcing bars in the foundation work. The bunkers will have a capacity of 1,200 tons of coal, and a 20-ton crane will assist in the work of unloading. The steel bunkers and conveyor plant are being made by the English Electric Co. with the Mitchell Conveyor and Transporter Co. There will be eight boilers of the latest Babcock and Wilcox type, with super-heaters, economisers, &c. In the engine-room there will be two 10,000-kw. turbo-alternators, running at a speed of 1,500 r.p.m. and generating at 6,600 volts three-phase. It is hoped the work will be sufficiently advanced to enable one generating set to be put into operation about the end of the year. There will be ample scope for future extensions. There are to be dining-rooms for the stokers and engineering staff, lavatories, bath-rooms, dark-room, cleaners' equipment, stores, laboratory, and a workshop, &c. A great quantity of peat is on the site, and Mr. Wheelwright has been considering using it as fuel. A Scandinavian expert has reported favourably on the question. The proximity of this generating station to Greenbank Gasworks will also make feasible the use of gas for fuel should circumstances allow it.

Bradford.—Proposed New Plant.—The Electricity Committee has adopted a report by the engineer on the growth of demand for electricity and the need for extension of plant. The engineer recommends the obtaining of estimates for a new boiler-house building, four boilers and necessary equipment, at the Valley Road Works, at a total cost of £322,700. This is the last extension which can be made at Valley Road, as the site will then be taxed to the utmost limit. The station is already four times the size contemplated when the foundations were laid. In view of the certainty that the demand will continue to grow, and that the only way to meet it will be by a new station, the Committee recommends that a resolution be sent to the Electricity Commissioners, pointing out the vital necessity for the immediate provision of a capital generating station for an area which should include Bradford; and, further, conveying the willingness of the Bradford Committee to proceed without delay with the construction of such a station on the Bradford Corporation's large estate at Esholt if the Commissioners deem such procedure desirable. The Esholt estate is close to the Midland Railway main London-Scotland line and the River Aire.

Fused Cable.—On May 5th a high-tension cable under City Road fused, resulting in an explosion and the blowing up of two manholes. The mishap is attributed to the soaking of the ground by the recent heavy rains. An immediate result of the occurrence was the cutting off of supply to one department of a local iron works.

Burnley.—Conditions of Supply.—In deciding to grant an application by the Healey Wood Mill Co. for a supply of electricity to drive a 50-h.p. motor, the Electricity Committee, in addition to requiring an agreement as to the extent of the supply, also stipulates for an undertaking by the company not to consume electricity after 4.45 p.m. in the winter months, if so required by the electrical engineer.

Canada.—Owing to the inability of the Hydro-Electric Commission to supply power, Baldwin's Canadian Steel Industry at Toronto will probably move elsewhere.—*The Times.*

China. — Foochow Undertaking. — The Foochow Electric Co., which is owned by Chinese shareholders, and has a monopoly of the sale of electrical energy in Foochow and its suburbs, is extending its service as far as Hung Shan Chiao, about eight miles distant. The company has two 1,000-kw. turbine sets, employs about 100 people, and has installed over 47,500 lights of 16 c.p. average. Plans have been made to extend the plant and install a tramway system in Foochow.

Coal Shortage.—Electricity Undertakings Affected.—The coal shortage has become very acute in several districts. The Swansea electrical engineer informed the Electricity Committee, on May 5th, that only half the proper supply was being received, and the position regarding power supplies for local industrial undertakings was becoming very serious. It was agreed that the Mayor (Alderman Sinclair) should consult the Coal Controller, and endeavour to secure preference in the matter of coal supplies. Last week the chairman of the Salford Electricity Committee stated that only two and a-half days' supply of coal remained in hand. The Manchester City Council recently expressed the opinion that coal intended for Manchester was being diverted elsewhere, and the reserve was only sufficient for two weeks' running. At Accrington the complaint is not merely of shortage, but the quality of the coal is stated to be extremely bad.

Coleraine.—Electricity Supply.—The Urban District Council has refused permission to a private company to carry out an electric supply scheme, and has decided to call in a consulting engineer with a view to adopting a municipal scheme.

Cullompton. — Electricity Supply Scheme. — A meeting of residents has adopted an electric light and power scheme for the town, the capital for which is estimated at £10,000. The use of overhead wires is proposed.

Dartford.—Plant Extension.—The Urban District Council is recommended to extend the plant at the electricity works, including the provision of a rotary converter of approximately 700-kw. capacity, and a boiler.

Darwen.—Year's Working.—The profit upon the electricity undertaking for the year ended March 31st, 1920, was £1,321, the largest since the inception of the works 20 years ago. Last year there was a loss of £1,140. The success is chiefly due to the economy effected in fuel consumption, which has been decreased by 20 per cent. per unit generated.

Dominican Republic.—Hydro-electric Plant.—The Compania Anonima Dominicana de Agua, Luz, y Fuerza Motriz of Santiago, Dominican Republic, will begin work at once upon the construction of a hydro-electric plant on the Jiminoa river in the mountainous interior of the Province of La Vega. The location chosen is about 25 miles south of the nearest railway station, La Vega. There is a rough trail from that city to Jarabacoa, but a road will have to be built to cover the rest of the distance. Because of the difficulty of transporting heavy machinery over this rough trail, only a 1,000-h.p. power plant will be installed at first, the intention being to build a light electric tramway from La Vega to the company's property before proceeding to install the larger plant, which will then supply light and power to La Vega, Salcedo, San Francisco de Macoris, Moca, and other small towns in the Cibao, as well as to Santiago and Puerto Plata, which are now supplied by the company's plant at Puerto Plata.—*Commerce Reports.*

Dover.—Loan.—The Town Council has applied for a loan of £1,000 for cables, &c., for the new housing site.

Dublin.—Issue of Stock.—At a recent meeting of the Corporation, a resolution was adopted to issue City Stock to the value of £27,500, the proceeds to be devoted to the extension of the electricity supply undertaking.

Exeter.—New Plant.—The difficulty of obtaining plant within a reasonable time has prompted the City Council to look well ahead in order to be able to meet future requirements, and the approval of the Electricity Commissioners to the purchase of additional turbo-alternators is being sought.

Fintona (Co. Tyrone). — Public Lighting. — The County Council has given the new Electric Lighting Co. permission to erect the poles and lines necessary for public lighting.

Kendal.—New Scheme.—It was stated at a Council meeting on May 5th, during a discussion on the new electricity scheme, that the cost would be from £8,000 to £10,000. The Electricity Committee recommended that Major Milnes, electrical engineer at Lancaster, be requested to prepare a report on the development of the existing electricity undertaking so as to meet prospective needs. It was decided to adopt the recommendation subject to the Electricity Commissioners' approval.

Kirkcaldy.—Sale of Undertaking.—As the Electricity Commissioners will not sanction extensions to the Town Council's power station, it has been decided to sell the whole of the undertaking to the Fife E.P. Co., a course which has received the Commissioners' approval.

Liverpool.—House Lighting.—It has been decided to extend the electric mains in connection with the Housing Committee's schemes at a cost of £45,000. This includes the electric lighting of artisans' dwellings in course of erection.

London.—St. Marylebone.—The Borough Council has notified consumers that a rebate of 12½ per cent. will be made on all charges for the March quarter. This includes the allowance made in respect of the reduction in the price of coal, which will remain in force until the Coal Prices Order is revoked.

The Borough Council has offered to give a bulk supply to Hampstead Borough Council at the rate of £3 per kw. of maximum demand plus ·7d. per unit (with fuel averaging 25s. per ton) plus ·015d. per unit for each increase of 6d. per ton in the price of coal. The Electricity Commissioners have approved this, and the Hampstead Council is negotiating for a supply of 1,500 kw.

Loans.—The Finance Committee of the L.C.C. recommends sanction of the following loans;—Hackney Borough Council, £11,500, for the purchase of motor converters, and Hammersmith Borough Council, £11,860, to defray the borough's share of the cost of linking-up with the Battersea and Fulham undertakings.

Mid-Lancashire. — Electricity District. — A joint gathering at Preston having discussed the delimitation of an area under the new Electricity Act, passed a resolution that it was desirable to define a separate electricity district of Mid-Lancashire, including the areas of the following authorities:—Accrington, Bacup, Blackburn, Blackpool, Burnley, Colne, Darwen, Haslingden, Nelson, Preston, Rawtenstall, Brierfield, Fleetwood, Lytham, St. Annes, and Whitworth.

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Portrush.—LOAN.—On the recommendation of Mr. W. Pleasance, consulting engineer, the Urban Council has decided to apply for a further loan of £1,000, to cover the cost of building the electricity generating station, making the total loan for the electric lighting scheme £16,000.

Tonbridge.—CABLE EXTENSIONS.—The Urban District Council is to apply for a loan for cables, and the supply is to be extended to Barden Park, at an estimated cost of £1,800.

HOUSING SCHEME.—Building has begun on the 500 houses to be provided under the local housing scheme. Electric light as well as gas will be available in the houses.

Severn Valley.—ELECTRICITY DISTRICT.—With reference to our last week's note under the above heading, the new electricity district proposed to be established by the Electricity Commissioners, is to include the cities and counties of Bristol and Bath, and parts of the counties of Gloucester, Worcester, Somerset, Wilts, Monmouth, and Hereford. Objections or representations may be made on account of the inclusion of any area in, or the exclusion of any area from, the district so provisionally determined and all such objections or representations must be made in writing addressed to the Secretary, Electricity Commission, Gwydyr House, Whitehall, London, S.W. 1, stating the grounds upon which the objections or representations are made, and must reach the said offices not later than July 31st, 1920. It being apparent to the Electricity Commissioners that the existing organisation for the supply of electricity in the district so provisionally determined should be improved, notice is given in the *London Gazette*, May 4th, that they intend to hold a local inquiry into the matter, and any authorised undertakers as defined in the Electricity (Supply) Act, 1919, any County Council or District Council, and railway company using or proposing to use electricity for traction purposes, any large consumer of electricity and any association or body directly concerned with the production or use of electrical energy within the district may before July 31st, 1920, submit in writing a scheme for effecting such improvement in organisation, including the formation of a joint electricity authority for the district, and any proposals for altering or adjusting the boundaries of the district so provisionally determined.

Shipley.—BRADFORD'S THANKS.—The District Council has received from the Bradford Corporation thanks for its ready co-operation in taking over portions of the Corporation electricity load in the emergency caused by breakdown of plant in October, 1919.

Swansea.—MAINS EXTENSIONS.—In accordance with the recommendations of the electrical engineer, the Council is to carry out extensions to the public supply mains, at a cost of £5,000, and to lay a private main, costing £3,000, to a local brickworks and laundry.

Turton.—EXTENSIONS.—Extensive alterations and extensions in the electrical services are contemplated. The scheme provides for four distinct areas—Bradshaw, Egerton, Horrobin and Edgworth, and each undertaking, whilst complete in itself, will be linked up with the other districts. The chairman of the Electricity Committee states that if the scheme is carried out, it will enable every part of the area to be supplied with the exception of Belmont and Entwistle. A sub-station will have to be erected at Bradshaw. A sum of £17,855 will be necessary to carry out the work, and sanction is being sought for the borrowing of £20,000.

Twickenham.—MAXIMUM PRICE ORDER.—An order has been issued fixing the maximum price for electricity supplied by the Twickenham and Teddington Electric Supply Co. at 10d. per unit, as from December 31st last.

Wrexham.—EXTENSIONS.—The Town Council has applied for a loan of £17,260 for a boiler, stoker, economisers, water softener, buildings, &c., and has sealed an agreement with the Bernard Oppenheimer Diamond Works, Ltd., for a supply of energy to its works at Acton, the cable to be used for other supplies at Acton.

Wallasey.—EXTENSIONS.—The Corporation is about to enter into contracts for the work of extending the electricity undertaking. The cost is estimated at £76,240. As an indication of the need for extension it is stated that the number of consumers has increased from 5,217 a year ago to 5,584, and the number of units generated has increased from 669,989 to 874,095. The question of supplying electricity to Birkenhead is also being considered.

Wimbledon.—LOAN.—The Town Council has applied for a loan of £40,000 for new steam-raising plant for the electricity works.

TRAMWAY AND RAILWAY NOTES.

Bury.—EMPLOYES' WAGES.—It having been reported to the Tramways Committee that the Tramway Industrial Council had agreed to the increasing of the Manchester and Salford employés' basic rates by ¼d. per hour, the Committee has decided to prepare a case to be submitted to the Industrial Council, showing that Bury cannot afford to grant such an increase to its tramway workers.

YEAR'S WORKING.—The profit upon the undertaking for the past year, £5,376, is to be transferred to the reserve fund, and it is stated that this is the first period in which the system has failed to contribute to the relief of the rates.

Bristol.—FARE INCREASE.—It is announced that the directors of the Bristol Tramways Co. intend to increase all fares on the system by at least 50 per cent. above the pre-war rates.

Canada.—TRAMWAY STRIKE.—London (Ontario) tramways, of which the staff is on strike, are being run by the Provincial Railway and Municipal Board, which is inquiring into the tramway company's ability to pay the increased wages demanded by the strikers.—*The Times.*

Croydon.—FARE INCREASE.—Tramway fares, which were originally 1d., are to be increased to 3d.

Continental. — AUSTRIA. — In connection with the impending electrification of the Arlberg Railway, the State Railway Administration proposes to electrify the Innsbruck-Landeck section.—*Economic Review.*

Darlington.—TRANSPORT EXTENSIONS.—A report upon the proposed extension of passenger transport to the Brinkburn Road district, has been presented to the Electricity and Light Railways Committee by the manager. A single line tramway track is estimated to cost about £17,000 per mile, overhead equipment £2,400 per mile, and a feeder cable £700. The cost of a single-line track from Greenbank Road corner to the N.E.R. offices *via* Greenbank Road, Hollyhurst Road, and Major Street, would be £19,000; *via* Salisbury Terrace and Wilson Street, £20,950; from Northgate, *via* Hopetown Lane and Brinkburn Road, £16,050. Two new double-deck cars would cost £2,760 each, but further expense under this head might be obviated if a 12 minutes' car service were introduced. A double-deck 'bus capable of holding 46 passengers would cost £1,920. The comparative total charges per car-mile are estimated as follows:—Greenbank Road route: Tramway, 22·8d.; railless cars (double deck), 21·2d.; 'buses (double deck), 29·3d. The respective charges for the Salisbury Terrace route would be 23d., 21·2d., and 29·3d.; and for the Hopetown Lane route, 21·7d., 21·1d., 29·3d.

Durham.—PROPOSED TRAMWAY.—At a meeting of Durham County Council, on May 5th, it was agreed that it was desirable to apply for powers to construct either a tramway or a light railway from the terminus of the Gateshead Co.'s system at Low Fell to Chester-le-Street; the surveyor was instructed to prepare a report on the matter, and the Parliamentary Committee to consider the question of promoting a Bill for the purpose.

Johannesburg.—TRAMWAY STRIKE.—On May 6th the tramway employés suddenly ceased work owing to the suspension of a conductor.

Maidstone. — EX-SERVICE MEN AS CONDUCTORS. — The Corporation has decided to employ a number of ex-Service men in place of women conductors on the borough tramway-cars. It is understood that the whole of the women will be gradually discharged in favour of partially disabled men.—*The Times.*

London.—TRAILER CARS.—The London County Council has secured the approval of the Ministry of Transport to a temporary extension in the use of trailer cars which were introduced during the war.

L.C.C. FARE CONCESSION.—On May 10th the scheme of charging a maximum fare of 2d. between the hours of 10 a.m. and 4 p.m., which has been in operation on the L.C.C. system south of the Thames since April 19th, was extended to the north of the river.

NEW ELECTRIC RAILWAY STOCK.—The Metropolitan Railway Co. is expecting new electrical stock shortly. The electric locomotives now in use to haul steam stock over the electrified lines are to be re-equipped so as to have a capacity of 1,200 H.P., instead of 800 H.P.

In 1913 the number of passengers carried by the London and South-Western Railway Co. in the area it has since converted to electric traction was 25 millions. The number fell in 1918 to 23 millions, but in 1919 it rose to 48 millions, an increase of 70,000 per day, as compared with 1915. The extension of the electrification to Guildford, *via* Leatherhead and Cobham, is contemplated.

ACCIDENTS.—On Wednesday afternoon last week all the electric train service to the Thames Valley was held up owing to the derailment of an electric train at Waterloo Station. A Bakerloo train caught fire on Friday evening last week; the electricity supply was cut off, and all the passengers were got out of the train safely.

Owing to the fusing of a cable at the Lots Road power station on May 9th electric trains were brought to a standstill for half an hour.

Merthyr Tydfil. — ELECTRIC VÉHICLE. — The Town Council has applied for a loan of £1,310 for the purchase of an electric vehicle.

Nelson.—FARE INCREASE.—Tramway fares are shortly to be increased, and it is understood all 1d. fares are to be abolished.

St. Annes.—TRAMWAY PURCHASE.—It is stated that the Bill being promoted in connection with the purchase of the Blackpool, St. Annes, and Lytham Tramway Co.'s undertaking by the Council will soon be passed. The purchase price is to be £135,000, and the system will change hands on November 1st next; 25 per cent. of the profits earned in the Lytham area is to be paid to the Lytham Council.

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Reading.—Year's Working.—The Corporation Tramways Committee reports a deficit—the first recorded—on the year's working of £6,787, as compared with a net profit of £5,061 last year.—*The Times.*

Wages in the Tramway Industry.—The Joint Industrial Council for the Tramway Industry for Yorkshire, Lincolnshire and North Derbyshire, at Leeds last week, made the following recommendations to the National Council. The area is divided into four groups. Group number one embraces Huddersfield, Bradford and Hull, in which the rates of pay are to be increased by 1d. per hour; group two, Sheffield and Leeds, increase ½d. per hour; group three, Halifax, Doncaster, Chesterfield, Lincoln, York and Barnsley, increase ½d. per hour; group four, Wakefield, Heavy Woollen District, Keighley, Rotherham, Mexboro', Dewsbury, Ossett and Grimsby, no advance recommended. The men's representatives on the Council are to ask the National Council for alterations to the grading system; 1d. per hour on the basic rate, to make the total advance in wages up to 10s., including 5s. and 1s. granted by the National Council last March. The advances recommended are retrospective to March 29th. A meeting was held to consider the employés' claim of a 10s. per week increase, the question of settlement having been referred by the National Council to the areas. Alderman Herbert Brown, of Leeds, presided over the meeting. A complete agreement not being reached, the recommendations of both sides were referred back to the National Council. The main point of difference between the two sides was that of differentiation between various towns' undertakings, the employers maintaining that some differentiation was necessary, whereas the men's representatives pressed for a flat rate all round.

York.—Further Fare Increase.—At a recent City Council meeting it was stated that the increase of all fares by ½d. had resulted in a decrease of 1 per cent. in the number of passengers and an increase of 25 per cent. in the revenue. More revenue was still required, and powers were being sought to raise workmen's and children's fares, with a minimum of 1d. In spite of strong opposition by the Tramways Committee, owing to the financial loss which will be involved, a resolution instructing the Committee to institute penny fares for short stages as a three months' experiment was carried.

TELEGRAPH AND TELEPHONE NOTES.

Australia.—Wireless Telegraphy.—At the Associated Chambers of Commerce's recent conference at Sydney, a motion was unanimously passed "that the Commonwealth Government be asked to do its utmost to have the present Pacific cable duplicated at the earliest possible moment, and also arrange for wireless communication with the U.S.A., Canada, and other parts of the world."

Telephone Revenue.—Some instructive figures relating to long-distance telephone trunk lines in Australia were also given by a delegate at the conference. According to this information the cost of upkeep and operation, including interest, for the year ending June 30th, 1919, was:—Sydney-Melbourne, £2,799: Melbourne-Adelaide, £1,897. The net profit on the Sydney-Melbourne line for the last few years was as follows:—1913, £2,787; 1914, £3,041; 1915, £4,283; 1916, £5,873; 1917, £7,643; 1918, £9,170; 1919, £9,300. The Adelaide-Melbourne line showed a profit in 1919 of £3,535. Last year the Sydney-Melbourne line showed a revenue of £12,099; in 1918 it was £11,928; and in 1917 £10,358. The Adelaide-Melbourne line showed the following revenue:—1917, £4,256; 1918, £4,706; 1919, £5,432. The cost of the lines was:—Sydney-Melbourne, £41,270; Melbourne-Adelaide, £16,690.

Belgium.—Time Signals.—M. Bijourdan, a member of the Academy of Science, has been appointed a director of the International Science Bureau, founded at Brussels, which is to send time signals all over the world by wireless telegraphy. It is reported that efforts are being made to transmit such signals by means of musical continuous waves at 200,000 metres wave length. The Bureau will transmit the time signals at 10.30 a.m. and 11 p.m.

Cable Delays.—The *Financial Times* draws attention to a curious consequence of the war, namely, that commercial houses in England have drifted into the habit of handing in their Continental traffic and long-distance cables rather late in the day. This habit has continued, although the service is now improved. The incidence of traffic as it is to-day is altogether different from the incidence of traffic as it was in pre-war days, and it would be as well perhaps that commercial firms and houses should realise that telegrams handed in in the morning for the Continent or for long-distance transmission would now be given a service practically equal to pre-war times.

Italy.—Wireless Communication.—Wireless communication has been established with Germany between stations at San Paolo, near Rome, and Königswsterhausen. The service is at present only available for an hour at a time.

London.—Wireless Press News.—A wireless receiving set has been installed in the London office of the *Daily Mail*. The apparatus, which was put into experimental operation on May 10th, is of the Marconi valve type, employing a 6-ft. wooden-frame aerial.

Sweden.—Telephonic communication has been established between Finland and Sweden, the line between Tornea and Haparanda having been completed.—*Technical Review.*

United States.—Cable Rates.—The trans-Atlantic cable companies have decided that the rates from Germany to the United States shall be the rates from Havre and Brest, plus the charges from Germany to those places. The rates as from London have been assimilated.

West Indies.—Cable Communication.—Cable communications were among the subjects discussed at the recent meeting of the Associated Chambers of Commerce of the West Indies, held at Barbados. The existing cable service between Great Britain and the West Indies received much adverse criticism. With the exception of Jamaica, these Colonies have the most imperfect telegraphic communication with the Home Country of any British possession throughout the world. This is evidenced by the fact that messages from British Guiana and Trinidad rarely take less than 10 days in reaching London, and frequently take as long as three weeks. Further, when they do arrive, they are so mutilated as to be frequently undecipherable. The conference proposed as a remedy that an all-red cable route should be provided, and agreed that the Law Officers of the Crown should be asked whether the present broken state of the cables had not provided sufficient cause for a termination of the existing agreement between the Imperial Government and the West India and Panama Telegraph Co.

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the Electrical Review *in which the "Official Notice" appeared.)*

OPEN.

Australia.—Melbourne.—May 31st. Victorian Railways Department. Four 4,500-kw., 1,500-volt traction converter sets, and eight 1,000-kw., 1,500-volt ditto. (April 30th.)

Sydney.—August 4th. N.S.W. Government Railways and Tramways. Two 1,000-kw. sub-station units. Chief Electrical Engineer, 61, Hunter Street, Sydney.

July 18th. City Council. Maximum demand indicators. Electric Lighting Department, Town Hall, Sydney.

Perth.—July 14th. P.M.G.'s Department. Telegraph and telephone instruments (various parts). Schedule 674.

June 16th. P.M.G.'s Department. Telegraph and telephone instruments (various parts). Schedule 680. (See this issue.)

Barnes.—June 7th. Urban District Council Electricity Department. Coal-handling plant and overhead steel or ferro-concrete bunkers. (See this issue.)

Belfast.—May 19th. Electricity Department. Coal-handling plant. (May 7th.)

Dundee.—May 21st. Electricity Department. Excavations and reinforced concrete foundations and extensions to Carolina Port generating station. Mr. H. Richardson, M.Inst.E.E., General Manager and Engineer, Electricity Department, Dundee.

Glasgow.—May 21st. Electricity Department. Cables (small india-rubber cables and flexibles), meters, and arc lamp carbons, for 12 months. (See this issue.)

Lincoln.—May 24th. Electricity Department. Coal-handling plant. (April 23rd.)

May 15th. Electricity Department. New or second-hand turbo-alternator, 1,000 to 2,000 k.v.a., 6,600 or 3,300 v., 50 periods, complete with condenser and all accessories. (May 7th.)

Leeds.—June 14th. Electricity Department. 12,000-kw. steam turbine, alternator and condensing plant. (See this issue.)

London.—Hackney.—June 9th. Electricity Department. Four water-tube boilers, each 33,000 lb. per hour capacity, with superheaters, mechanical stokers, &c.; four induced-draught plants; four fuel economisers; one 10,000-kw. turbo-alternator and exciter, with ventilating fan and air filter or cooler; one surface condensing plant; two circulating water motor-driven pumps; E.H.T. switchgear; two 20,000-kw. coupler panels; one 10,000-kw. generator panel; six 2,000-kw. and one 4,000-kw. feeder panels. (May 7th.)

Manchester.—June 7th. Electricity Department. Main and auxiliary switchgear; Section A, 33,000-volt and 6,000-volt main switchgear; Section B, pressure-testing switchgear; Section C, 420-volt A.C. auxiliary switchgear; Section D, 240-volt D.C. auxiliary switchgear. (April 30th.)

May 19th. Electricity Committee. Cable supplies and cable laying work (33,000 v.). Mr. F. L. Hughes, Secretary, Electricity Department, Town Hall.

New Zealand.—Wellington.—June 30th. Tender Board. Public Works. Electrical equipment for the Arthur's Pass section of the Midland Railway. Particulars from the Department of Overseas Trade, 73, Basinghall Street, E.C.

Auckland.—September 1st. Harbour Board. For the supply of electric capstans and spares. Messrs. W. & A. McArthur, Ltd., 18-19, Silk Street, Cripplegate, London, E.C. 2.

South Africa.—Mossel Bay.—Electric lighting equipment. (See this column, April 23rd.)

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Sweden.—H.M. Consul at Stockholm (Mr. S. E. Kay) reports that the Harbour Authorities at a Swedish port are now in the market for four electric cranes, of 2½ tons and 4 tons lifting capacity. Those at present used at the Harbour are of German manufacture. Further particulars on application to the Department of Overseas Trade in London.

CLOSED.

Aberdeen.—Electricity Committee :—

One 300-lb. pressure boiler, £4,205.—Babcock & Wilcox, Ltd.

Barrow.—Electricity Committee. Accepted :—

Engine oils.—Vacuum Oil Co., Ltd.
Copper wire.—B. I. & Helsby Cables, Ltd.
Joint boxes.—W. T. Henley's Teleg. Works Co., Ltd.
Electricity meters.—Chamberlain & Hookham, Ltd.
Prepayment meters.—Ferranti, Ltd.
Half-watt lamps.—W. R. Thornton & Sons, Ltd.
Earthenware pipes —Doulton & Co., Ltd.
Wood casing.—E. Last & Son.
Bitumen.—Dussek Bitumen Co., Ltd.
Annual inspection of battery.—Tudor Accumulator Co., Ltd.
Re-stacking No. 2 cooling tower, £520.—Davenport Engineering Co., Ltd.
Two 250-kw. motor converters, £4,812.—Bruce Peebles & Co., Ltd.

Canterbury.—Town Council :—

Horizontal double-acting geared pump, electrically-driven.—Tangyes, Ltd., £327.

Doncaster.—Town Council :—

Two turbo-generating sets.—James Howden & Co., £48,542.

Johannesburg.—Electricity Committee. In March, 1916, the Council accepted the tender of Messrs. Sykes & Co., Ltd., for two 3,000-kw. Parsons turbo-generating sets, but owing to war conditions, these could not be supplied. In August, 1919, an offer from Messrs. Sykes to supply two 3,000-kw. Parsons turbo-generating sets, at £40,950, was accepted. Since then the demand for electricity for tramways, power and lighting, has increased to such an extent that the two 3,000-kw. sets will be insufficient for the town's requirements. The Committee, therefore, recommends that a 6,000-kw. Parsons set be substituted for the second 3,000-kw. set. This Messrs. Sykes have offered to supply at an extra cost of £17,325, and to give delivery only four months later than in the case of the second original set. The Council has decided to accept the offer.

London.—Wimbledon.—Town Council :—

Re-construction of plant at refuse destructor.—Heenan & Froude, Ltd., £3,112.

St. Marylebone. — Electricity Committee. Recommended. Plant extension scheme, 1919 :—

Four cast-iron chutes for the coal bunkers and stoker hoppers of the two new boilers, £310.—Aiton & Co., Ltd.

E.H.T. switchgear :—	Time for delivery.		
British Thomson-Houston Co., Ltd. ..	11½ mths.	..	£14,672*
Met.-Vickers Elec. Co., Ltd.	8/9 ,,	..	£11,136*
A. Reyrolle & Co., Ltd. (part only) ..	8/9 ,,	..	£3,502†
Ferguson, Pailin & Co., Ltd. (recom.)	4/5 ,,	..	**£12,448**

*Not complete †Plus erection &c., and exclusive of L.T. gear and selector panels.

The space available for the accommodation of this gear being limited, the Committee considers the tender of Messrs. Ferguson, Pailin & Co., Ltd., is most suitable.

Pneumatic coal-handling plant, £4,500.—H. J. King & Co., Ltd. (recom.).
Lea recording apparatus, £226 plus £6, for the supervision and adjustment after erection of the Council's workmen.—Lea Recorder Co. (recom.)
Cables.—Practically the whole of the E.H.T. and L.T. cables required are included in the schedules of the contract of the B. I. & Helsby Cables, Ltd., and will be ordered as soon as the market is favourable.

Motherwell.—Town Council :—

Electric light installation; extensions to slaughter house.—The Belmos Co., £105.

Peterborough.—Town Council :—

Cables.—Callender's Cable & Construction Co., Ltd., £18,750.

Wakefield.—The Corporation has accepted the tender of the Reader Electrical Co., Ltd., at £769, for the electric lighting of the Elm Street houses.

Wrexham.—

Boiler for the electricity works.—John Thompson (Water-Tube Boilers), Ltd., £5,611.

FORTHCOMING EVENTS.

Physical Society of London. — Friday, May 14th. At the Imperial College of Science, South Kensington. At 5 p.m. Ordinary meeting.

Electrical Power Engineers' Association (Derby and District Section).—Saturday, May 15th. At the Arcadia Café, High Bridge, Lincoln. At 3.30 p.m. Open general meeting.

(Manchester District Section). — Thursday, May 20th. At the Milton Hall, Deansgate, Manchester. At 7 p.m. Paper on "Sub-stations: Design and Equipment," by Mr. W. Kidd (resumed discussion).

Royal Society of Arts.—Wednesday, May 19th. At John Street, Adelphi, W.C. At 4.30 p.m. Paper on "Electrical Osmosis," by Mr. J. S. Highfield.

Institution of Electrical Engineers.—Thursday, May 20th. At the Institution of Civil Engineers, Gt. George Street, S.W. At 5.30 p.m. Annual general meeting.

(Students' Section).—Friday, May 14th. At King's College, Strand, W.C. At 7 p.m. Annual general meeting. Paper on "Electrical Motor Control Devices," by Mr. E. G. Humfries.

British Electrical and Allied Manufacturers' Association.—Thursday, May 20th. At the Savoy Hotel. At 7.30 p.m. Annual dinner.

Royal Institution of Great Britain. — Friday, May 21st. At Albemarle Street, W. At 9 p.m. Lecture on "The Thermionic Valve in Wireless Telegraphy and Telephony," by Prof. J. A. Fleming, F.R.S.

NOTES.

Train Fire.—Another ghastly story of a railway smash comes from India, where a passenger train ran into a standing goods train near Moradabad. According to *The Times* report, the first three coaches of the express were smashed, and "caught fire, owing to the bursting of a gas tank. The carriages were, unfortunately, overcrowded with passengers. The train contained three Hindu marriage parties, only three members of which escaped death, and out of 50 Gurkha soldiers all except four were either killed outright or burnt to death. There were also many women and children, of whom only a few remain alive. . . . An eye-witness gives a heartrending account of the sufferings of passengers." The number of killed is given as 150, while 57 were injured.

Is it not high time that the dangerous practice of installing gas tanks on railway trains was prohibited?

Electricity Supply Rifle League.—The following are the results to the end of April, 1920 :—City Co., 563—Hampstead, 524; Metropolitan, 569—Poplar, 467; Metropolitan, 572—Shoreditch, 564; Central, 566—Shoreditch, 577; Central, 574—Poplar, 514; Central, 567—City Co., 559; Metropolitan, 569—St. James's, 515; Poplar, 534—St. James's, 532; City Co., 563—Hackney, 528; Metropolitan, 568—Hampstead, 512; Shoreditch, 571—St. James's, 531; Shoreditch, 574—Poplar, 523; Hackney, 538—Hampstead, 526; Hackney, 561—St. James's, 512.

	Shot.	Won.	Lost.	Scores—For.	Against.	Points.
Metropolitan ...	4	4	0	2,278	2,088	8
Shoreditch ...	4	3	1	2,285	2,192	6
Central	3	2	1	1,707	1,650	4
City Co.	3	2	1	1,685	1,619	4
Hackney... ...	3	2	1	1,617	1,601	4
Poplar	4	1	3	2,038	2,249	2
St. James's ...	4	0	4	2,120	2,225	0
Hampstead ...	3	0	3	1,562	1,669	0
Brompton ...	0	0	0	—	—	0

Pony Electrocuted.—Under this heading, the *Daily News* recently gave particulars of an unusual accident. A Taunton chimney-sweep drew up his pony and trap at an electric light standard, and tied up the pony by means of a light chain from the bit to the standard. As he was unloading the trap, the pony suddenly fell down dead, and the reason was discovered later to be a rather large leakage current.

The Technical Training of Disabled Men.—The first meeting of the Bradford Local Technical Advisory Committee for Training Disabled Ex-Service Men (Electricity, Power and Light), was held privately on May 4th. Messrs. L. Jessop, H. Collinson, and J. W. Dawson (vice, Mr. R. H. Wilkinson, tramway manager), represented employers; Messrs. J. Carter, F. Clarke, and F. Thompson represented the workpeople. Prof. W. M. Gardner, M.Sc., Principal of the Bradford Technical College, Mr. W. H. N. James A.R.C.S., A.M.I.E.E., chief of the Electrical Department of the Technical College, and Mr. M. E. Hodgson, chief technical officer, Leeds, North of England Division, Industrial Training, were present as consultative members, and the officials were Mr. W. H. Leach, Secretary of the Bradford Employment Exchange, and Mr. J. W. Sullivan, clerk to the Employment Exchange.

Mr. Hodgson opened the meeting and outlined the functions and aims of the Committee, stating that they were responsible for the admission of suitable men, for the supervision of the training, and for placing the men in employment after training. He said the equipment of the Bradford Technical College, after some little structural alteration, would be eminently suitable for the work. The scheme of the local education authorities, slightly revised, had been accepted by the Ministry of Labour, and would be put into operation as soon as the additional equipment was installed. It was intended to extend the training accommodation by vacating a portion of the college occupied by an engineering class, transferring that class to temporary premises.

The members present commented favourably on the fact that the school would be entirely under the supervision of the local education authority, rather than the Ministry of Labour, feeling that local control would be conducive to greater efficiency than Government control. It was remarked, with gratification, that when the new equipment was finished with—when the supply of trainees was exhausted—it would become the property of the Technical College for ordinary electrical training purposes. The Government grants would be £951 for equipment, £65 for loose tools, and £8 for wiremen's tools.

Mr. L. Jessop (Jessop & Boydell, Ltd., electrical contractors), was elected chairman of the Committee; Mr. J. Carter (E.T.U.), vice-chairman, and Mr. W. H. Leach (Secretary of the Employment Exchange), secretary.

In discussion on the proposed scheme, Mr. Clarke assured the meeting that the Electrical Trades Union would facilitate in every possible way the training of suitable disabled ex-Service men. They realised that the trade was capable of absorbing a considerable amount of additional skilled labour, and the scheme would provide this, while ensuring employment for the disabled men.

It was stated that it was intended ultimately to include training in all phases of industrial electrical work, but for the present the course would have to be confined to training men for the electrical contracting trade and as dynamo sub-station and switchboard attendants. It will be gratifying news to disabled men wishful of undergoing the training, that the scheme is really coming to fruition. It was announced that the scheme at Bradford is, for the time being, at any rate, to cater for the whole of Yorkshire, except Sheffield.

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Appointments Vacant.—Tracing clerk (female) for the Newport Borough Electricity and Tramways Department; two assistant lecturers and demonstrators in electrical engineering (£315, rising to £440) for the Battersea Polytechnic; charge engineer (£316) for the Stalybridge, Hyde, &c., generating station; assistant mains engineer (£4) for the Bridlington Corporation Electricity Department; constructional draughtsman (£325) for the Borough of Doncaster Electricity Department; assistant power-station engineer (£400 to £500 + £200 to £220) for the London County Council Greenwich power station; mains superintendent (£300) for the Weymouth Borough Electricity Works. See our advertisement pages to-day.

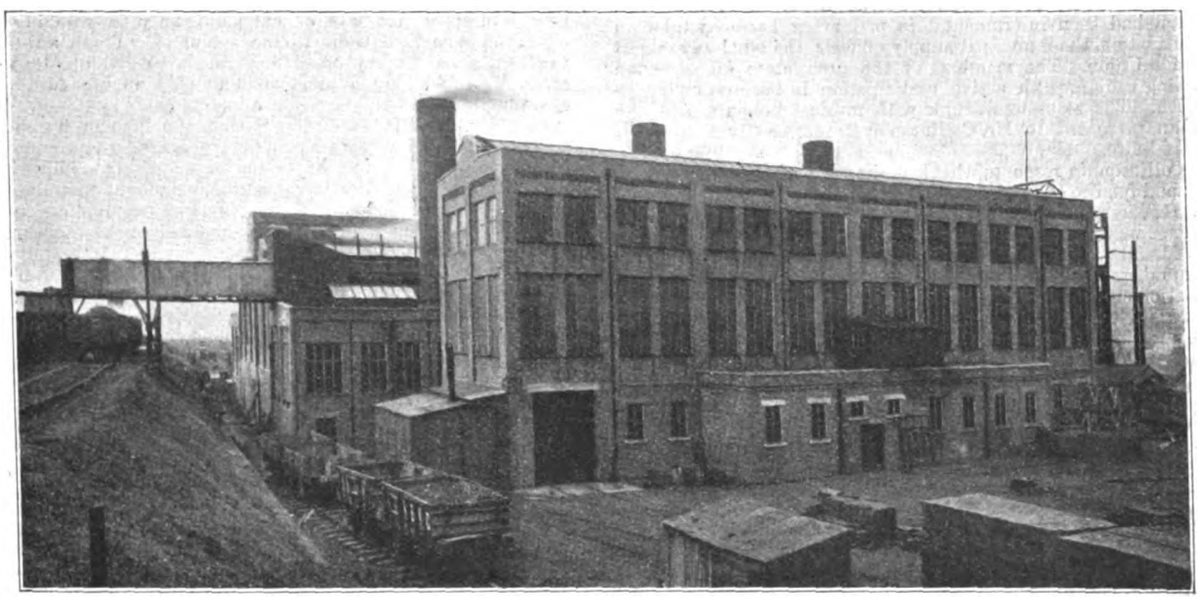
Electrically-Propelled Tugs.—According to "Quex" of the *Evening News*, marine motor makers are attempting to displace steam as the propelling agent of Thames tug boats, but up to the present they have not been altogether successful. With the present cost of coal the fact that a motor tug does not consume fuel while standing by or waiting for a job is a big consideration. A tug always has to be ready to answer an emergency call, which means that many tons of coal are consumed without moving the tugs an inch. Further, the motor takes up less space than that occupied by the steam engine and its attendant boilers. But difficulties are encountered in connection with the reversal and speed variation of the internal combustion engine, and the conditions of the river are such that the engine-room telegraph is constantly in use. The result, says "Quex," will probably be that the Thames tugs will be the first British vessels to adopt the electric drive that is increasing in popularity in America. The Diesel engine will then work steadily on, generating electricity, while on the bridge the skipper will have a switchboard which will permit him to control the propelling electric motors at his will.

Clyde Valley Power Co.'s Extensions.—Since publishing our account of recent extensions of the Clyde Valley Co.'s power stations, we have received a photograph of the station at Clyde's Mill, Cambuslang, which is reproduced herewith.

people who receive domestic electric lighting service in various foreign countries. The estimates include only that portion of the population actually living in electrically-lighted dwellings, and have been made after a thorough search through Government conservation and consular reports, census figures, &c. Reliable data in several of the larger foreign countries are not obtainable.

Country.	Population.	Dwellers in electrically lighted abodes. Number.	Per cent.
Argentina	7,833,000	437,500	5 6
Australia	5,792,000	650,500	11·2
Belgium	7,571,000	106,000	1·4
Chile	3,506,500	16,000	0·4
China	320,650,000	240,000	0·08
France	39,601,500	2,475,000	6·3
Holland	6,492,000	22,000	0·34
Italy	36,120,000	3,874,500	10·7
Japan	53,697,000	24,308,500	45·3
New Zealand	1,099,500	157,000	14·3
Norway	2,391,500	527,000	22·0
Portugal	5,957,000	19,500	0 33
Rumania	7,508,000	56,000	0·75
Russia...	164,737,500	448,500	0·26
Siam	8,309,000	20,500	0·25
Spain	20,356,000	564,500	2·7
Sweden	5,679,500	946,000	16·7
Union of South Africa ...	6,600,000	216,000	3·3
United Kingdom	46,089,000	7,791,500	16·8

Electric lighting in the homes of the Old World is as yet undeveloped; the number of electrically-lighted dwellings in this portion of the world should materially increase in the next few years. The New World, including in this term Australia, New Zealand, and Japan, has adopted domestic electric lighting quite generally, although a large proportion of the population of South America can never be considered as potential users of electricity. In Sweden the Government, in an effort to stem the tide of migration from the country to the cities and towns, is extending the electric transmission systems into the rural districts as fast as possible, and the number of electrically-lighted dwellings in that country naturally will materially increase during the next few years. Japan appears to lead the foreign-speaking world in the percentage of inhabitants in electrically-lighted dwellings. The size of the average installation, however, is pitifully small. Only 2 2 per cent. of the total number of families supplied are served through meters, and the number of lamps they use represents about 15 per cent. of the total. In China the electrical industry is as yet in its infancy; electric lighting, however, is becoming very popular among the better classes in the interior cities. In Argentina there are estimated to be more than 350 central stations, but most of these are small. In Buenos Aires, one of the most progressive cities of the continent, only about 10 per cent. of the population are active consumers of electricity, or about 160,000. Australia has a large percentage of people who can afford to live well, and there is no real poverty such as exists in other countries of the world. The proportion of the population using domestic electric service will probably increase materially as the advantage of this system of illumination is better appreciated.



Clyde's Mill Power Station, Cambuslang.

A Freak Metering Problem.—Under the above title a recent issue of *Power* gives an account of a peculiar instance of careless wiring. A two-storey building was originally wired for a three-wire service, the upper floor being fed from one outside wire and neutral and the lower part from the other outside wire and neutral. The service was changed over to two-wire by connecting up at the entrance and installing a two-wire meter. Then the house was divided into two parts, and so it became necessary to install two distinct circuits, each with a two-wire meter. The tenant of the upper floor was much puzzled to find that month after month his account was as large as that of the downstairs occupant although the latter had a power load in addition to lighting. The supply authorities made tests, and found that the meters were in proper working order; but when one month the account for the lower part of the house was abnormally large while the other tenant's meter showed a zero reading, further investigations were made. It was then discovered that the wiring had never been changed except at the visible points of the meter-board, which left it three-wire and made only two circuits for the meters, with the result that the latter were in parallel. When the fuse between the line and the upstairs consumer's meter blew out, the whole of the load was recorded on the other meter, which naturally gave rise to complaints on the part of the occupant of the ground floor.

A Domestic Electric Service Census.—In order that a more general idea may be obtained of the potential market for small household electrical devices throughout the world, a survey has been undertaken by the *Electrical World*, in which an effort has been made to estimate as closely as possible the number of

Fatality.—A foreman fitter at the Luton Corporation electricity works, Thomas Roebuck, 36, met with a terrible death on Monday. He entered, on Sunday, a large steam boiler, which had been allowed to cool down, in order to remedy a leakage. While inside the boiler, he gave instructions for a valve to be opened to drain off some water. By some mishap, the wrong valve was opened, allowing steam to enter the boiler, and Roebuck was terribly scalded, and died in hospital on Monday.

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A Liverpool Charge.—J. E. Pugh, butcher, was fined £5 and five guineas costs on a charge of having fraudulently consumed electricity to the value of £1. the property of the Liverpool Corporation. According to a provincial paper the meter had been removed from the shop before defendant commenced business there, but certain fittings remained, and it was alleged that at his instigation a connection with the main had been effected. When the lights were found on in the daytime, he explained that he had not got a meter, and was only testing the light. On his behalf it was urged that he had not acted fraudulently.

Educational.—MANCHESTER UNIVERSITY.—In connection with the publicity campaign now in progress by means of which it is hoped to place the University on a sound financial footing the *Manchester Guardian* has published an eight-page supplement, illustrated by drawings and photographs of the University, and containing a number of interesting articles. Viscount Bryce, O.M., contributes reminiscences of the early days of the University, and "Seventy Years of Progress" gives an outline of its history since its institution in 1851. Two fine illustrations of the Whitworth Hall are given.

Social Functions.—ELECTRICAL CONTRACTORS' ASSOCIATION.—Members of the Bradford Branch of the Association and friends held a dinner, on April 30th, at Bradford, to honour Mr. Percy Collinson, their hon. secretary, who is to take up the presidency of the E.C.A. in June. The chair was occupied by Mr. A. Smith (Messrs. Smith and Croft), and the guests, in addition to Mr. Collinson, included Mr. Thomas Roles, M.I.E.E., Bradford city electrical engineer; Mr. C. E. Allsop, commercial manager, Bradford electricity department; Messrs. F. Barnett and W. H. Parker, consumers' department of the Bradford electricity undertaking; Messrs. J. Dyson and L. W. Douthwaite, representing factors and wholesalers; Mr. A. Jowett, district chairman, Electrical Trades Union, and chairman, Bradford District Joint Industrial Council; and Mr. F. Clarke, district secretary, E.T.U.

After the honouring of the loyal toast, Mr. L. Jessop (Messrs. Jessop & Boydell) proposed the toast of "The Guest of the Evening." He referred to the valuable work done by Mr. Collinson during his 10 years' secretaryship of the Bradford branch. Mr. Collinson had been instrumental in preserving harmony between the contractors, the municipal supply officials, the wholesalers, and the Trade Union. The members of the Association all regretted his having to relinquish active participation in business owing to ill-health. The toast was drunk with musical honours, and the chairman presented to Mr. Collinson a handsome silver cake-dish and cake-knife.

Mr. Collinson, in response, thanked the gathering for their good wishes and for the beautiful present.

Mr. H. Moss, proposing the toast of "The Visitors," said that gathering was unique in the history of the electrical trade in Bradford. It was the first time members of the trade had met in such numbers, and had as their guests representatives of the Corporation supply, the wholesale factors, and Trade Union officials. With regard to the Trade Union officials, it would cement the friendly feeling which had prevailed for some time between the workers' representatives and the employers of labour in the district. This had largely come about through the Joint Industrial Council.

Mr. L. W. Douthwaite, responding, said that at a meeting, the previous day, of the Electrical Wholesalers' Federation, he had been greatly struck to see on how many points the factors' interests and aims coincided with those of the N.E.C.T.A.

Mr. F. Clarke, responding on behalf of the Electrical Trades Union, wished Mr. Collinson a speedy recovery to health and many more years' service to the industry.

Mr. Herbert Collinson, proposing the toast of "The Bradford Electricity Department and its Engineers," said the trade had enjoyed very pleasant relationships with the Corporation department.

Mr. Thomas Roles, in response, said he was glad the industry was not to lose the services of Mr. Collinson, and he hoped to see, during Mr. Collinson's presidency, closer relationships between the supply and the contracting industries.

Mr. C. E. Allsop (commercial manager, Bradford electricity department) proposed the toast of "The Electrical Contractors' Association," and the Chairman suitably responded.

An excellent musical programme was provided by professional entertainers during the evening.

The B.E.A.M.A. Annual Dinner.—The B.E.A.M.A. annual dinner—the first since the war—will be held at the Savoy Hotel on Thursday next at 7 for 7.30 p.m. Lord Ampthill, President of the Association, will be in the chair, and amongst the speakers are Sir John Snell, Sir C. Ellis, K.C.B., Sir Allan Smith, M.P., K.B.E., Rear-Admiral F. L. Field, C.B., Mr. Roger T. Smith, President of the I.E.E., Mr. W. L. Hichens, and Mr. James Swinburne.

Tramcar Accident.—While a Huddersfield tramcar driver was reversing the trolley pole of his car, another car close behind moved, and he was crushed between the two, and had to be taken to hospital. William Marsland, the driver of the second car, was standing on the road at the time his car began to move. He instantly jumped on to the platform, and reversed the car, but could not avoid the collision. Norman Davy, conductor of Marsland's car, questioned as to how the car came to start without the driver, said he heard the sound of a bell as if warning him that the car was about to start, and he released the hand brake. Both cars were full of passengers at the time of the collision.

Inquiries.—A correspondent wishes to find a college or other institution where a course in electrochemistry is given.

The B.E.A.M.A.: New Members.—We are informed that the following firms have been recently elected members of the British Electrical and Allied Manufacturers' Association:—

Crabtree, J. A., & Co., Ltd.	Walsall
Crossley Bros., Ltd.	Openshaw
Crypto Electrical Co., Ltd.	London
English Electrical Co., Ltd.	London
Fielding & Platt, Ltd.	Gloucester
Heatley-Gresham Engineering Co., Ltd.	Letchworth
Keighley Gas Engine Co., Ltd.	Keighley
National Gas Engine Co., Ltd.	Ashton-under-Lyne
New Switchgear Construction Co., Ltd.	Sutton
Parsons, C. H., Ltd.	Birmingham
Parsons Motor Co., Ltd.	Southampton
Pearn, Frank, & Co., Ltd.	Manchester
Premier Gas Engine Co., Ltd.	Sandiacre
Robson, John (Snipley), Ltd.	Shipley
Roy, W. H., & Co.	Manchester
Shanks, Alex., & Son, Ltd.	London
Tok Mfg. Co., Ltd.	London

INSTITUTION NOTES.

Association of Engineers-in-Charge.—The thirteenth annual dinner was held at the Holborn Restaurant, on Saturday last; Mr. Frank Bailey (president) was in the chair, and there was a large attendance of members and guests. Amongst the latter were Dr. Macnamara, Mr. G. W. Humphreys, Prof. J. E. Petavel, Mr. R. P. Wilson, O.B.E., Major E. S. Saunders, O.B.E., Mr. T. A. Cooper, Mr. H. P. Boulnois, Mr. W. C. Clifford Smith, O.B.E., Prof. H. S. Hele-Shaw, Captain H. Riall Sankey, C.B., and Mr. W. H. Booth.

After the loyal toasts, Prof. Hele-Shaw, proposing "Industry and Education," said that they might congratulate themselves on the changed position with regard to technical education; now there were abundant facilities, three-quarters of a million students were in training, and large grants were made by the Government. The new Education Act was of extraordinarily far-reaching scope; education would continue to the age of 18. Youth was the time for learning, and every opportunity must be given to learn. The engineer would have a great part to play in the future of the country.

In reply, Dr. Macnamara said that the layman watched with admiration the development of new agencies of communication, transport, &c., the fruit of brains superlatively equipped. The scientist and the artificer in co-operation wrought miracles. Many of the discoveries hastened by the war awaited application to the peace needs of the world. Years ago he taught the three R's; now the three R's that the country wanted were "Research, Research, and more Research." As Minister of Labour, he had a profound belief in the sound good sense of the British people.

Proposing "The Association," Mr. Boulnois said that combination was in the air; the Trade Unions apparently got all they asked for—by combination. The members of the Association were working for the good of mankind, but, in many cases, their emoluments were far too small; was it fair that they should go on improving themselves for the benefit of their employers without adequate reward?

Mr. Bailey replied to the toast, referring to the difficulties under which their work had been carried on during recent years, and expressing the hope that their efforts would be more suitably rewarded, though theirs was not a coercive Association. It was not easy nowadays to control labour, but a little sympathy with the men in their charge would go a long way. The Association had been very active during the war; the Metropolitan Munitions Committee was formed in 1915, and two of their members (Messrs. Strick and McFee) were the first to produce successful 18-pr. shells. The chairman of the Association, Mr. J. E. Watkins, and the officers, including Mr. W. McLaren, Mr. W. H. Ball, Mr. H. A. Murray, and the hon. secretary, Mr. A. E. Penn, had rendered invaluable services. He felt sure that goodwill, which was now dormant, would be restored in due time.

Captain Sankey proposed "Guests and Friends" and urged that the past-presidents should attend the meetings of the Association, forming a link with the senior institutions. Prof. Petavel replied, suggesting that the motto of the Association ("Fides et Justitia") might be freely translated, "Loyalty and Fairplay."

Mr. J. E. Watkins (chairman of the Association), proposing "Our President," expressed their gratitude to Mr. Bailey for his unfailing assistance during the past six years. No matter how busy he was—and during the war he had shouldered many heavy duties—he was always accessible to the officers of the Association. The Metropolitan Munitions Committee had done splendid work under Mr. Bailey, with the assistance of Captain Sankey, Major Conacher, and Messrs. A. J. Claxton, E. McGegan, and Allcock. Captain Penn (secretary) supported the toast in similar terms, pointing out that Mr. Bailey was the originator of the Metropolitan Munitions Committee, backed by Captain Sankey; for four years he was trustee of the Committee, then chairman, and, later, chairman of the Park Royal Filling Factory, which employed 8,000 people. The toast was accorded musical honours, and Mr. Bailey returned thanks, stating that the members of the Munitions Committee had formed a most efficient staff, while the London County Council, through its Educational Department, had afforded great assistance. Mr. Allcock had brought the Perivale factory up to the highest pitch of efficiency.

A musical entertainment was provided, and the proceedings were very enjoyable.

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Institution of Civil Engineers of Ireland.—"The Possibilities of Employing Electric Motive Power on Irish Railways" was the subject of a paper read by Mr. P. A. McGee, A.C.G.I., in Dublin, last week. Being predominantly an agricultural country, Ireland's immediate potentiality to do work according to the power-house test was, he said, small. But, with a view to its development, a study of her electrical possibilities was being made. With multiple unit cars on the railways, the country could have a much better service, at a much less cost than at present, whilst electric power being available all over the country, could be utilised in industry in almost every direction.

South African Institute of Engineers.—It is announced in the April *Journal* that as a result of efforts to bring the scientific societies of South Africa into closer working, a building is shortly being obtained as a Centre. Substantial financial assistance is being given by the Transvaal Chamber of Mines, which, in addition to loans, has offered to subscribe 10s. for every £1 raised by the societies concerned. The Johannesburg Club has been purchased for the purpose for £22,500, but further additions would bring the total up to £35,000. The chairman of the meeting at which these statements were made, stated that the assistance of the Chamber of Mines was a fine tribute of appreciation of the work done by the scientific and engineering bodies for the industries of the country, and they accepted the gift with great thankfulness and a realisation of the trust which was imposed upon them.

South African Institute of Electrical Engineers.—The March *Transactions* records the formation of a new class of membership to be called the Telegraph Associate, and the award of the Institute's gold medal for 1919 to Prof. G. V. Adendorff for his paper entitled "Notes on the Application of Synchronous Condensers to Large Power Systems."

Iron and Steel Institute.—At the annual Convention of the Institute in London last week, reviewing the progress made in the ferrous industries during the last 50 years, Dr. J. E. Stead, F.R.S., President of the Institute, said, in connection with the question of recovering the heat from blast-furnace slag, that it was a matter worthy of the most serious consideration of engineers. Even if only 33 per cent. of the heat were recovered from the 15 million tons of slag produced in Great Britain alone, it would represent about 350,000 tons of carbon per annum.

The enormous rapidity of the development of the electric steel furnace during the last five years was also referred to by Dr. Stead. Before the war only a few electric furnaces were used in connection with the iron and steel industry in Great Britain, but soon after 1914 a large number of melting furnaces were erected in Sheffield and other parts of the country to deal with the enormous mass of shell borings produced. They had been largely used to replace crucible melting, and had come to stay. Immense quantities of special alloy steel were made by their aid.

Before the war progress had been most rapid in Germany, where the conditions were particularly suitable. The United States came second, with Italy and France also ahead of England. Now production in this country was surpassed only by the United States and Germany. Germany still held second place, but only because most of the steel there was refined basic Bessemer steel, while British furnaces were in practically all cases melting cold scrap. The actual number of furnaces and the power used was greater than in Germany. By the end of 1918 our annual production had gone up from 10,000 tons, which was the figure before the war, to about 150,000 tons. During the war this steel was used for making bullet-proof plates, aeroplanes, motor-cars, armour-piercing shells, and steel helmets.

The President awarded the Bessemer Gold Medal for 1920 to Mr. Harry Brearley (Sheffield). The Council's report, which was approved, stated that the Prince of Wales had accepted honorary membership of the Institute, the total membership of which now stood at 2,181. There was a deficit on the year's working of £1,109. —*The Times.*

National Association of Supervising Electricians.—A very interesting and instructive lecture on "Wireless Telegraphy" was given before a large gathering of members and visitors at St. Bride's Institute, on May 4th, by Mr. Maurice Child. The subject was dealt with in a clear and interesting manner, illustrated by practical demonstrations. Messages were picked up from outside sources by arrangement with the G.P.O.

Institution of Electrical Engineers.—WESTERN CENTRE.—At the thirty-fifth ordinary general meeting held at Swansea on May 3rd, Dr. C. V. Drysdale delivered his Kelvin lecture "Modern Marine Problems," before a large attendance of members. The chair was taken by Mr. A. J. Newman, in the absence of the chairman of the Centre, Mr. Arthur Ellis.

Association of Mining Electrical Engineers.—The annual meeting of the Yorkshire Branch took place at Leeds, on May 8th, under the chairmanship of Mr. J. W. Mitchell. The following gentlemen were elected as officers:—President, Mr. J. W. Harbottle; vice-presidents, Messrs. J. W. Mitchell and J. R. Lee; hon. secretary and treasurer, Mr. H. Green. During the evening a discussion ensued on "Sub-Station Practice."

Institute of Physics.—The need has long been felt for a corporate body analogous to the Institute of Chemistry, which would represent the profession and strengthen the position of workers engaged in physics, and which would also form a bond between the various societies interested. At present the physicist is hardly recognised as a member of one of the professions, but the vital importance of many developments of physics during the war and the certainty of its growing importance both in science and industry, are bringing about a change in this respect. It is one of the aims of the new Institute of Physics to secure recognition of the position and value of the physicist, and it is felt that such recognition can only be obtained by the co-operative action of all the physicists in the country.

The Institute has been founded by the co-operation, in the first instance, of the Faraday Society, the Optical Society, and the Physical Society of London, and the first Board is constituted from representatives appointed by the Councils of these Societies. It is hoped that in the course of time other societies will associate themselves with the Institute. Members of the Institute who are also members of more than one of the co-operating societies will obtain a reduction of the subscription to those societies.

There will be three classes of members: Ordinary Members, Associates (A.Inst.P.) and Fellows (F.Inst.P.). Only the two latter classes, membership of which will require full professional qualifications, will be Corporate members.

The Institute has already received promises of support from leading physicists, and the initial expenses are covered by a guarantee fund amounting to over £1,200.

The first President of the Institute is Sir Richard Glazebrook, K.C.B., F.R.S.; Sir Robert Hadfield, Bart., F.R.S., is treasurer, and Prof. A. W. Porter, F.R.S., honorary secretary. The other members of the board are:—Dr. H. S. Allen, Inst. Commander T. Y. Baker, R.N., Prof. F. J. Cheshire, C.B.E., Dr. R. S. Clay, Mr. W. R. Cooper, Prof. W. H. Eccles, Major E. O. Henrici, Dr. C. H. Lees, F.R.S., Mr. C. C. Paterson, O.B.E., Major C. E. S. Phillips, Dr. E. H. Rayner, Mr. T. Smith, and Mr. R. S. Whipple.

Mr. F. S. Spiers has been appointed Secretary to the Institute, and further particulars and forms of application for membership may be obtained from him at 10, Essex Street, Strand, W.C. 2.

Rugby Engineering Society.—The offices of this Society have been moved to 10, Elborow Street, Rugby.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

When the Leeds City Council, last week, considered proposals for advancing the salary of Mr. C. N. HEFFORD, city electrical engineer, from £1,200 to £1,500 per annum, and a similar advance to the gas engineer, the Labour representatives put up a hot opposition. The trend of their arguments seemed to be that they are now out to oppose everything that tends to cause further increases in the cost of living, direct or indirect. Increases of wages for their own workers, presumably, are not in this category, but advances of salary to officials apparently are. They suggested that the basic standard of living was now approximately £250 per year. They admitted that men of unusual ability might be entitled to two, three, or even four such "standards," but contended that no man was entitled to more than four—that is, £1,000 a year—so they opposed the proposals to increase two salaries which are already above five "standards." Their somewhat novel idea, which they said was likely to become the policy of the National Labour Party, was not successful, and the increases were adopted by 31 votes to 21. Their attitude reminds us of the famous declaration of Mr. John Burns that no man was worth more than £500 per annum, and his own personal proof of its inaccuracy.

Mr. SCOTT-TAGGART, lately in charge of the wireless valve department of the Edison-Swan Electric Co., Ltd., has resigned for the purpose of taking up a more important position with the Radio Communication Co., Ltd. His technical services in connection with matters relating to thermionic valves will at present be at the disposal of the Edison-Swan Electric Co. when required.

Mr. E. TOWNSEND, of the Penzance staff of the Western Union Cable Co., who is leaving to join the staff at New York, has been presented by his colleagues with a gold watch.

The Liverpool Corporation has made the following appointments: Mr. F. W. T. TURNER, mains assistant; Messrs. J. G. Q. Williams, J. A. Phillips, and W. Mayhew, high tension inspectors; and G. Preston, assistant inspector of installations.

The marriage took place on May 1st of Mr. F. HIGGINS, chief electrical engineer at the Winscombe Electrical Works, Somerset, and Miss Clara Mitcham.

The staff and employés of the Stoke-on-Trent Corporation electricity department recently presented Mr. and Mrs. S. G. MARSTON with a silver tea set. Mr. Marston is taking up the position of distribution engineer with the Sunderland Corporation electricity department.

Mr. H. J. HAWKINS, of the Karachi Electric Supply Corporation, Ltd., to whose new developments we refer in our "City Notes," to-day, is leaving for England this month. While here on leave his address will be 8, Albert Road, Brockley, S.E. 4.

Mr. S. G. C. RUSSELL has now retired from the control of the electrical inspection department of the Phœnix Assurance Co., and is retained by the company for purely consultative work. His address will be as hitherto, No. 17, Sherborne Lane, King William Street, E.C.

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Mr. E. B. HUNTER has been apponted by the directors as electrical engineer to the Phœnix Assurance Co., Ltd., in succession to Mr. S. G. C. Russell.

Mr. H. BRITTAN, for a number of years electrical engineer-surveyor for the Vulcan Boiler & General Insurance Co., at Newcastle-on-Tyne and North-East Coast, has joined Messrs. J. J. Greenfield & Co., Ltd., of Carliol Square, Newcastle-on-Tyne, and he asks for trade catalogues to be sent to him there.

Kettering Urban District Council has increased the salary of Mr. C. B. TUTT, chief assistant electrical engineer from £350 to £400 per year.

Blackpool Tramways and Electricity Committee recommends that the salaries of the traffic superintendent and the tramways engineer be increased from £400 to £500, and that of the chief clerk and cashier from £305 to £400 per annum.

Mr. G. F. SCHREIBER has been appointed inspector-general of telegraphs and telephones in Egypt, vice Mr. J. S. Liddell, appointed Under Secretary of State to the Minister of Communications.

Mr. C. JERMYN FORD has resigned his seat on the board of the British Electric Traction Co., Ltd., and Mr. J. S. Austen has been elected a director.

Obituary.—MR. E. BULL.—The death occurred last week at Guildford, Surrey, of Mr. Edward Bull, who, we are informed, was the only surviving member of the party who laid down the first cable across the Atlantic, linking up Great Britain with the U.S.A. Mr. Bull, who was over ninety when he died, actually received the first message transmitted by cable to this country from America. For many years he was superintendent of the Eastern Telegraph Co.'s station at Porthcawl, and many cable operators in this country and abroad owe much to his efforts in training young men.

NEW COMPANIES REGISTERED.

African Concessions Syndicate (1920), Ltd. (166,966).—Private company. Registered April 30th. Capital, £5,000 in 2s. shares. To take over the business of The New African Concessions Syndicate, Ltd. (incorporated in 1910), and to carry on the business of an electric light, heat and power supply company, &c. The first directors are: Major W. A. Wills, Cavalry Club, Piccadilly, W.; A. H. D. Cochrane, Blairfield, Staplehurst, Kent (director of Welgedacht Exploration Co., United African Lands and Transvaal Lands Co.); W. Praeger, Buckminster, Grantham (private secretary to Earl of Dysart). Secretary: E. S. Briggs. Solicitors: Coward, Hawksley & Co., 30, Mincing Lane, E.C. Registered office: 10-11, Broad Street Avenue, E.C.

Atlas Welding Co., Ltd. (11,384).—Private company. Registered in Edinburgh April 30th. Capital, £3,000 in £1 shares. To carry on the business of welders, boilermakers, ship repairers, engineers, electricians, &c. The subscribers (each with 200 shares) are: G. G. Musted, 62, Saltown Road, Glasgow, engineer and electric welder; A. H. Millen, 1, Melfort Avenue, Dumbreck, Glasgow, constructional engineer. The first directors are: G. G. Musted and Archibald H. Millen. Qualification, £200. Secretary: G. G. Musted. Registered office: 62, Saltown Street, Glasgow.

Wardley Smith, Ltd. (167,154).—Private company. Registered May 5th. Capital, £2,000 in £1 shares. To take over the business carried on at Vine Place, Milkstone Road, Rochdale, as "Wardley Smith," and to carry on the business of electricians, mechanical engineers and manufacturers, workers and dealers in electricity, motive power, light and heat, switchgear manufacturers, &c. The first directors are: W. I. B. Ward, 5, Nicholson Street, Deeplish, Rochdale, electrical engineer; E. Brierley, 89, Spotland Road, Rochdale, electrical engineer; F. Smith, 68, King Street East, Rochdale, electrical engineer. Solicitor: J. A. Hadson, The Butts, Rochdale.

Electrical Industries, Ltd. (167,108).—Private company. Registered May 4th. Capital, £2,000 in £1 shares. To carry on in the U.K., the Colonies, India and elsewhere the business of manufacturers of electric fires, lamps, filaments and radiators of all kinds, stoves, meters, &c. The subscribers (each with one share) are: E. Woodroffe, 9-10, Pancras Lane, E.C.4, C.A.; T. Scott, 9-10, Pancras Lane, E.C.4, C.A. E. Woodroffe signs as director. Solicitor: F. S. Clark, 11, Pancras Lane, E.C. Registered office: 9-10, Pancras Lane, E.C.4.

E. I. C. Magnetos, Ltd. (167,032).—Private company. Registered May 3rd. Capital, £75,000 in £1 shares. To take over the business of E. I. C. Magnetos, Ltd. (incorporated in 1913), and to carry on the business of manufacturers of magnetos and appliances of all kinds for ignition or starting in connection with internal-combustion engines, &c. The subscribers (each with one share) are: W. H. Baker, The Elms, West Smethwick, law clerk; W. A. Shaw, 51, Court Lane, Erdington, Warwickshire, clerk. The first directors are to be appointed by the subscribers. Secretary: E. C. Cole. Solicitor: S. Vernon, 83, Colmore Row, Birmingham. Registered office: Royal Wellington Works, Sampson Road North, Birmingham.

Alamo Electric, Ltd. (167,158).—Private company. Registered May 6th. Capital, £5,000 in £1 shares. To carry on the business of dealers in and agents for the sale of the "Alamo Lighting and Power Sets." The subscribers (each with one share) are: H. Gaskell, 244, St. James Court, S.W.1, engineer; W. M. Carver, Coombe Weybridge, engineer (both directors of Drake & Gorham, Ltd., and other companies). The first directors are: H. Gaskell and W. M. Carver. Solicitor: G. D. Colclough, 24, Austin Friars, E.C.2.

Heyes & Co., Ltd. (167,085).—Private company. Registered May 4th. Capital, £20,000 in £1 shares. To take over the business of an electrical engineer carried on by W. A. Heyes at Water Heyes Works, Waterside, Wigan, Lancs., as "Heyes & Co." The first directors are: W. A. Heyes, 26, Marsden Road, Southport; A. V. Heyes, 26, Marsden Road, Southport. Secretary: J. C. Muir. Solicitor: J. Wilson, 22, King Street, Wigan. Registered office: Waterside, Powell Street, Wigan.

Garrett, Green & Co., Ltd. (166,907).—Private company. Registered April 29th. Capital, £4,000 in £1 shares. To take over the business of electrical and mechanical engineers carried on at 139, Derby Street, Burton-on-Trent, by G. W. Green and R. L. Calder, as "Garrett, Green & Co." The first directors are: G. W. Green, 16, Grange Street, Burton-on-Trent; R. L. Calder, 3, Moor Street, Burton-on-Trent; G. W. Green, senr., Elderfield Lodge, Coventry Street, Kidderminster; W. J. Cadler, 40, Sackville Street, W. Solicitor: W. Ashford, 55, Great Marlborough Street, W. Registered office: 139, Derby Street, Burton-on-Trent.

British "Dynamo," Ltd. (167,071).—Private company. Registered May 4th. Capital, £25,000 in £1 shares (15,000 preference). To carry on the business of electrical and general engineers, manufacturers of and dealers in electrical and other appliances, &c. The subscribers (each with one preference share) are: A. Watt, Morley's Hotel, Trafalgar Square, W.C., merchant; L. C. Thornton, 48, Lyncroft Gardens, West Hampstead, N.W.6, engineer. The subscribers are to appoint the first directors. Solicitors: Jenkins, Baker and Co., 3, London Wall Buildings, E.C.

Ever-Ready Company (Great Britain), Ltd. (167,171).—Registered May 6th. Capital, £500,000 in £1 shares (200,000 7 per cent. cumulative participating preference). To carry on the business of electricians, electrical engineers, manufacturers of and dealers in electrical appliances, apparatus, novelties and specialities, &c., and to enter into an agreement with the British Ever-Ready Co., Ltd. The first directors are: C. H. C. Moller, 100, Cheyne Walk, S.W.; S. Stern, 255, West 84 Street, New York; M. Goodfellow, Hillinorbon, Castle Hill, Maidenhead; C. H. Dade, 17, The Avenue, Beckenham, Kent; A. H. Sheppard, Wayside, Friern Watch Avenue, N.12 (all directors of the British Ever-Ready Co., Ltd.). Qualification, £250. Solicitors: Courbould-Ellis, Mitchell and Mawby, 1, Church Court, Clement's Lane, E.C.

Stanley Gayner & Co., Ltd. (166,855).—Private company. Registered April 27th. Capital, £3,000 in 2,500 shares of £1 each and 10,000 shares of 1s. each. To carry on the business of electrical engineers, motor, aeroplane, iron and steel manufacturers, &c. The subscribers (each with one share) are: S. Gayner, 132, Claude Road, Cardiff, engineer; E. Pearse, 21, Marlborough Road, Cardiff, managing director. The subscribers are to appoint the permanent directors. Registered office: Park Lane, Queen Street, Cardiff.

MacInnes, Clark & Co., Ltd. (11,166).—Private company. Registered in Edinburgh April 26th. Capital, £1,000 in £1 shares. To carry on the business of electricians, mechanical, water supply and electrical engineers, patternmakers, boilermakers, millwrights, plumbers, joiners, &c. The subscribers (each with one share) are: J. Bruce, 7, Firpark Terrace, Dennistoun, Glasgow (director, Craig & Co., Ltd.); W. Jack, Mainhirst Cottage, Airdrie (director, Craig & Co., Ltd.); D. B. Mungo, 137, West Regent Street, Glasgow, solicitor. The first directors are: H. J. MacInnes, 57, Airlie Gardens, Hyndland, Glasgow; and W. R. Clark, 2, Hopetoun Place, Townhead. Secretary: D. B. Mungo. Registered office: 18, Holland Street, Glasgow.

Tofield & Robinson, Ltd. (166,892).—Private company. Registered April 28th. Capital, £10,000 in £1 shares. To carry on the business of electricians, electrical contractors, electrical, mechanical, lighting, motor and general engineers, &c. The first directors are: H. C. Tofield, Mill House, Thimble Mill Road, Smethwick; W. T. Hellaby, The Chestnuts, Water Orton, Warwick; B. French, 69, Bewdley Hill, Kidderminster. Registered office: 165, Edmund Street, Birmingham.

Watson-Norie, Ltd. (166,962).—Private company. Registered April 30th. Capital, £8,000 in £1 shares. To take over the business carried on by R. Norie, R. C. Watson and J. Norie at Back Park Road and 2, Clyde Street, Wallsend-on-Tyne, Northumberland, as "Watson-Norie," and to carry on the business of electricians, electrical and structural engineers, &c. The subscribers (each with one share) are: R. Norie, 3, Bedford Gardens, Monkseaton, electrical engineer; J. Norie, 117, Brighton Road, Gateshead, electrical and mechanical engineer; R. C. Watson, 13, Croft Avenue, Wallsend, electrical and mechanical engineer. The first directors are not named. Solicitor: T. A. B. Forster, Collingwood Street, Newcastle-on-Tyne. Registered office: 42, High Street, Wallsend.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Smale & Collins, Ltd.—Further charge on land and hereditaments in Twiss Road and East Street, Hythe, dated April 26th, 1920 (supplemental to mortgage dated April 1st, 1920), to secure £727. Holder: H. G. Smale, 20, Parkhill, Ealing, W.

Simms Motor Units (1920), Ltd.—Land registry charge on certain land and premises in Finchley dated April 30th, 1920, to secure £4,818 15s. Holder: T. G. Payne, "Ingerthorpe," Great North Road, Highgate, N., also land registry charge on above-mentioned property dated April 29th, 1920, to secure all moneys due or to become due from company to London Joint City and Midland Bank, Ltd.

V. G. Middleton & Co., Ltd.—£4,000 debentures authorises April 29th, 1920, whole amount issued, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees.

Charing Cross, West End and City Electricity Supply Co., Ltd.—Trust deed dated April 12th, 1920, to secure £250,000 6½ per cent. 5-year secured notes, also deed dated April 9th, 1920 (supplemental to trust deed dated April 30th, 1901, and Indentures dated September 12th, 1902, and June 17th, 1904), to secure £3,333 further debenture stock ranking *pari passu* with £530,000 debenture stock secured by trust deeds, also deed dated April 9th, 1920 (supplemental to trust deeds dated March 31st, 1908, and December 9th, 1909), to secure £82,264 further debenture stock ranking *pari passu* with £650,000 debenture stock secured by principal deeds, also deed dated April 10th, 1920 (supplemental to deeds dated March 31st, 1908, December 9th, 1909, and April 9th, 1920), securing £117,736 further debenture stock ranking *pari passu* with £752,264 debenture stock charged on company's City undertaking and assets and money belonging to the undertaking £125,500 4 per cent. and £225,000 4½ per cent. debenture stock, and electric undertakings, generating and distributing stations, cables, works and other assets, present and future, including uncalled capital. Trustees: Law Debenture Corporation, Ltd.

Radio Communication Co., Ltd.—Mortgage debenture dated April 28th, 1920, to secure £5,000 and further advances (if any) up to a maximum of £15,000, charged on the company's property, present and future, including uncalled capital. Holders: Indo-European Telegraph Co., Ltd.

Dick's Asbestos Co., Ltd.—Mortgage dated April 16th, 1920, to secure all moneys due or to become due from company to National Provincial and Union Bank of England, Ltd., charged on certain properties in Canning Town and East Ham.

Dartmoor Electric Supply Co., Ltd.—Issue on April 22nd, 1920, of £150 debentures, part of a series already registered.

Kartret Engineering Co., Ltd.—Debenture dated April 19th, 1920, to secure all moneys due or to become due from company to Barclay's Bank, Ltd., charged on the company's undertaking and property, present and future, including uncalled capital.

Spensers, Ltd.—Particulars of £20,000 debentures authorised February 17th, 1920, present issue £16,100, charged on the company's undertaking and property, present and future, including uncalled and unpaid capital. No trustees.

Kinetic Co., Ltd.—T. Rimmington, of 43, Gallowtree Gate, Leicester, as Receiver on April 23rd, 1920, under powers contained in debentures dated January 13th, 1910.

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Underground Electric Railway Co. of London, Ltd.—Trust deed dated April 8th, 1920, to secure £700,000 "three-year notes" charged on £681,000 (nominal) London Electric Railway 4 per cent. debenture stock, £413,000 (nominal) 4 per cent. perpetual debenture stock of the City and South London Railway Co., £200,000 (nominal) London Electric Railway 4 per cent. preference and £10,000 6 per cent. (free tax) cumulative preference shares of £10 each (fully paid) in the Associated Equipment Co., Ltd. Trustees: National Provincial Union Bank of England.

Kensington and Knightsbridge Electric Lighting Co., Ltd.—Issue on April 13th, 1920, of £25,000 debenture, part of a series already registered.

Weldings, Ltd.—Satisfaction in full on March 9th, 1920, of mortgage debenture dated April 29th, 1919, securing £1,500.

CITY NOTES.

Urban Electric Supply Co., Ltd.

The gross profits for 1919 were £59,825, as against £63,890 for 1918. The balance carried to net profit and loss is £55,604. Interest, debenture stock redemption, and income tax, absorb £47,998; £3,716 was brought forward; £10,000 is put to reserve for depreciation, and £1,322 is to be carried forward. In common with other provincial undertakings the company has suffered severely during the past year from its inability to adjust its charges sufficiently to meet the constantly increasing costs of supply, with the result that the profits do not admit of the payment of any dividend. To overcome this difficulty the directors joined with Edmundsons' Electricity Corporation in promoting a Bill in the present session of Parliament to enable the company to earn a reasonable return on its capital. They regret to report that the Bill was rejected by the committee to whom it was referred. The directors are, therefore, now endeavouring to secure the necessary relief by other means.

	Load in KW.		Profits.	
	1918.	1919.	1918.	1919.
Hawick	3,545	3,816	£6,509	£5,608
Stamford	1,756	1,824	2,387	2,008
Weybridge and Walton	3,918	4,170	4,590	4,990
Godalming	1,986	2,032	2,382	1,715
Twickenham and District	10,171	11,416	14,716	11,919
Dartmouth	1,070	1,121	607	1,859
Camborne and Redruth	8,396	9,272	8,609	7,753
Newton Abbot	1,602	1,895	2,932	3,226
Grantham	2,070	2,255	8,074	6,995
Glossop	1,438	1,546	3,470	4,939
Berwick	1,161	1,250	479	loss, 750
Caterham	1,080	1,248	1,056	1,607
Newbury	1,320	1,459	905	716
Cornwall Co.	—	—	7,200	7,200
Totals	39,503	43,299	£63,766	£59,784

Dublin & Lucan Electric Railway Co.—Dividend of 5s. per share on 5 per cent. preference shares on account of arrears for year ending December, 1919.

Stock Exchange Notices.—The Committee has specially allowed dealings in the following under Temporary Regulation 4 (3):—

British Electric Transformer Co., Ltd.—137,500 7 per cent. cumulative preference shares of £1 each, fully-paid, Nos. 325,001 to 462,500; 162,500 ordinary shares of £1 each, fully-paid, Nos. 462,501 to 625,000, after issue of letters of acceptance.

Simms Motor Units (1920), Ltd.—30,000 shares of £1 each, 10s. paid, Nos. 1 to 30,000.

The committee has ordered the undermentioned to be officially quoted:—

Adelaide Electric Supply Co., Ltd.—250,000 5 per cent. "A" cumulative preference shares of £1 each, fully paid (Nos. 1 to 250,000).

British Aluminium Co., Ltd.—400,414 ordinary shares of £1 each, fully paid (Nos. 900,621 to 1,301,034).

London Electric Railway Co.—152 ordinary shares of £10 each, fully paid (Nos. 36,358 to 36,509).

London & Suburban Traction Co., Ltd.—The revenue for 1919 was £37,395, against £46,294 for 1918, plus £7,092 brought forward. Deducting all expenses chargeable to revenue, including debenture and loan interest, and providing for the sinking fund charges upon the 5 per cent. debenture stock, £1,205 remains to be carried forward. The increased costs of working have compelled the associated tramway companies to deposit Bills in Parliament seeking authority to increase their maximum powers of charge. Lord Ashfield has rejoined the board and been elected chairman.

Commonwealth Edison Co.—The report for 1919 shows: Electric operating revenues, $30,366,426; expenses (including amortisation and depreciation, $2,880,254), $19,519,506; net electric operating revenues, $10,846,919; uncollectable operating revenue, $119,938; taxes, $2,355,000; municipal compensation, $895,193; net operating income, $7,476,787; other income, $619,801; gross income, $8,096,589; deductions from gross income, $950,213, leaving $7,146,375; interest on funded debt $2,299,236; dividends paid, $3,942,340; balance carried to surplus, $904,798.—*Financial Times.*

Dudley, Stourbridge and District Electric Traction Co., Ltd.—Dividend 4 per cent. on the ordinary shares for 1919. £1,000 to reserve; £2,000 to renewals; £65 carried forward.

Potteries Electric Traction Co., Ltd.—Capital expenditure during 1919, £3,908. Revenue £252,438, or £46,304 more than 1918. The expenses have increased by £51,590, although many repairs and renewals have again been deferred. After deducting all expenses, including debenture interest, and £15,000 for renewals, £20,000 is put to reserve, 5 per cent. is paid on the preference shares, and 5 per cent. on the ordinary, leaving £12,082 to be carried forward. Owing to repeated wage advances and the higher cost of materials, expenses have very largely increased. Gross receipts have also increased by reason of higher fares and other causes. "Wages continue to advance, and the raising of additional revenue becomes more difficult." The Bill deposited by the Corporation to confirm the agreement of sale of the undertaking to the Stoke-on-Trent Corporation was withdrawn, as it failed to obtain the necessary approval of the ratepayers.

Karachi Electric Supply Corporation, Ltd.—This company held an extraordinary meeting at Karachi on April 10th, when it was resolved to increase the capital from ten lakhs to 30 lakhs of rupees. Three lakhs were to be offered to existing shareholders at par. The chairman, Mr. M. de P. Webb referred to the prospects ahead, especially with regard to demands for energy for industrial purposes. In addition, over three hundred applicants for energy for lighting purposes were waiting to be connected. Three lakhs of rupees were required at once to pay for the three new large engines and dynamos, two of which were now on their way from England to Karachi. The managing agents have under preparation a scheme for a greatly enlarged generating station to be equipped with steam turbo-generator, each of 1,000 KW.—that is, each will be larger than the entire capacity of the present plant. Industrial enterprises in and around Karachi are expected to be greatly stimulated as a result.

North of Scotland Electric Light & Power Co., Ltd.—The result of working during 1919 is satisfactory considering the conditions. In Montrose, connections increased from 1,217 KW. to 1,555 KW.; Brechin from 857 to 908 KW.; Inverness from 1,996 KW. to 2,088 KW.; total 4,551 KW. Gross profit £6,409, against £6,644 in 1918. Debenture and loan interest £2,615; after writing £71 off suspense account, providing £208 for income tax on undivided profits, and including £1,214 brought forward, 3 per cent. dividend is to be paid, £2,500 put to renewal reserve, and £729 carried forward. The death of two directors (Mr. D. S. Campbell and Dr. Valentine Stone) occurred during the year; Mr. D. Lackie was co-opted to fill one of the vacancies.

Northern General Transport Co., Ltd.—The company own the investments, which cost £438,706, in the Gateshead, Tynemouth and Jarrow electric tramway undertakings. During 1919 the Gateshead and Jarrow companies made distributions to their shareholders from their reserves. The amounts so received by this company have been carried to reserve. The gross traffic receipts of the motor transport undertaking again show an increase due to the larger number of vehicles in service, but costs of operation continue to rise rapidly. There has been put to sinking fund £1,260; 6 per cent. preference dividend £6,522; 10 per cent. on the ordinary shares £22,711; carried forward £14,010.

Minehead Electric Supply Co., Ltd.—Units sold during 1919 increased by 25,560. Profit on trading after payment of debenture interest £956, plus £37 brought forward. After paying preference dividend, putting £330 to depreciation and reserve, and paying 5 per cent., free of tax, on the ordinary shares, £45 is to be carried forward. The new engine and generator ordered in February, 1919, have only just commenced running. The nominal capital is to be increased to £20,000, and the existing 800 £10 preference shares are to be converted into 8,000 shares of £1 each.

Shanghai Electric Construction Co., Ltd.—Supplementing our note of last week the profit for 1919 was £154,567, compared with £71,537. The loss by exchange on subsidiary coinage in 1919 was £52,139, which is equal to 16.29 per cent. on the capital of the company. The ratio of depreciation to gross takings increased during the year, and still shows an unfavourable tendency. The traffics and net receipts for the current year continue to be satisfactory. The 15 trailers and seven railless electric cars have not yet been brought into service owing to the difficulties and delays incidental to manufacture.

Indian Electric Supply and Traction Co., Ltd.—Mr. J. G. B. Stone, presiding at the annual meeting on May 7th, said that the year had been one of great difficulty. The position had now improved. Units sold had increased in all departments, excepting for special contracts where there was a decrease due to the temporary stoppage at some of the mills owing to labour unrest. In order to provide an increased margin of safety a second-hand 500-KW. set had been secured. Very considerable developments in the business were anticipated. The tramway had been more remunerative than in the previous year; passengers carried and traffic earnings had improved, but a heavy expenditure on repairs had had to be met.

Hurst, Nelson & Co., Ltd.—Interim dividend of 1s. per share (5 per cent., free of tax).

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Bastian Meter Co., Ltd.—The net profit for 1919 (after writing £1,250 off goodwill) was £976, plus £151 brought forward. The directors recommend payment of the 6 per cent. dividends on the cumulative preference shares for the two years ended December, 1919, amounting to £241, also a dividend of 3 per cent. on the ordinary shares for 1919, leaving £588 to carry forward.

West African Telegraph Co., Ltd.—Dividend of 2 per cent., making 4 per cent., free of tax, for 1919.

STOCKS AND SHARES.

TUESDAY EVENING.

THERE is every indication in the Stock Exchange markets that the public are taking a hand amongst investment stocks and shares. Business, however, still comes tamely, and it is impossible to gauge the tendency of the Stock Exchange for long at a time. Excess Profits Duty has now come to be regarded as fixed, so far as this year is concerned, at 60 per cent., and there is a disposition to wait and see how this is likely to affect industrial companies. The past success with which sellers have passed on taxes to the consumers encourages the idea that there is not likely to be much diminution in dividends, but this remains to be seen, and meanwhile the buyer of industrials treads softly. Something of a feature is the strength of rubber shares, which is somewhat surprising in view of the low price of the raw material, though explainable by reference to the fact that rubber companies are selling their produce at excellent prices for forward delivery. Consequently, rubber shareholders are content to retain their investments for future profits.

With so many causes of unsettlement in the air, the tendency is still to buy gilt-edged stocks in preference to those of the more speculative order. Therefore it comes about that quite a number of good-class preference shares, which lately have been inclined to droop, are now taking a turn for the better. There is, indeed, a public demand for anything of the sound order offering 7½ to 8½ per cent. on the money. While many of the recent comers afford the latter rate and more, the conservatism of the investor leads him to prefer the older-established concerns, and to accept a lower rate of interest from these than can be obtained from newer comers. Nevertheless, it happens occasionally, to the exasperation of the proprietor of shares in which there is not much market, that when he comes to sell he finds the nominal quotation is not the correct market value, and he is offered some lower figure than that which appears in the list. The reason is that unless shares should actually come to market, the prices are left standing until somebody wants to deal, and it is only then that the seller discovers that the 7 per cent. Bank Rate has had a greater effect upon his stock than was apparent in the price being left unaltered.

By refusing the offer of the London General Omnibus Company in regard to wages, the men have caused dulness amongst the electrical railway issues, although Underground incomes hold their price. London and Suburban Traction preference fell away to 3s. on the report just out. The Toronto Power Company invites tenders for repayment of their stock by the 4½ per cent. debenture holders, and allows until May 28th for these to be sent in. Prior to the issue of the circular, the price was standing at 57-60, and this is quoted by the company in its invitation, but now the stock has risen to 65½, and possibly might command still more. It is always difficult for a stockholder to know at what price his tender is likely to be accepted by a company in such circumstances as these.

Bromptons are ¼ down to 6⅜, bringing the yield to nearly 9½ per cent. on the money. Westminsters pay 9½ per cent. and South Londons rather more. Kensingtons have come down 5s. to 4¾, the return in their case amounting to 7½ per cent. on the money. Metropolitans afford 10 per cent. at their lowered price of 3. Considerations of yield seem to affect these electric lighting shares hardly at all: the market is dull and heavy. With coal higher, it is not likely that any illumination shares will increase in popularity. Electric Constructions are easier at 22s. English Electric ordinary stand about 22s. 6d. Yorkshire Electric Power ordinary, £4 paid, were recently negotiated at 29/16, while the 5 per cent. debenture stock, which came out at 88, last changed hands at 85½. The £35 paid scrip is about 35½. Newcastle-on-Tyne 7 per cent. preference keep very steady at 20s. 6d. Notting Hill ordinary shares can be bought on the basis of 20s. 9d.; the company's 6 per cent. preference have not been dealt in for five months in the Stock Exchange, when the last recorded bargain was at 8½.

Melbourne Electric Supply new shares, issued at 25s. and with 10s. paid, maintain 1-16 premium. Indian Electric Traction 7 per cent. convertible preference, fully paid, are at 1s. discount. Permission has just been granted to deal in the partly-paid British Electric Transformer shares, and the nominal price, 5s. paid, is "a small discount to a smaller premium." Shropshire and Staffordshire Electric Power 6 per cent. preference are quoted about 14s., the 5½ per cent. first debenture stock being 89. A small lot of Urban Electric Funded dividend certificates was sold the other day at a florin per £1. The preference remain at 27s. 6d., in spite of the dividend having just been passed.

Fairly numerous dealings occur in the new shares of the cable companies, and Westerns at 5 for the £1 paid and 13½ for the fully-paid are in some demand. Eastern Extensions are 4 7-16 £1 paid and 13⅜ fully paid. Eastern Telegraphs are 10s. 6d. for the 2s. paid and 27s. 6d. for the £1 paid, and the new Globes, £1 paid, are 4⅜ buyers. There is not much doing in the senior issues. Eastern ordinary is ¼ lower at 159½, and the others in this group show no movements. United River Plates drooped to 7⅞. West India and Panama fell to 15s. on the passing of the interim dividend. Marconis are again a poor market, the parent shares dropping back to 3⅜, and the new ordinary, issued at £3 and with 35s. paid, falling in unison to 36s. Canadian Marconis are dull at a shade above 10s., and Marines at 2⅛ have gone back slightly on the week. Anglo-Americans show no change. The 6 per cent. preferred offers good security and 7½ per cent. on the money, and the deferred yields the round 8 per cent. Telegraph Constructions at 22½ are again 20s. lower.

Most of the Mexican "securities" have gone back on account of the rebels' successes of the past few days. Brazilian Tractions eased off to 48½, but rallied to 50. The preferred at 81½ are 2 down. Bombay Electric preference at 12½ are another pound lower, the ordinary being 110. The Anglo-Argentine issues remain dull, and British Columbia Electric Rails are irregular. In the armament list, Vickers keep somewhat heavy on a good deal of provincial selling. The strength of rubber shares underwent some trifling modification as the price of the product slipped back to a florin per lb.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1918.	Dividend 1919.	Price May 11, 1920.	Rise or fall.	Yield p.c.
HOME ELECTRICITY COMPANIES.					
Brompton Ordinary	5	12	6⅜	– ¼	£9 6 1
Charing Cross Ordinary	4	7	8½	–	9 0 8
do. do. do 4½ Pref.	4½	4½	9¼	–	8 18 8
Chelsea	3	4	8	–	6 8 4
City of London	8	10	11½	–	8 6 4
do. do. 6 per cent. Pref.	6	6	9	–	6 13 4
County of London	7	8	9	–	8 17 10
do do. 6 per cent. Pref.	6	6	8⅜	–	6 17 2
Kensington Ordinary	6	7	4⅜	– ¼	7 7 5
London Electric	Nil	2½	1⅜	–	5 5 6
do. do. 6 per cent. Pref.	6	6	8½	–	9 4 8
Metropolitan	5	6	8	– ½	10 0 0
do. 4½ per cent. Pref.	4½	4½	2½	–	8 0 0
St. James' and Pall Mall	10	12	6¾	–	8 16 10
South London	5	6	3⅜	–	9 13 0
South Metropolitan Pref.	7	7	18/9	–	7 0 0
Westminster Ordinary	8	10	5½	–	9 10 6
TELEGRAPHS AND TELEPHONES.					
Anglo-Am. Tel. Pref.	6	6	77⅛	–	£7 14 10
do. Def.	22/6	1½	18⅜	–	8 0 0
Chile Telephone	5	6	6⅜	–	£4 12 2
Cuba Sub. Ord.	7	7	9⅜	–	£7 7 4
Eastern Extension	8	10	15⅛	–	£6 9 1
Eastern Tel. Ord.	8	10	159½	– ½	£6 5 5
Globe Tel. and T. Ord.	8	10	15⅜	–	£6 7 0
do. do. Pref.	6	6	8⅛	–	7 1 2
Great Northern Tel.	22	—	23⅛	–	9 15 6
Indo-European	12	10	40	–	6 5 0
Marconi	25	—	3⅜	– ⅛	7 8 0
Oriental Telephone Ord.	10	—	2⅛	–	8 11 0
United R. Plate Tel.	8	—	7⅞	– ½	£6 5 3
West India and Panama	1/8	—	⅜	– ⅛	—
Western Telegraph	8	10	15⅜	–	£6 7 0
HOME RAILS.					
Central London Ord. Assented	4	4	44⅜	–	8 19 9
Metropolitan	1	1½	20	–	8 8 0
do. District	Nil	Nil	17	–	Nil
Underground Electric Ordinary	Nil	Nil	2	–	Nil
do. do. "A"	Nil	Nil	5⅛	–	Nil
do. do. Income	5	4	63½	–	6 6
FOREIGN TRAMS.					
Anglo-Arg. Trams. First Pref.	Nil	Nil	3⅛	– ¼	—
do. do. 2nd Pref.	—	—	3	–	—
do. do. 5 Deb.	5	5	57⅛	–	8 18 10
Brazil Tractions	—	—	50	+1	—
Bombay Electric Pref.	6	6	12½	–1	4 16 0
British Columbia Elec. Rly. Pfce.	5	5	55½	+1	9 2 0
do. do. Preferrred	2½	5	48⅜	–2	10 6 2
do. do. Deferred	Nil	8	44⅜	–	6 14 10
do. do. Deb.	4⅜	4⅜	55	–⅜	8 8 6
Mexico Trams 5 per cent. Bonds	Nil	Nil	23½	–6	Nil
do. 6 per cent. Bonds	Nil	Nil	20	–	Nil
Mexican Light Common	Nil	Nil	12½	–	Nil
do. Pref.	Nil	Nil	17⅜	–	Nil
do. 1st Bonds	Nil	Nil	86	–	—
MANUFACTURING COMPANIES.					
Babcock & Wilcox	15	—	8	–	£5 0 9
British Aluminium Ord.	10	10	1⅛	–	9 8 9
British Insulated Ord.	12½	15	1⅛	–	7 14 8
Callenders	25	—	8/-	–	7 15 6
" 6½ Pref.	6½	6½	4⅛	–	6 16 10
Castner-Kellner	20	—	4	–	—
Crompton Ord.	10	—	22/-	–	9 1 10
Edison-Swan, "A"	10	—	1⅛	–	8 19 10
do. do. 5 per cent. Deb.	5	5	70⅜	–	6 5 9
Electric Construction	10	—	22/-	–1/-	9 1 10
Gen. Elec. Pref.	6⅛	6⅛	18/6	–	7 6 6
do. Ord.	10	—	1⅜	–	£6 8 1
Henley	25	15	2⅜	–	7 1 9
do. 4½ Pref.	4½	4½	8⅜	– ¼	6 18 6
India-Rubber	10	—	15½	–	£7 11 0
Met.-Vickers Pref.	—	8	2-⅛	+ ⅛	6 18 5
Siemens Ord.	10	10	25/6	–6d.	£7 11 9
Telegraph Con.	20	20	22½	–1	£6 6 9

* Dividends paid free of Income Tax.

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FURTHER REMARKS ON THE EFFICIENCY OF DOMESTIC ELECTRIC HEATING.

By G. W. STUBBINGS.

A RECENT series of articles in the ELECTRICAL REVIEW, from the pen of Mr. B. L. Klemens, has been written with the idea of demonstrating the superior over-all efficiency of the electrical method of domestic heating as compared with the use of gas. The conclusion arrived at by the writer of these articles is that the thermal efficiencies of the two processes are in the ratio of 18 to 14¾ in favour of electricity, such thermal efficiency being defined as the relation between a given number of heat units actually available for domestic use and the potential heat units contained in the coal used to produce the former number of heat units.

This conclusion is interesting, and as gratifying to electrical engineers interested in electricity supply as it seems to have been unpalatable to engineers connected with the gas industry. An examination of the arguments employed to arrive at this conclusion reveals a considerable lack of clearness, and the present writer has, therefore, gone afresh into the whole matter with the idea of setting out the problem in as concise a manner as possible. The results do not quite agree with those of Mr. Klemens, and it appears probable that sufficient justice has not been done to the claims of gas. A further examination of the case for electricity hardly makes it appear that Mr. Klemens's estimate of the efficiency of the electrical method is an unfavourable one, but rather one representing more or less ideal conditions not yet realised.

The method of domestic heating which, according to gas engineers, offers the maximum economy and advantages, is the use of certain of the products of the distillation of coal, by direct combustion, these products being gas and coke. The fact that other products have an enormous industrial value is of the highest importance, but not strictly relevant to the question of thermal efficiency. The fundamental data concerning the process of gas production, as accepted by Mr. Klemens, may be taken as follows :—

Average B.TH.U. per lb. of coal	13,000
Gas obtained per ton of coal destroyed ...	15,000 cb. ft.
Average B TH.U. per cb. ft. of gas	480
Coke obtained per ton of coal destroyed ...	8 cwt.
Coke used for the destruction of 1 ton of coal	4 „
Net yield of coke per ton of coal destroyed	4 „
Average B.TH U. per lb. of coke	11,000

From these data the efficiency of transformation from coal to gas can easily be obtained. Taking as a basis 1 ton of coal :—

B.TH.U. contained in coal	2,240 × 13,000 =	29,120,000
„ in resultant gas	15,000 × 480 =	7,200,000
„ „ „ coke	448 × 11,000 =	4,928,000
Total B.TH.U. in products of destruction of 1 ton of coal ...		12,128 000
Efficiency of conversion, 12·13 × 100/29·12 ...		= 41·5 %

The next factor to be considered is the efficiency of utilisation of the actual heat in the gas and coke by the consumer, and the data which have been furnished by the gas authorities, and accepted by Mr. Klemens, are as follows :—

Gas used in cooker and boiling-rings in equal quantities :
Efficiency of cooker, 13·6 %.
Efficiency of rings, 50 %.
Overall efficiency of utilisation of gas = ½ (50 + 13·6) = 31·8 %.
Efficiency of coke boiler, 60 %.

Considering again the products of destruction of one ton of coal, these are used as follows :—

4 cwt. of coke, containing 1·93 × 10^6 heat units at 60% efficiency.
15,000 cb. ft. of gas, containing 7·2 × 10^6 heat units at 31·8 % efficiency.
Over-all efficiency of utilisation = (7·2 × 31·8 + 4·93 × 60)/(7·2 + 4·93) = 43·0 %.

A figure of 41·5 per cent. is then arrived at as the efficiency of conversion of coal into coke and gas, and a figure of 43 per cent. as the efficiency of utilisation of the available heat content of these two products. Mr. Klemens, in one of his articles, apparently doubts the possibility of using the whole of this coke. This objection, however it may apply to purely domestic uses, ignores the many other possible uses of coke. One obvious use is for combustion under steam boilers for power-raising purposes, in which circumstances, it must be remembered, an efficiency of utilisation in the neighbourhood of 80 per cent. is quite practicable. It seems, therefore, that to accept an average figure of 60 per cent. for the efficiency of utilisation of the heat content of coke is not unjustifiable.

Using the two efficiencies arrived at, the over-all thermal efficiency of the gas method of heating is given by their product, and this efficiency is accordingly 0·43 × 0·415, or 17·8 per cent. This figure is appreciably better than that of 14·66 per cent. deduced by Mr. Klemens, and is practically the same as that taken by him to represent the over-all efficiency of the electrical method.

This latter figure of 18 per cent. requires examination. It is based on a 20 per cent. efficiency of conversion of the potential heat units of coal into electrical energy, and an efficiency of utilisation of this electrical energy of 90 per cent. With the latter figure few will quarrel seriously, although it may, perhaps, be taken to represent fair average, and not unfavourable, conditions. It must also be remembered that an efficiency of 90 per cent. will not apply to boiling appliances of the hot-plate type. The figure of 20 per cent. efficiency of generation of electrical energy, given by the gas authorities as the maximum possible with the most up-to-date plant and under most favourable conditions, is tacitly assumed by Mr. Klemens to be a low estimate of the actual efficiency obtainable under normal average conditions. It will, therefore, be interesting to see exactly what is meant by a 20 per cent. efficiency of conversion. This inquiry may conveniently be set out as follows :—

1 KW.-hour = 3,411 B.TH.U.

To produce 1 KW.-hour at consumer's service requires 3,411/20 % = 17,055 B.TH.U. at the works.
Average B.TH.U. per lb. of coal used for electricity supply, 11,000.
Lb. of coal containing 17,055 B.TH.U. = 17,055/11,000 = 1·55.
Lb. of coal per unit sold = 1·55.
Assuming 80 % of units generated reach consumers' terminals.
Lb. of coal per unit generated = 1·55 × 0·8 = 1·24.

A figure of 1·24 lb. of coal per unit generated can hardly be considered an unfavourable estimate from the point of view of electricity, and will perhaps for some considerable time only be possible with a high load factor. The probable load factor of an electric heating load would not appear to be high. But this would depend largely upon the popularity of electricity for heating purposes.

It may be interesting to assume an average good figure obtainable in present-day circumstances, and to see what over-all efficiency this leads to. The assumption of 2½ lb. of coal per unit generated will not be on the high side for the average undertaking, taken over an extended period, and assuming as before an efficiency of distribution, &c., of 80 per cent., this will correspond to 2·5/0·8 or 3·12 lb. of coal per unit sold. We then have—

1 KW.-hour = 3,411 B.TH.U.
Coal required to produce 1 KW.-hour = 3·12.
Average B.TH.U. per lb. of coal = 11,000.
Total heat units required to produce 1 KW.-hour = 3·12 × 11,000 = 34,320.
Efficiency of conversion = 3,411/34,320 = 10 % nearly.

It does not, therefore, seem unreasonable to conclude that from the standpoint of thermal efficiency, the gas authorities can offer a more economical system of domestic heating than can the electricity supply undertakings at the present time.

The most promising application of electricity for cooking purposes is to be found in the electric oven, possessing as it does the advantages of cleanliness and convenience, together with that of turning out better cooked food with a markedly less decrease in weight, than the gas oven can ever hope to do. These advantages should be sufficiently weighty to overcome any disability in point of thermal efficiency, but it will not be a waste of time to compare on this basis the

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gas with the electric oven. We have, then, considering the gas oven :—

Average efficiency of conversion of coal to gas and coke = 41·5 %.
Efficiency of utilisation of gas in oven, 13·6 %.
Overall thermal efficiency of gas oven = 13·6 % × 41·5 % = 5·65 %.

For the electric oven, on a present-day basis of 2½ lb. of coal per unit generated:—

Efficiency of conversion of coal to electrical energy = 10·0 %
Efficiency of utilisation ... ... 90·0 %
Over-all thermal efficiency of electric oven = 90 % × 10 % = 9 %

proving that from the standpoint of over-all efficiency, the electric oven is eminently superior to the gas oven.

The above figures relate to ultimate thermal efficiencies, and would show that although the use of the electrical oven gives superior results to those of gas, the combined efficiency of the whole of the domestic heating processes, including the provision of hot water, is more favourable with gas than with electricity. The fact that the use of electricity for heating purposes is making such rapid strides in no wise contradicts this conclusion, but simply indicates that ultimate thermal efficiency is not the only factor which fixes the value of any system of heating in the judgment of the actual user. A factor of far greater interest to the actual user is that of cost of operation, since it does not necessarily follow that a given amount of useful heat will cost the same whether produced by the combustion of gas or by electrical means. It may, therefore, be of interest to work out the comparative figures for the cases of a gas and an electric oven, taking for this purpose a basis of 3d. per unit for electricity, and 5s. per 1,000 cb. ft. for gas. We have, then :—

Cost of electricity per KW.-hour	... 3d.
B.TH.U. actually obtainable ...	... 3,411
Efficiency of utilisation in oven	... 90 %
Useful B.TH.U. per unit.	= 3,411 × 0·9 = 3,070
Useful B.TH.U. per penny	= 3,070/3 = 1,023
Cost of gas per 1,000 cb. ft. ...	... 5s.
B.TH.U. per cb. ft.	... 480
B.TH.U. obtainable per 1,000 cb. ft.	... 480,000
Efficiency of utilisation ...	... 13·6 %
Useful B.TH.U. per cb. ft.	= 480,000 × 0·136
Useful B.TH.U. per penny	= 480,000 × 0·136/60 = 1,088

On the basis assumed, which does not unduly favour electricity, gas and electricity are about equally advantageous as regards cost of operation.

It therefore seems clear that, as regards cost of operation, electricity will usually be more expensive than gas. But, again, it must be remembered that, however important cost of operation may be in industrial matters, it is not a factor of paramount importance in domestic life. If, for instance, means are required for boiling kettles of water in the scullery of a house, the use of a gas ring is rational, but if the same process is to be carried out in the dining room, the inferior ultimate thermal efficiency of the electric kettle will not stand in the way of its adoption, owing to the fact that on the score of cleanliness, convenience, and general desirability, it is the only possible device. It seems, therefore, that electrical men can be quite content with the manifold advantages of the apparatus they can place before the householder—which advantages are quite weighty enough to secure its introduction into a rapidly increasing number of homes—without claiming for such apparatus a thermal efficiency it does not really possess. The inherent thermal inefficiency of the process of the conversion of the potential energy of coal into the mechanical energy necessary to drive electrical machinery seems to preclude the possibility of electricity ever being the most economical method of producing domestic heat. Considerations of ultimate thermal efficiency are, however, of minor importance in a very large number of homes—comfort, cleanliness, and convenience being accounted of sufficient moment to ensure that electricity for heating purposes will find a rapidly increasing use.

Report on German Industrial Conditions.—Mr. Bonar Law states that a report of industrial and commercial conditions in Germany at the close of the year 1919 will shortly be published. Commercial Commissioners who are stationed at Berlin and Cologne will report periodically on the conditions in Germany.

FAILURES OF TURBO-GENERATORS AND SUGGESTIONS FOR IMPROVEMENTS.

At a meeting of the North Midland Centre of the Institution of Electrical Engineers, at Leeds on March 9th, Mr. J. Shepherd read his paper on the above subject, an abstract of which appeared in the Electrical Review of January 16th. The chairman of the Centre presided, and expressed the pleasure of the members at seeing Mr. Shepherd once more amongst them.

Opening the discussion, the Chairman said the trend of advance in any class of machinery was always at a very rapid rate of change. Mr. Shepherd was the first engineer who had had the courage to come forward and point out the absolute necessity now of considering the great step in advance. The difficulties of obtaining clean air had been very much brought to the front, and some of the members who were present some time ago would remember Mr. Helford's account of what happened to one of the Leeds machines that was nominally clean but really dirty. Mr. Shepherd had boldly brought forward the proposition that the whole machine should be one large water jacket, and Messrs. Parsons, who were always pioneers, had definitely produced a water-cooled rotor. Mr. Shepherd went a long way in advance of that. He recognised that they must tackle the vexed problem of the end turns. The great merit of his solution was that in introducing those new appliances he at the same time tried to adopt and improve on any of the old refinements in the way of supporting coils which had been found so necessary in improving the earlier types of machines. In fact, he attempted to go a great deal further in supporting coils than had been done yet. They could certainly record their appreciation of the courage and foresight which Mr. Shepherd had shown in writing his paper.

Mr. Johnson Wright said that stators had given them a rough time during the past thirteen years, and he (Mr. Wright) had had experience of many of the break-downs referred to. In the early days a great deal of the trouble on the stators was due to a loose core. He agreed with Mr. Shepherd that many of the soft cores were due to insufficient supports in the teeth. He could remember where the supports only consisted of one-sixteenth steel dead edge up against the lamination. The steel yielded and the teeth vibrated, and after a short time they broke and the machine was wrecked. Some of Mr. Shepherd's ideas for overcoming the trouble with rotors were original. The weak point was the end curve. Phosphor bronze had been shown to be absolutely unreliable, because they could not calculate—no matter how many test pieces they had—the strength of the material. The casting might look all right, but when the machine was put up it might be found all wrong inside. Mr. Shepherd had referred in his paper to steel bands, and these were the solution of the matter. The speaker favoured either a nickel chrome or a phosphor bronze cap. With the one with steel strip or phosphor bronze wire they had all the advantages of the metal as support and also the strength, because they could calculate the strength of a steel strip or phosphor bronze wire, whereas they could not ascertain the strength of a casting. With regard to rotors, there was a point always to be avoided in the design, to which Mr. Shepherd had not referred. It had been the practice a few years ago to make the rotor end conical in form, and the cap also conical in form. The idea was that the cap secured the winding. That was an excellent idea, but in the case he had in mind it was found that the tremendous end throws set up the centrifugal forces acting on the plane, with the result that a two-inch key was easily sheared off. Mr. Shepherd had shown on the screen photographs of machines made by Messrs. Parsons. He, personally, did not think that enough credit had been given to Messrs. Parsons for the development of the water-cooled rotor. It was a sound mechanical device, and the rotors ran remarkably well. As to the figure in which Mr. Shepherd showed a diagram of the stator on the water cooling principle, he did not much care for the idea of making an outlet at the coupling. It seemed to him it would be impossible to make a watertight running joint so that they could keep the water out of the alternator. Apart from finding room for the air ducts required in ships—with large machines up to 20,000 KW., it was a hard enough job to find room for the air ducts in a station. As far as ship propulsion was concerned, it seemed to him that water cooling had got to come sometime or another.

Mr. Brown said it did not matter whether they were dealing with 50,000-KW. or 5,000-KW. machines—there was the question of insulation. He supposed 95 per cent of the breakdowns in electrical machinery, particularly in some small-sized machines, were first of all connected with the failure of insulation. A few occasionally were due to mechanical weaknesses, but there was no question about it that what they needed to make a satisfactory machine was better insulation. The insulations which Mr. Shepherd had pointed out to them in those large machines were almost of necessity built up with mica in some form or other, but at the same time it was difficult to put mica in some machines. By

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reason of that one had to fall back on the ordinary cotton covering. It did not seem to matter much what sort of varnish they used or what method they adopted in the winding of the coils, it was not long, if the machine was allowed to get dusty or dirty, before they got insulation troubles. The point which the author had put before them with regard to the water-cooled machine, although it dealt largely with the larger machines, and the difficulty of obtaining clean air, seemed to point to him that there would be an opportunity even with medium sized machines, particularly where they were working in very awkward and dry and dusty situations. Quite a number of such places existed in the country, and if only a satisfactory method of water cooling could be adopted he was sure it would meet with a great deal of success. If better methods could be adopted for keeping down temperature, the machines could be run at a very much larger output than the normal rate. It had been mentioned that it was impossible almost to find out whether faults existed in phosphor bronze castings or not, but with X-rays inspection apparatus they could now pierce through five or six inches of metal, and he hoped that in due course they would be able to examine a casting to a very much greater extent than they could at present. The whole paper seemed to show what troubles there were even to-day with insulation, and he could only hope that Mr. Shepherd's paper would be the means of lessening a great many of their existing troubles in that direction.

Mr. Thorpe (Leeds) said that he would be interested to know whether Mr. Shepherd had considered the destructive effect of suddenly generating steam in the event of a heavy "short" producing local heat in the neighbourhood of the water-cooled elements. He (Mr. Thorpe) had had a good deal to do with the development of new ideas other than in electrical lines, and he knew the difficulties which had to be encountered by those who endeavoured to bridge the gap between the manufacturer and the user, and it was very satisfactory to come across a paper of this type.

In his reply, Mr. Shepherd said that the problem of cooling had only arisen within the last few years, and since the high speed machines first began to be introduced. Ever since 1879 designer after designer with one exception had constructed machines up to the present time relying on the imperfect way of cooling by blowing air through them. Now they had got to the size when the amount of heat to be got rid of approached that of a small condenser. When they got a "short" on a machine with a collective power behind it, at large stations he did not think any insulation supported in any other way than shown on the slides, that was by clamps here and there, would ever hold the coils adequately against those enormous forces. The time was coming when with high speed machines they would have to have stresses greater still. This would force them to introduce water-cooling or oil cooling, and when that had been done then they could face the redesigning of the supports something after the fashion which he had indicated. He was glad that Mr. Johnson Wright agreed that the safest band for supporting the rotor bindings was the high tensile steel one. Steel flexible bands and tape and wire had been used in the past, and had proved failures in a good many cases. Bands had failed for two reasons. They were put upon coils at a fairly high tension, and there was nothing to prevent a coil sinking under the pressure of the bands upon them. And, secondly, there was nothing to support the band except the coils, whereas if one had a device as shown on the rotor in fig. 9, there was an adequate way of centring and supporting a band quite irrespective of the coils under it, and with drawn steel wire tape they were dealing with the strongest and most reliable material known, because in its manufacture it was subject to stresses as high or higher than any which would be experienced in working. It had been suggested that he had hardly given sufficient credit to Messrs. Parsons. He would, however, remind them that on page 9 of his paper he had stated: "Various designs have been proposed using liquid cooling. Whilst the majority of them are of foreign origin the initial adoption of water cooling to modern machines is to be credited to Messrs. C. A. Parsons & Co., Ltd." He, Mr. Shepherd, would have said more when he wrote the paper if he had known, as he now knew, that Messrs. Parsons had made so many of their machines with water-cooled rotors, but it was not until he read his paper at Newcastle that he had the first opportunity of seeing their water-cooled machine. With regard to the criticism of the device shown in fig. 13, that that was merely a diagram of the discharge of the water at the coupling, and had certain objections, he quite agreed. That was only one way of getting rid of the water. Another way was to drill the rotor shaft and discharge the water at the low pressure end of the turbine. With regard to the size of cooling ducts with large machines, those were immense and of deep proportion. He did not see how with the usual amount of engine-room space one could find room for those ducts. In the paper he had given some figures of representative ships with the sizes of the cooling ducts necessary for air cooling, and in working out those sizes he had allotted a high air velocity of 2,000 ft. per minute. If they took that extreme example of modern engineering, the battle cruiser of 180,000 H.P., the diameter of the air duct for both the generators and the motors was 19.6 ft. in diameter. He supposed most of them had been on board a modern battleship, and had seen how the machinery was cramped together. In a very small space they would cram in something like 12,000 H.P. Of course, such condensation of power was only possible when oil fuel was employed. In such cases, to get in large air ducts became impossible. In answer to Mr. Brown, he would say that mica was certainly the best insulation provided it was applied correctly. An incidental advantage of water cooling was that they kept dust from the machine, and the presence of dust was a fairly frequent cause of surface leakage and breakdown. Mr. Thorpe had helped him very considerably in developing the idea of water cooling, so much so that it was difficult to say which were his opinions and which Mr. Thorpe's. He was much indebted to the latter for his suggestions. The question whether one should employ water or oil for cooling had been raised by various people. The advantage of water was that they could easily get it, and that its specific heat was about double. Therefore they had the maximum cooling effect with water over that of oil. If they were going to have leakage the question was, which would do least harm, water or oil? He should not recommend any method of construction in which there was any possibility of leakage, and with modern methods of construction one could construct devices in which there was little or no risk of leakage. There was, however, the possibility of a breakdown and subsequent leakage. In such a case, before they got right down to the core, he thought there would be no doubt but that the protective relays of the system would have operated, and the arc causing the burn out would have disappeared before it got within reach of oil or water. He would rather have water leaking into the machine putting the fire out round the insulation, than oil. The particular water device would be cut off. Hot water could be circulated round the remainder, and the machine could very rapidly be dried out, and unless the burn out was a very serious one the machine could be on load again very quickly. He did not think there would be any danger of any destructive effect as raised by Mr. Thorpe unless the relays hung up and the steam was discharged into a very active arc when there would be destruction. Generally they would have that destruction whether they had oil or water, but he could not contemplate on a big system a total failure of protective relays so that they would have water playing into an active arc.

A hearty vote of thanks was accorded to Mr. Shepherd for his paper.

ELECTRICAL PRECIPITATORS IN JAPAN.

A number of electrical precipitators have been installed in Japanese smelters since 1918 by the Metallurgical Research Institute, which owns the Japanese rights of the Cottrell process. The installations, according to *Chemical and Metallurgical Engineering*, are all similar, consisting of from one half to ten repeated sections, each containing 64 pipes, 12 in. in diameter and 16 ft. long. Ordinarily one motor generator serves two sections, each set comprising a 15-H.P., 50-cycle, 500-volt, 3-phase motor, a 10-K.V.A., 50-cycle, 200-volt generator, and a 10 or 15-K.V.A. transformer capable of giving 100,000 volts on the secondary.

At the Ashio smelter, Furukawa Mining Co., two treaters were installed in 1918; one to treat the mixed gases from four McDougall roasters, two copper blast furnaces, and four converters; and the other to treat the gases from a reverberatory furnace after having passed through waste-heat boilers.

The gases are drawn through the main treater and discharged directly from the fan casings, while those of the reverberatory furnace are drawn through the reverberatory treater by the natural draught of the stack. As the revergeratory furnace is not operating continuously at present, the gases and those of eleven pot roasters, four blast furnaces and four copper converters are mixed and treated entirely by the main treater. Thus the gas volume now handled by the main treater seems somewhat in excess of 150,000 cu. ft. per min., as designed. The amount of dust collected varies from six to ten long tons per 24 hr. The efficiency of precipitation seems to depend upon the nature of the furnace charge and the moisture and temperature of the gases treated. When the conditions are very favourable, it runs as high as 98 per cent., passing a white smoke, but sometimes it drops to about 70 per cent., when the smoke acquires a yellow tint. When the conditions are such that the charging voltage can be raised above 80,000 volts with a comparatively small increase of the current, precipitation is very satisfactory.

Several years ago a large dust chamber was installed, using the Roesing wire system. The gases passed from this chamber to four large stacks, in which they were diluted by the forced admission of fresh air, before being discharged into the atmosphere. The main treater was installed at the side of this dust chamber, so the gases pass through the dust chamber before going through the treater. The numerous suspended wires in the dust chamber were removed, so that only the heavier dust, which is of more value because of its higher

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percentage of metals, would be caught in the chamber and all the lighter dust which cannot be efficiently collected by gravity settling would be caught in the Cottrell treater.

The precipitated dust contains rather large quantities of the oxides of arsenic. These oxides are extracted by subliming the dust in a small reverberatory furnace, and the cinders resulting, which are quite rich in copper, are sent back to the pot roasters after being briquetted.

At the Kamioka smelter, Mitsui Mining Co., the gases passing through the treater come from the following furnaces: Three lead-smelting blast furnaces, two liquation furnaces, five softening furnaces, and all the lead-refining furnaces and kettles. The Kamioka smelter is located in the heart of the sericulture district, and the residents in the vicinity strenuously objected and demanded heavy indemnities, claiming that the smelter smoke damaged the mulberry leaves and killed the silkworms. Therefore, every effort was made to complete and start the Cottrell plant at an early date. About 1 to 1½ tons of dust are collected per day in a three-section treater.

At the Naoshima smelter, Mitsubishi Mining Co., the erection of a smelter was permitted by the Government on the condition that the smelter gases would be cleaned by the Cottrell process. The operation of the treaters was, therefore, begun when the smelter started up in March, 1919. It was designed for a capacity of 80,000 cu. ft. per min., assuming a velocity through the pipes of 5 ft. per sec. The lead-bearing fumes from the lead-smelting furnaces and the fumes from the McDougall roasters and converters of the copper smelter are mixed, and are both treated by the precipitator. Natural draught is furnished by a stack 150 ft. high and 10 ft. inside diameter.

The smelter being only recently started, the furnaces are not yet running at their full capacity and the gas volume handled runs from 40,000 to 45,000 cu. ft. per min. Visual clearance by an S-section plant is practically perfect. The dust collected every 24 hours amounts to about 1.5 tons.

The treater at the Ikuno smelter, Mitsubishi Mining Co., handles the gases from two blast furnaces smelting copper ores. After passing through an old dust chamber, the gases are drawn through the treater by an exhaust fan and are discharged from the old stack. At the first trial the treater showed good efficiency, but this lasted only a couple of days and then the operation became so unsatisfactory that the diminution of smoke could scarcely be recognised even when the treater was charged at a high potential. After experimenting in various ways, it was decided to humidify the gases, a practice which was found necessary for satisfactory precipitation in several American plant. A dozen orchard spray nozzles of 1-16-in. diameter arranged in the dust chamber using water at 120 lb. pressure per sq. in. injected a fine spray into the gases before they entered the treater. Thus precipitation was conspicuously improved and the efficiency raised to about 95 per cent., and at the same time the operator can raise the charging voltage to 80,000 volts while the current is only 30 amp. When, in order to examine the effect upon precipitation, the water sprays are turned off, the charging potential drops and the current increases so that the clearance becomes as low as 50 per cent.

The amount of dust precipitated per 24 hours is about 0.6 ton.

At the Nikko electrolytic copper refinery, Furukawa Mining Co., the gases from two cupellation and two reduction furnaces are treated to recover silver-bearing lead dust. The treater consists of one section of 32 pipes arranged in a rectangle. The treater was started in May, 1919.

The amount of the precipitate is about 100 lb. per 24 hours. The power consumption is comparatively high, being from 2.5 to 5 KW.

TRANSFORMERS FOR ELECTRIC FURNACES.

On March 23rd before the North Midland Centre of the Institution of Electrical Engineers, at Sheffield, Mr. J. Lindley Thompson, M.Sc., read his paper on "Transformers for Electric Furnaces," an abstract of which appeared in our issue of January 30th, 1920.

Mr. W. M. Selvey, who presided, said that there was no subject in which Sheffield had more right to take an interest than that of electric furnaces. Sheffield had by far the greatest percentage of furnaces in the kingdom, and Mr. Thompson had been actively concerned with the design of many transformers, not a few of which had been applied to furnaces in Sheffield.

Mr. Yerbury (Sheffield) thought the troubles with their transformers had been very largely attributable to their having to work on two-phase furnaces. He asked the author what conclusion his company came to regarding their investigation into the suggestion that certain transformer failures in Sheffield were attributable to resonance. Also what size of transformer should be the maximum, having regard to the heating effect, &c., on very large sizes. The recommendations on page 11 of the paper were excellent, and would doubtless be followed by those responsible for installing furnaces.

Mr. Hinings remarked that he was interested in the Berry furnace transformer, which was a circular-shell type, having a centre core upon which the windings were wound. It would have been interesting to members if the author had explained that and other unique designs which had been referred to. His (Mr. Hinings) firm had turned out a large number of transformers of the Berry type during the war. In fig. 1 of Mr. Thompson's paper, he noticed that the interleaving of the low-tension bars was carried right through to the furnace, so that actual contact could only be made on one side of the busbars. He suggested that it was better to bring that interleaving to just outside the top of the transformer tank, and then separate the polarities and connect the busbars to them. By that means contact on both sides of the busbars was obtained. The connection shown in fig. 1 appeared to be rather long compared with the width. If it was drawn to scale it measured 2 ft. 8 in. by 8 in., and required the use of a spring on each bolt for clamping. He would like Mr. Thompson to tell them if the bottom right-hand bolt in the side view of fig. 1 had to be phosphor bronze, or did he use steel? It seemed to him that that particular bolt came within a field which might cause trouble. He was interested to hear of Mr. Thompson's patent, but on looking up his firm's records he learned that the half-turn design was used by his company in the early part of the century, although it was not patented. They had had transformers of the half-turn design working quite satisfactorily during the last fifteen years. On page 2 of his paper Mr. Thompson made a great point of having the tappings in the middle of the winding. He (Mr. Hinings) contended that they were still liable to very high stresses, and required also to be reinforced. As far as the transformers were concerned, he could see no limit to the size, but it was a question whether the supply authorities could deal with the large loads of such an intermittent nature. Mr. Thompson had talked about 8,000 KW. furnaces. He wondered how many supply authorities could deal with them, especially if they were installed a long way from the generating station.

Mr. Redmayne said that the steel manufacturer found that by taking one and a half full load he could melt steel quicker. He did it, and the effect upon the transformer was harmful.

Mr. Walker said Mr. Thompson did not make any remarks on the type of switch gear, though that was an important item in furnace installation. In many cases they found the switch continually tripping, due to the time limit fuses blowing. He had often found the time limit fuse holder was discarded, and he had come across cases where a piece of No. 22 copper wire was wrapped round and round the contact clip. In one case of a bad breakdown which he thought was brought about by there being four strands of No. 22 copper wire across a time limit fuse, it blew the switch tank off, and played havoc with the transformer plant in general. He believed that the supply authorities in Sheffield had recommended that each switch should be opened out at least every month. Whilst once a month would do in ordinary cases, he personally thought that once a week or fortnight at least the oil tank should be lowered to note if the oil needed changing. In a month the oil was badly carbonised, at least it was so when the war was at its highest, and the transformers were worked hard. As to the transformers, could Mr. Thompson give them any idea as to how often he would consider a transformer winding should be lifted for examination?

Mr. Thompson, replying, said the troubles referred to were only in one case due to the transformer itself, through inefficient drawing out. All other troubles were traceable to faulty switch gear, bad lay-out of furnace connections, or to dampness in the sub-station, &c. On one transformer he remembered the high tension pressure flashed over from the high-tension lead to the low-pressure lead, a distance of something like 6 to 9 in. In that same sub-station another transformer flashed over in a similar manner—he thought it was due to moisture coming in through the roof of the station and causing the flash over. As to the maximum size of transformer which Mr. Yerbury inquired about, he did not think there was a maximum size. They could build up to any size of transformer within loading limits. There was no trouble in building transformers up to 50,000 K.V.A. The size of the transformer was limited by the size of the furnaces that could be made and used commercially. As to the 8,000 K.V.A. suggested, he would advocate that it be put in three units so as to facilitate handling and accommodation. The Berry transformer had certainly been used a great deal, and was in use with furnaces. Shell-type transformers were described in the paper, and he thought the same remarks applied to the Berry as to the shell types there described. As to the interleaving described by Mr. Hinings, he thought that would be for a transformer of somewhere about 500 K.V.A., and would be for transformers located directly under the furnace or close to it. He considered if they were to take a furnace transformer of 2,000 K.V.A. capacity and try to run it with a single set of positive and negative leads they would have no voltage across their furnaces when they got to the other end of the leads. With regard to the bolts shown in fig. 1, they made them of steel. The clamp plates of the clamps were made of phosphor bronze so that they had no magnetic circuit round the conductor. He did not think he had seen any transformer with a half turn other

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than that in which the half turn was taken out as a tapping and used as a starter with rotors. He knew several Berry transformers which had a half turn, but it was not on balance. It was out of balance, the catch got hot if it was run on that type. The patent covered all the plugs, &c. The suggestion that the tapping should be in the middle of the winding was not for the purpose of reducing the possible voltage pressure on the winding, but for reducing the voltage across the winding, and that led the voltage to the wires in connection with the winding. If the tappings were on the winding when they were working at the minimum high pressure the voltage across the whole of the wiring was in ratio. If they had an 11,000-volt transformer on low pressure of 75, 76, and 85, when they were working on the 85 tapping the voltage across the high-tension wires of that tapping was approximately 16,000. He agreed that the tappings, wherever they were, should be reinforced. The size of transformer would depend on the supply company's mains. If it was at a moderate pressure it would have to be almost directly on the station or adjacent to the station. He did not think there would be much trouble about bulk supply from large systems. In connection with the question of the currents, he found that on practically all the installations there was only one ammeter on the primary side of a three-phase set, which was very misleading, especially with a Scott-connected transformer group which might be taking 50 per cent. overload. In connection with two-phase furnaces, when the hearth was not conducting one transformer could easily be loaded to 50 per cent. above its normal value, whilst the meter on any one phase might only read normal. He had known cases where transformers had been running in that condition many days before anyone found it out so far as the load was concerned. It was a necessary condition in the case of two-phase furnaces in order to dry out the bed of the furnace when first putting it in. With regard to regulators, &c., there were one or two installations in the country where regulating transformers were used in preference to tappings. He did not know why they had not been more used, unless it was the question of cost and perhaps floor space. The question of switch gear had not been touched on in the paper since it was entirely in connection with the transformer, and the connections between the transformer and furnace that he was interested in, and could give most information upon. The oil ought to be examined at least once in six months if the transformer was run at anything like a reasonable percentage. The transformer should be lifted if the oil showed any sludge. The suggestion of having recording meters on the panels of the furnace transformer gear was quite a good one. In fact he thought they ought to be just as much used as with the steam supply. In several cases he knew of they had installed recording ammeters. He thought that the only reason they were not used more was because of the question of cost, and possibly the trouble of changing and re-changing the records.

A vote of thanks was accorded to Mr. Thompson for his very interesting paper.

HIGHLAND WATER-POWER.

On April 13th, 1920, Mr. J. M. M. Munro, M.I.E.E., A.M.I.C.E., gave an interesting lecture before the Scottish Centre of the Institution of Electrical Engineers, at Glasgow.

The lecture dealt with the nature, need, and urgency of a preliminary investigation of the entire field of national potable and power water supply, and the organisation necessary to undertake it.

The problem was fully to utilise and equably to distribute the whole water resources of the country for the maximum benefit of all. In the highlands of Scotland, where special conditions prevailed, the permanent interests of the local highland people must not be overlooked. Water power and improved transport were the keys of the only door separating the highlands from a fair share of national prosperity. If that door were not opened, the Highlands might become a second Ireland. Its people would not for ever consent to live upon a few sheep and the gratuities of sportsmen.

The preliminary inclusive general survey could most quickly be accomplished under the auspices of interim district Water Committees appointed by groups of County Councils.

Schemes ripe for accomplishment could be undertaken by permanent Area Water Boards. These boards would be semi-public local water authorities trading under statutory powers. A Government contribution towards cost would probably be necessary, but the main capital would be borrowed through local authorities and others demanding or reserving water or power supply. These boards would not distribute beyond their area, but would sell water there to local authorities, and electrical energy to the electricity district authorities. It was suggested that water rights be vested in County Councils empowered to collect from water boards a small taxation rate on water taken from their county. The object was a relief of oppressive rating in thinly populated counties.

Water schemes now outlined would be profoundly modified by detailed study of their areas. Insufficient preliminary information was available regarding localised rainfall on high and even on low levels, on seasonal and daily rates of outflow, on stream contour levels, on water storage possibilities, and on all the long series of items requisite for reliable planning and approximate costing of national water possibilities.

The extent and approximate value of lands to be eventually submerged, fishery rights, water power rights, amenities and numerous allied matters needed investigation and possibly parliamentary action before any proposition was approved. A complete national scheme must precede any area scheme.

The lecture closed with a short review of the possibilities of trade development in the Highlands as incidental to the general utilisation of the national water power resources for the national benefit.

ELECTRIC WATER HEATERS.

Where oil is fired under a boiler it is necessary to have steam to operate the oil pump and burner before the latter can be lighted. This necessitates firing with other fuel for a period before the main boilers are started in order to generate the auxiliary steam required. In order to save this fuel and to obviate the necessity of paying the fireman overtime, a Portland, Ore., U.S.A., manufacturer has, according to a writer in the *Electrical World*, introduced into his works two 10-kw. induction electric water heaters to generate sufficient steam to operate the oil pump and burner. These heaters are brought into operation by means of a time switch, and the pressure is controlled by a contact-making pressure gauge which is set to cut in the heaters at 60 lb., and to cut them out at 80 lb. pressure. The essential features of this installation, by means of which steam is made available when the factory commences work, are shown in fig. 1, in which A is

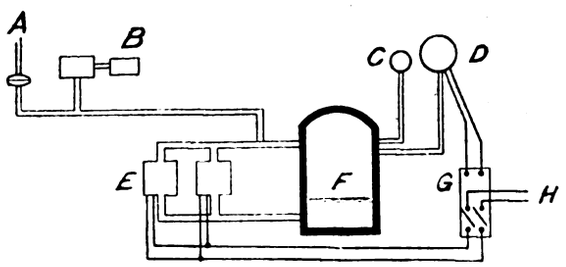

Fig. 1.—Electric Steam Generator.

the pipe line to the boiler; B the oil pump; C the indicating pressure gauge; D the contact-making pressure gauge to maintain the steam pressure within the limits stated above; E the induction water heaters; F the 50-gallon asbestos-lagged water tank; G the time switch; and H the 240-volt A.C. supply mains. It takes about one hour in the morning to obtain a steam pressure of 80 lb., and about 20 kw. hr. is consumed. The installation has been in use for over a year, and is giving every satisfaction.

There are a number of industrial undertakings in different countries which have isolated hydro-electric stations, and surplus electric power is ordinarily available under such conditions. If the electrical generating plant were operated at full capacity and the surplus power used, the revenue obtained therefrom would be practically 100 per cent. profit. For industrial purposes many undertakings require hot water or steam. If the surplus electric power mentioned above could be employed to heat the water, the cost of the fuel saved, less the capital and depreciation charges on the heater, would represent a net decrease in operating expenses. An electric water heater can be utilised either to heat water for direct use, or as a "temperature booster" in the boiler feed-water line between the usual feed-water heater and the boilers.

A very simple, rugged, and inexpensive electric water heater, built of ordinary standard wrought-iron pipe, for use under the circumstances outlined above, was described in a recent issue of the *General Electric Review*. The heater consists of a length of iron pipe, through which the water to be heated flows, and through the wall of which an electric current is passed, thus generating the heat.

A heater designed to absorb 1,000 kw. is shown in plan and elevation in fig. 2, while fig. 3 is a diagrammatic sketch of the complete system of water and electrical connections. The heater consists of three sections, in multiple so far as the hydraulic connections are concerned. Each section is built up of 10 lengths of 1.5-in. wrought-iron pipe, eight standard return bends, and one special return bend arranged to be

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connected to the busbars. The three sections are mounted side by side on asbestos lumber or other insulating supports, and are connected to the inlet and outlet headers E and D. All joints between the heater pipes and bends or headers, in addition to having standard pipe threads, are arc welded to prevent water leakage, and provide good electrical contact. The heater is enclosed in a chamber, the walls of which are built up of heat-insulating brick, with a cover that is easily removable for inspection. The dimensions of the complete heater are relatively small, and it may be connected, as shown in fig. 3, in an existing water system to "boost" the temperature with almost no disturbance to the system, the only changes required being the insertion of two pipe T's and the valve A. The inlet and outlet pipes, I and O, of the heater

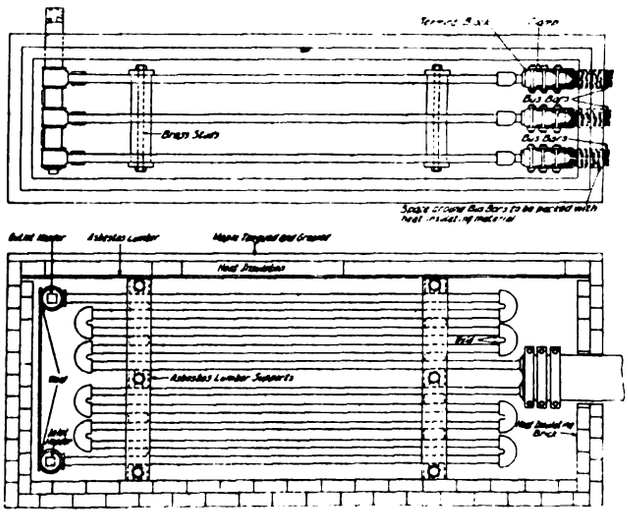

FIG. 2.—A 1,000-KW. IRON-PIPE ELECTRIC WATER HEATER.

are connected one to each of the T's, and have a valve in each pipe for cutting the heater out of the system. When the heater is in use valves B and C are open, and valve A is either wholly or partially closed, depending on the volume of water flowing through the main. Circulation is assisted by the cold water entering at the bottom and the hot water leaving at the top

An indicating flow meter is connected at I in the inlet pipe and determines the correct opening of the valve A to give the desired water flow through the heater. The instrument may be made to trip the oil switch when the water flow falls to a predetermined minimum value, or, when the heater is used

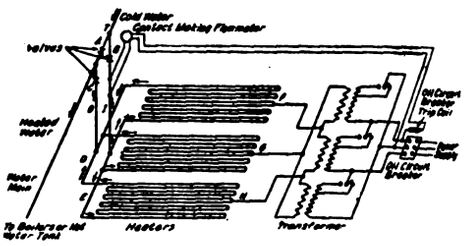

FIG. 3.—HYDRAULIC AND ELECTRICAL CONNECTIONS OF HEATER.

intermittently, to close the switch when the flow exceeds the minimum safe value. Thus the operation of the heater can be made automatic. From the electrical line terminals F, G, and H, the three heater sections constitute three electrical resistances connected together by the headers E and D. The three sections are similar with equal resistances, and if the terminals F, G, and H are connected to a 3-phase supply of suitable voltage, the power input will constitute a balanced 3-phase load. On the 1,000-KW. heater in question, 50 volts are required across the terminals supplied by a water-cooled, 3-phase, step-down transformer. The entire equipment, heater, transformer and switchboard occupies a floor space 8 ft. by 12 ft. and a height of 9 ft.

At first sight it would seem that the operating power factor of a device using iron pipe to carry a heavy A.C. must be low, but this is not the case. As the current density is increased the ratio of reactance drop to resistance drop decreases with a consequent increase in power factor. A curve plotted from actual test results on an iron-pipe water heater operating on a 40-cycle circuit at a current density high enough to take full advantage of the foregoing characteristic, shows that a power factor of 90 per cent. on a 40 or 25-cycle, and 80 per cent. on a 60-cycle circuit is realised. Under average conditions the over-all efficiency, including transformer losses, should always be above 90 per cent.

The saving that can be effected by the utilisation of surplus electric power to heat water that would otherwise have to be heated by purchased fuel is in most cases estimated to be sufficient to make the installation of a heater of the type described above well worth while.

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

An Electric Clothes Drier.

The *Journal of Electricity* recently gave the following details of an electric clothes drier (fig. 1), invented by an American. This is built for use in the home, and has approximately the same capacity as the average washing machine. It operates on the centrifugal principle, the outer diameter of the basket which contains the clothes travelling at 7,000 ft. per minute, throwing the water out, which in turn is replaced by air

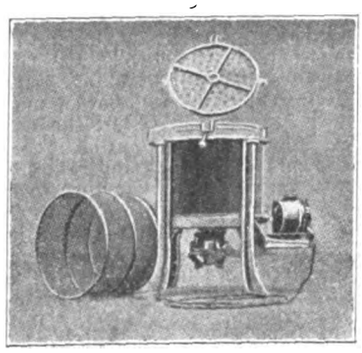

FIG. 1.—ELECTRIC CLOTHES DRIER.

drawn in from the centre and forced through the clothes. It will dry for ironing in from 12 to 15 minutes with no danger of injury to the finest piece of material and no broken buttons.

The machine occupies a space of 24 in. by 30 in. and stands 26 in. high, weighing approximately 200 lb. It is operated by a ½-H.P. electric motor through a governor clutch mounted on the driven shaft, and is automatic in its action in picking up the load, the load also governing the clutch. This clutch makes it possible to start with a motor just big enough for running the load.

A New Squirrel-cage Rotor.

MESSRS. HIGGS BROS., of Dynamo Works, Sherbourne Road, Balsall Heath, Birmingham, have recently patented a bar-winding particularly applicable to squirrel-cage rotors, constructed in the following way:—Drawn copper of suitable rectangular section is used. Before this is inserted in the rotor, one end of the bar is twisted at right angles to itself, and then inserted in the rotor core, as shown

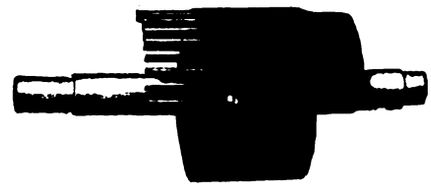

FIG. 2.

in fig. 2. The rotor is designed so that these bars, when inserted, practically touch one another at the ends. When all the bars are assembled, the other end of each bar is also bent at right angles, then the ends are welded between the joints. The finished rotor is shown in fig. 3. The advantages of the rotor constructed by this method are obvious. The usual rotor end rings are entirely dispensed with. The extension of the bar itself forms the ring. No flux or

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brazing compound is used in making the joints, only pure electrolytic copper throughout. They are preferably welded with oxy-acetylene apparatus, and when this is done the ends of the bar are a continuous ring. It is a sound mechanical job, and there is not the usual fear of nuts, bolts, and screws coming loose. When the rotors are constructed and the end rings cast on, there is always the chance of poor joints. A

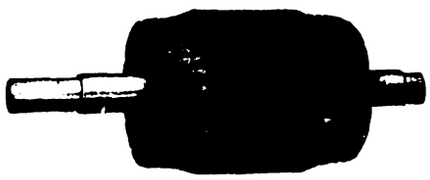

Fig. 3.

large number of these rotors are in use, and not in a single instance has a complaint been received regarding them.

Battery Testers.

The H.B. Shontz Co., of New York, has, after lengthy experiments, recently placed on the market the "Shuro" cell tester, of which we give an illustration (fig. 2). The instrument, which has been specially designed to meet the requirements both of garages and private car owners, is provided with a simultaneous volt-ammeter, mounted in such a position that it can be easily read, and is amply protected, the light above the instrument giving a clear indication of the condition of the battery. In the volt-ammeter the upper scale indicates volts from 0 to 2, and the lower one amperes from 0 to 250, the accurate voltage and amperage of the cell to which the tester is applied being thus recorded under a

Fig. 4.—The Shuro Battery Tester.

discharge test. Thus, if an eleven-plate cell shows 1.55 volts and 180 amps., it may be regarded as doing well. The makers point out, however, that voltage is not always a true guide to the condition of a battery, as all the cells may be low and uneven, and need only a recharge. Trouble is, on the other hand, present when a cell stands at 0.1 volt or more below the remaining cells, which are strong and show no tendency to weaken when the tester is connected. The device is claimed to test every cell of a battery individually and under full load, indicating the current and the voltage of each cell. A bright light is shown by the lamp when the cell is strong and a dim light when the cell is weak. The instrument, which weighs 2 lb., requires the use of a special 1½-volt bulb.

Another American invention of a similar nature is the Springfield high-rate discharge instrument, made by the Service Products Co., of Springfield, Ohio, of which an illustration is given herewith (fig. 5).—It is intended for use in the detection of damaged or faulty cells, and, as will be seen, comprises a voltmeter with reading 2-0-2, graduated in tenths, mounted on two steel posts which terminate in a convenient handle. When the points of the instrument are brought into contact with the terminals of the battery with a steady pressure and wiping effect, the current is through a fixed resistance which determines the rate of discharge. The resistance has a current capacity of 80 amps. cold and 70 amps. when hot. If the insulation of a cell is defective, the needle will gradually recede towards the centre as the high-rate discharge takes place, while if the cell has an open circuit or broken connection inside or outside, the finger will remain at zero. The instrument will not only be found useful in the accumulator repair depart-

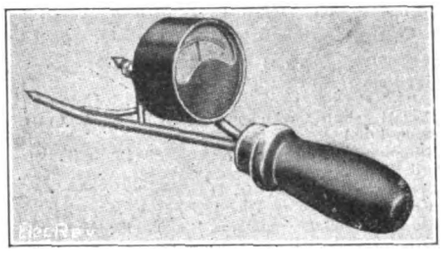

Fig. 5.—The Springfield Battery Tester.

ment of motor garages, but it can be used to test batteries *in situ*, the test of each cell only lasting from 10 to 20 seconds.

Milli-ampere Meter for the Blind.

A unique adaptation of a standard milli-ammeter has recently been made by the General Electric Co., Ltd., 67, Queen Victoria Street, E.C.4. In connection with electro-therapeutics a milli-ammeter was required which could be conveniently used by the blind to enable them to measure or maintain a definite value of current. An instrument, which reads from 0 to 50 milli-amperes, is provided with an external

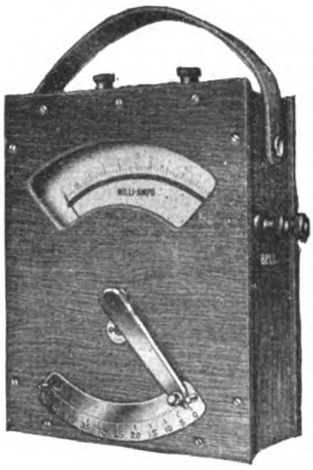

Fig. 6.—Milli-ampere Meter for the Blind.

arm moving over an embossed scale with the calibration similar to the instrument scale. Attached to this movable arm in the interior of the instrument are two contacts, either of which makes electrical connection with the pointer of the instrument. When in use the arm is set at the reading desired, and by means of a clear toned bell ringing when the pointer is touching one contact, and a muffled toned bell ringing when touching the other, the operator is able with a regulating resistance to obtain any desired current. On the other hand, if it is desired to read the current flowing, the instrument is placed in circuit with the movable arm set at zero, and as soon as the current is switched on, the clear bell commences to ring and continues to do so until the operator swings over the arm beyond the position of rest of the pointer of the instrument. The muffled bell then rings, and by a nice adjustment of the movable arm a position can be obtained in which neither bell will ring, when the reading can be taken from the embossed scale.

Electropercussive Welding.—The *American Machinist* recently published an article on the method of joining wires by connecting to the terminals of a charged condenser and bringing them suddenly together. Sufficient electrical energy is liberated by the discharge to melt the wires, while the force of the blow welds them together. A machine suitable for jointing aluminium and other wires up to No. 13 gauge is described. One wire is held in a chuck at the base of the apparatus, while the other is clamped into a holder free to slide in vertical guides. The holders are connected to the terminals of an electrolytic condenser by a circuit containing an adjustable inductance, and are kept short-circuited till required. The condenser is coupled up to a source of supply through resistances. The wires have their ends prepared by a special cutter, the switch is opened and the upper holder is allowed to fall, when, if all adjustments are correct, a perfect weld is immediately made. Oscillographic tests with No. 18 B. & S. aluminium wire show that the power expended at the weld reaches 23 kw. for an instant, but the entire weld is made in 0.0012 sec.; the total energy is about 0.00000123 kw.-hour per weld. The process is well adapted to welding copper connections to aluminium.

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NEW PATENTS APPLIED FOR, 1920.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by MESSRS. SEFTON-JONES, O'DELL AND STEPHENS, Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

11,488. "Application of electricity to heating of hot-bulb internal-combustion engines for starting, &c." W. BLAIR and T. J. HEATLIE. April 26th.

11,493. "Portable electric vacuum cleaners." G. A. CELLI. April 26th. (Italy, April 24th, 1919.)

11,516. "Framework of magneto armatures." L. E. BRUNER and P. J. M. LEFEVRE. April 26th.

11,519. "Conversion of electric currents." SIEMENS-SCHUCKERTWERKE. April 26th. (Germany, February 7th, 1917.)

11,560. "Electric welding apparatus." T. E. MURRAY. April 26th. (United States, May 2nd, 1919.)

11,590. "Electrical method of reproducing distant scenes visually." B. F. S. BADEN-POWELL. April 27th.

11,616. "Electrical connectors for electric heating, &c., appliances." C. H. ARCHER and AUTOMATIC TELEPHONE MANUFACTURING CO. April 27th.

11,617. "Telephone systems." AUTOMATIC TELEPHONE MANUFACTURING CO. and C. GILLINGS. April 27th.

11,618. "Call indicators." AUTOMATIC TELEPHONE MANUFACTURING CO. April 27th.

11,624. "Spark plug." J. M. MCKERNAN. April 27th.

11,625. "Combination switches." R. K. WINNING. April 27th.

11,638. "Harmonic generator or regenerator." WESTERN ELECTRIC CO. April 27th. (United States, April 28th, 1919.)

11,658. "Impregnating paper, &c., with electrical insulating compounds, &c." C. J. BEAVER and E. A. CLAREMONT. April 27th.

11,662. "Sparking plugs." G. HOWELL. April 27th.

11,665. "Portable electric lamps." L. FULLER and FULLER'S UNITED ELECTRIC WORKS. April 27th.

11,667. "Wireless telephony and telegraphy." H. MORRIS-AIREY, H. L. CROWTHER and L. A. MCDOUGALD. April 27th.

11,718. "Electric torch and attachment for motor-vehicles." R. S. PATERSON. April 28th.

11,721. "Terminal for cables for ignition and electrical systems on internal-combustion engines." R. S. PATERSON. April 28th.

11,725. "Sparking plugs." E. S. ROBERTS. April 28th.

11,731. "Electric side lamps of motor vehicles and attaching lens to lamp body." A. GEORGE and F. H. LEES. April 28th.

11,733. "Toy electric motors." F. HORNBY. April 28th.

11,735. "Wireless telegraphy systems of the arc gap type." L. T. BARKER. April 28th.

11,748. "Means of supporting electrodes in vacuum tubes for wireless telegraphy, &c." F. O. READ & CO. and J. SCOTT-TAGGART. April 28th.

11,757. "Sparking plugs." R. COLIN. April 28th.

11,771. "Method of making spark-plug insulators." A. E. ALEXANDER. (General Ceramics Co.) April 28th.

11,774. "Automatic circuit-breaker." FILBAR ELECTRIC HEATER, LTD., and C. KRATT. April 28th.

11,777. "Electric distant control apparatus." SOC. DITE DA ET DUTILH. April 28th. (France, May 26th, 1919.)

11,782. "Combined electric dynamo or motor and pump." A. E. SHINER. April 28th.

11,791. "Ignition devices for internal-combustion engines." H. W. F. IRELAND, H. LUCAS and J. L. MILLER. April 28th.

11,798. "Distributors for magneto-electric machines." C. B. REDRUP. April 28th.

11,819. "Magneto-electric machines." BRITISH THOMSON HOUSTON CO. and A. P. YOUNG. April 28th.

11,824. "Means for starting internal-combustion engines." A. J. ADAMS. April 28th.

11,837. "Conduits for electrical conductors." C. S. DAVIDSON and C. E. MORRIS. April 29th.

11,842. "Electric switches." W. A. LEGGE. April 29th.

11,849. "Sparking plugs." T. L. CLARK. April 29th.

11,852. "Ceiling-rose for electric wires or cables." A. J. ROWLEY. April 29th.

11,880. "Dynamo-electric machines adapted for synchronous working." L. J. HUNT and SANDYCROFT, LTD. April 29th.

11,888. "Electrical indicators for railway signal, &c., amps." W. H. I. WELCH. April 29th.

11,894. "Machine switching telephone exchange systems." WESTERN ELECTRIC CO. April 29th. (United States, September 14th, 1917.)

11,895. "Electrical condensers." J. JOSEPH and H. W. SULLIVAN. April 29th.

11,902. "Sparking plugs." J. W. E. LAKER. April 29th.

11,903. "Electrical apparatus." AJAX, LTD., C. A. COOPER and D. F. SELL. April 29th.

11,904. "Duplex and multiplex telegraphy." EASTERN TELEGRAPH CO. and B. DAVIES. April 29th.

11,930. "Electric fly switches." C. A. DAMEY. April 29th.

11,934. "Recovery of zinc by electrolysis." ELECTROLYTIC ZINC CO. April 29th. (Australia, December 24th, 1919.)

11,935. "Electric switches." G. GALLO and F. VILLARBOITO. April 29th (Italy, April 29th, 1919.)

11,936. "Electric switches." G. GALLO and F. VILLARBOITO. April 29th. (Italy, April 29th, 1919.)

11,941. "Electric generators." J. GORDON HALL. April 29th.

11,943. "Sparking plugs." E. & F. COOPER. April 29th.

11,952. "Resistance elements for electric muffle furnaces, melting furnaces, &c." A. IMBERY. April 30th.

11,957. "Holders or fittings for incandescent electric, &c., lamps." W. E. SHUTTLEWORTH. April 30th.

11,971. "Holder for electric welding." G. UGLOW. April 30th

11,976. "Device for utilisation of tidal power for driving dynamos. &c." G. DAVIES. April 30th.

11,998. "Preventing oxidation of electrical, &c., apparatus." F. C. PERREM. April 30th.

12,006. "Electric lamp holders." W. A. I. BOOTH. April 30th.

12,015. "Combined electric switch terminal." G. B. ANDERSON and B. BUCKNALL. April 30th.

12,022. "Electric immersion heaters." J. NOLAN. April 30th.

12,028. "Electric heating resistances." THERMOS AKT. GES. April 30th. (Germany, January 16th, 1915.)

12,029. "Electric heating appliances." THERMOS AKT. GES. April 30th. (Germany, December 5th, 1914.)

12,035. "Die for wrapping paper on wire, &c." E. A. CLAREMONT. April 30th.

12,043. "Method of preventing loss of zinc in electric battery." A. POUCHAIN. April 30th.

12,053. "Telephone systems." WESTERN ELECTRIC CO. April 30th. (United States, May 21st, 1919.)

12,056. "Trip mechanism for electric ignition devices for internal-combustion engines." A. J. ADAMS. April 30th.

12,057. "Trip mechanism for electric ignition devices for internal-combustion engines." A. J. ADAMS. April 30th.

12,064. "Electric resistance materials." W. C. G. HALWARD and J. J. M. KLUYTMANS. April 30th.

12,070. "Electric heaters." D. ANDERSON and C. SCOTT-SNELL. May 1st.

12,102. "Automatic electro-magnetic accumulator charging switch." J. TAYLOR. May 1st.

12,111. "Active material for electric accumulators." H. LEITNER. May 1st.

12,120. "Electricity meters." CHAMBERLAIN & HOOKHAM and S. JAMES. May 1st.

12,135. "Electric welding." J. E. POLLAK (Maschinenbau Akt. Ges. Seebach). May 1st.

12,143. "Process for manufacture of refractory and insulating products." J. E. DELAUNAY and G. L. DIMITRI. May 1st. (France, November 21st, 1916.)

12,145. "Process for manufacture of refractory and insulating products." J. E. DELAUNAY and G. L. DIMITRI. May 1st. (France, July 16th, 1918.)

12,146. "Electric valves." G. GILES. May 1st.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

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5,321. SIGNALLING LAMPS. A. C. W. Aldis and C. J. Burke. April 11th, 1916. (Complete accepted, November 17th, 1916. Patent sealed, November 17th, 1916.) (141,077.)

1918.

2,153. MACHINE-SWITCHING TELEPHONE SYSTEMS. Western Electric Co., L. Polinkowsky, J. G. Hackley and G. Deaken. (Western Electric Co. and C. E. Stevens, in part.) February 6th, 1918. (141,080.)

3,333. MACHINE SWITCHING TELEPHONE EXCHANGE SYSTEMS. Western Electric Co. and L. Polinkowsky. (Western Electric Co., in part.) February 25th, 1918. (141,081.)

3,530. MACHINE-SWITCHING TELEPHONE EXCHANGE SYSTEMS. Western Electric Co. and L. Polinkowsky. February 27th, 1918. (141,083.)

10,864. REGULATING DEVICE FOR DYNAMO-ELECTRIC MACHINES. O. Imray (Bosch Akt. Ges., R.). July 2nd, 1918. (141,084.)

20,168. SHADED POLE MOTORS AND THE LIKE. E. S. Carey. December 5th, 1918. (141,099.)

20,254. MANUFACTURE OF ELECTRIC-DYNAMOS AND MOTORS. A. Lyon & Wrench, T. L. R. Cooper and J. C. Todman. December 6th, 1918. (141,101.)

21,930. AUTOMATIC TELEPHONE EXCHANGE SYSTEM. Sterling Telephone & Electric Co. and W. C. Davey. December 31st, 1918. (141,106.)

1919.

216. DYNAMO-ELECTRIC MACHINES. E. J. Harman and E. Le Bas. January 3rd, 1919. (141,116.)

370. PROTECTIVE DEVICES FOR ALTERNATING CURRENT ELECTRIC DISTRIBUTION SYSTEMS. British Thomson-Houston Co. and E. B. Wedmore. January 6th, 1919. (141,121.)

3,753. DEVICES FOR INDICATING THE POSITION OF ELECTRIC SWITCHES, GAS FITTINGS, OR THE LIKE IN ROOMS OR OTHER PLACES. J. E. Arnold. August 14th, 1919. (141,150.)

4,166. ELECTRIC REGULATOR OF THE INDUCED-CURRENT MOTOR TYPE. G. di L. Pestarini. February 19th, 1919. (141,154.)

6,320. ELECTRICAL STEAM-GENERATING PLANTS. H. Pfenninger. March 13th, 1919. (141,170.)

7,960. FASTENING OF METAL BASES TO GLASS VESSELS SUCH AS ELECTRIC INCANDESCENT LAMPS. British Thomson-Houston Co. (General Electric Co.). March 29th, 1919. (141,182.)

8,448. RECEIVING METHODS OF RADIO-TELEGRAPHIC AND RADIO-TELEPHONIC SIGNALS. C. Bardeloni. October 3rd, 1916. (141,185.)

8,608. ELECTRIC RESISTANCE DEVICES. C. L. Browne and S. H. Heywood & Co. April 5th, 1919. (141,188.)

9,168. WIRELESS RECEIVING AND TRANSMITTING APPARATUS. J. Erskine-Murray and J. Robinson. April 10th, 1919. (141,190.)

10,112. DELAY-ACTION ELECTRIC SWITCHES. J. W. White. April 23rd, 1919. (141,195.)

12,765. OPERATING AND TRIPPING MECHANISM OF OIL BREAK ELECTRICAL SWITCHES. R. T. Norton. May 21st, 1919. (141,217.)

13,552. ELECTRIC CONTROL GEAR FOR DYNAMO-ELECTRIC MACHINES. R. H. Barbour and J. R. Walton. May 29th, 1919. (Cognate application 29,826/19.) (141,225.)

14,305. DIRECT-CURRENT DYNAMO-ELECTRIC MACHINES. B. J. Shillito. June 5th, 1919. (141,231.)

14,350. ELECTRIC TRANSFORMERS. Vickers, Ltd., and F. R. Baerlocher. June 5th, 1919. (141,232.)

14,417. CONSTRUCTION OF SPARKING-PLUG FOR INTERNAL-COMBUSTION ENGINES. G. H. Negus. June 6th, 1919. (141,233.)

14,792. DISTRIBUTION FOR IGNITION APPARATUS. C. Olivetti. June 11th, 1919. (141,238.)

15,910. FIELD TELEGRAPH AND TELEPHONE EXCHANGES. A. A. Clarke and E. E. Price. June 24th, 1919. (141,243.)

19,721. MAGNETO-ELECTRIC IGNITION APPARATUS FOR INTERNAL-COMBUSTION ENGINES. Scintilla. September 13th, 1918. (132,498.)

21,151. WIRELESS TELEGRAPHY AND THE LIKE. C. P. Ryan. August 29th, 1919. (141,269.)

22,172. ADJUSTMENT FOR TOOTHED WHEELS IN MAGNETO-ELECTRIC IGNITION APPARATUS FOR INTERNAL-COMBUSTION ENGINES. Scintilla. October 1st, 1918. (133,296.)

25,930. MEASUREMENT OF THE WATTLESS COMPONENT OF ALTERNATING ELECTRIC CURRENT POWER. S. Z. de Ferranti, G. Wall and Ferranti, Ltd. October 22nd, 1919. (Addition to 137,090.) (141,285.)

26,715. ELECTRIC-SWITCHING MECHANISM. Westinghouse Electric and Manufacturing Co. October 30th, 1918. (134,543.)

28,695. ELECTRIC SWITCHES FOR CONTROLLING ELECTRICALLY-HEATED APPARATUS. H. Jaggi-Zumbuhl. June 21st, 1919. (141,294.)

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1,475. ELECTROLYSERS. G. G. Hepburn. February 22nd, 1919. (Divided application on 139,296.) (141,305.)

5,738. AUTOMATIC TELEPHONE EXCHANGE SYSTEM. Sterling Telephone and Electric Co. and W. C. Davey. December 31st, 1918. (Divided application on 141,106.) (141,310.)

5,868. AUTOMATIC TELEPHONE EXCHANGE SYSTEM. Sterling Telephone and Electric Co. and W. C. Davey. December 31st, 1918. (Divided application on 141,106.) (141,311.)

5,869. AUTOMATIC TELEPHONE EXCHANGE SYSTEM. Sterling Telephone and Electric Co. and W. C. Davey. December 31st, 1918. (Divided application on 141,106.) (141,312.)

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THE

ELECTRICAL REVIEW.

VOL. LXXXVI. MAY 21, 1920. No. 2,217.

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THE RATING OF MACHINERY.

THE remarkable change in money values which has taken place during the past few years is, of necessity, causing considerable anxiety among business men throughout the country. It is a difficulty which crops up at every turn, because there are undoubtedly many cases in which serious hardships will be caused if the practice of stereotyping present values for any considerable number of years ahead is resorted to, as is threatened in some instances. The problem is a peculiarly difficult one with regard to the rating of property generally, and whilst we believe a broad view may be taken in the matter of general rating, when the quinquennial assessment is finally made this year, signs are not wanting that in relation to the rating of machinery, the full pound of flesh will be demanded.

An important principle is at stake here, because conditions are so fluctuating that whilst he would be a rash person who would foretell any fall in the cost of labour, nevertheless the ordinary laws of economics will almost certainly come into play to bring about reductions in other directions, yet what do we find some assessment authorities doing in the matter of machinery assessments? The new valuation lists have not yet been prepared throughout the country, but it is known that in some instances where they have been prepared, the assessments have been doubled and even trebled. Hasty action of this sort is seriously to be deprecated, and we can only imagine it is based on the principle which was so strongly put forward in connection with the Profiteering Act, that a man could not be said to be profiteering if he charged for an article a price based on the cost of replacing it. If the basis of the new assessment is to be the replacement value of all existing plant, then, indeed, will an intolerable burden be placed upon industry, and every step must be taken to bring that point before the various Unions.

We are aware that the authorities in London are averse to stereotyping future legislation too much upon present conditions, but although it may be said that a new valuation will be made in five years' time, our knowledge and experience of rating authorities is such that we would rather not have the trouble and expense of arguing the case for a reduction at the next quinquennial valuation. One of the leading valuation authorities in London recently, before a Parliamentary Committee, expressed the view that values would eventually settle down at about 70 per cent. above the figures of 1914, and that is a long way from the 200 and more per cent. which we are informed is being placed upon existing assessments by some authorities. There is need for concerted action, and it is satisfactory to note that the Machinery Users' Association is keenly alive to the injustice which may well be perpetrated unless a watchful eye is kept upon rating authorities as a whole. Unhappily, it is no uncommon thing for Government Departments to differ, and although there is a desire on the one hand on the part of Departments which have not to collect taxes, to go warily, on the other hand, it cannot be overlooked that in giving evidence before the Select Committee on War Wealth, the officials of Somerset House expressed the view that values in future should be

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taken on the present basis. From more than one point of view that is undeniably an unsound doctrine, desirable though it may be from the tax-collector's point of view.

In the first place, such an expression of opinion will inevitably react upon the authorities throughout the country, without investigation of the premises upon which it was based, or the circumstances in which it was offered to the Committee. More important than that, however, is the position in which manufacturers and machinery users will be placed where, as is the case almost invariably, plant exists which was bought several years ago. This merely serves to emphasise the serious position of machinery users. Much plant bought years ago can only be replaced or repaired at a very high cost, and under great difficulties even then. The result is that, if assessments are to be made upon present values, there will be a large amount of partly worn-out machinery standing in books at excessive values. In the present condition of trade, every encouragement should be given to machinery users to put their works in good order, quite apart from the general unsoundness of the policy of stereotyping the future upon a condition of affairs which must inevitably change for the better to some extent within the next few years. There ought clearly to be a differentiation between machinery, and the purchase price, with an adequate allowance for depreciation, is the only logical and sound basis.

An Epoch-Marking Paper.

THERE is, it must be confessed, a certain lack of distinction about many of the I.E.E. papers; while they are often of very great technical interest and value, they seldom touch that pitch which, like Duddell's lecture on the arc, arouses the audience to enthusiasm and marks a day with a red letter in the annals of science. But on Thursday last week Mr. Sydney Evershed, whose papers are rare but always superlatively good, once more came forward with a masterpiece of scientific literature, worthy to rank with the most noted essays on electrical science that the Institution has been privileged to hear. Indeed, in the discussion, his paper was declared to do for permanent magnets what Dr. Hopkinson's did for electromagnets, in that it swept away the devices of empiricism and established the subject on a sound scientific foundation.

The paper itself was somewhat uninviting in appearance; it offered 46 pages of good hard reading, on a subject with which the majority of the audience had little direct association. But the lecture which the author delivered, without the aid of notes, put a wholly different complexion on the matter. Lucidly expressed, and relieved by sparks of dry humour, it lightly traversed the whole field of the 20 years' work embodied in the paper, and leading on from molecular theory to experimental study, finally made it clear that the author had found a key to the secrets of permanent magnetism—a key which all the time had been hanging on the nail, so to speak, awaiting someone with the patience and insight that would enable him to see it.

While we cannot do full justice to Mr. Evershed's illuminating lecture, or to his monumental paper, we give elsewhere a report of the proceedings; and in congratulating him upon a great achievement, we may assure him that the "practical" paper which he has promised will be awaited with the keenest interest and anticipation.

The Chitty Motor.

IN our issue of October 10th, 1913, we drew attention to four motors installed at the printing offices of Messrs. United Newspapers, Ltd., which for five years had been driving two big Hoe presses. We pointed out that these motors differed in many respects from current practice, but most of all in the remarkable output obtained in comparison with their dimensions and weight, each giving 120 B.H.P. at 230-650 R.P.M., and weighing 30 cwt. They gave complete satisfaction to the mechanical superintendent of the company, Mr. G. W. Mascord, and ran at a safe temperature. Moreover, their cost to manufacture was extremely low. We urged that, in the best interests of the electrical industry, full advantage should be taken of the possibilities of improvement in output for weight and size that were evidently still far from exhausted.

Those motors were built by the Rees-Roturbo Manufacturing Co., Ltd., to the designs of Mr. Henry Chitty. As we fully anticipated, the accuracy of our statements was immediately challenged, but we did not ask our readers to accept them blindfold; we urged them to go and see the machines themselves. The correspondence which ensued ran on for many weeks, without in the least modifying the fact that the machines were solid realities and fulfilled the claims we made for them.

Had not the war intervened, the manufacture of machines of this type would, doubtless, have been developed. Over six years have passed, and the subject—so far as publication is concerned—has lain dormant, but not forgotten; we have looked forward to the resumption of activity in this quarter, and we are gratified now to be in a position to say that production has commenced, and arrangements are in progress for the manufacture of these motors and dynamos on "mass production" lines. Last week we had the pleasure of seeing two machines running on load; they were similar machines, on the Hopkinson—or rather, the Kapp—test, one acting as motor, and the other as generator, and the losses being supplied electrically by a third machine of another make. The normal rating of both machines was 500 amperes at 220 volts, 1,440 R.P.M.; they ran without sparking or undue heating, both at normal load and with 660 amperes on the motor, which load was thrown on and off repeatedly without effect on their behaviour. The weight of each machine, including its bedplate, was 1,750 lb., and its dimensions were correspondingly small. The normal input to the motor was 110 KW., and the mean efficiency 93 per cent. The specific weight was 17 lb. per KW.

These figures speak for themselves to the expert; for those who are not dynamo designers, we may say that the output is more than twice that usually expected from machines of this size—like that of the machines we described in 1913.

The Ayton Presentation.

IT was with great pleasure that we took part in the recognition by the electric vehicle industry of the splendid work that Mr. Frank Ayton has accomplished as founder, hon. secretary, and, finally, chairman of the Electric Vehicle Committee; a report of the proceedings at the dinner at which he was the guest of honour is given in our "Notes" columns to-day. The excellent progress that has already been achieved in the face of innumerable obstacles was fully recognised by the speakers, but the keynote of the speeches was the magnificent prospect that lies before this branch of the electrical industry. Never before has its future been so rosy. The eight-hour day has sealed the fate of horse traction, petrol is continually growing dearer and scarcer, and the electric vehicle is going to be the saviour of the situation. Moreover, the Electricity Commissioners have announced their intention of encouraging the use of electric vehicles, by granting powers to corporations to establish garages and charging stations; this is the supreme need of the industry, which has always been hampered and restricted in its development by the lack of charging facilities.

In its early days the industry suffered from recurring attempts, not so much to establish a sound business as to exploit the investing public, but those times, we hope, are past; the industry is now in the hands of men who are determined to establish it on a firm industrial basis, it has before it an unexampled opportunity, and we look forward to an immense development in the near future.

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THE KINGSTON-UPON-THAMES ELECTRICITY WORKS.

It will be remembered that during the Municipal Electrical Convention of June, 1913, members of the M.E.A. visited the riverside borough on the completion of extensions to the electricity works which cost about £15,000. The new plant, which we described at the time,* was inaugurated in September, 1913, and was said to be practically the first of its kind to be installed in this country. Two Diesel engine sets of the M.A.N. type, each coupled to a Siemens 270-kw. flywheel alternator, were installed, the intention being to decrease fuel costs and wages and repair costs in the boiler house.

One 4-cycle set with a low fuel consumption took the whole load of the station for an average of 16 hours per day, the boilers being shut down entirely during such hours. In order to obviate the risk of stoppage, it was decided to be less costly to install another Diesel set rather than to keep boilers banked during the day. A two-cycle engine was selected, which in addition to stand-by duties, assisted the old steam plant on peak loads. During the year ended March 31st, 1918, the steam plant generated 939,122 units at a fuel cost of £9,183, or 2.346d., while the Diesel engines generated 746,913 units at a fuel cost of £1,942, or 0.623d. per unit sold.

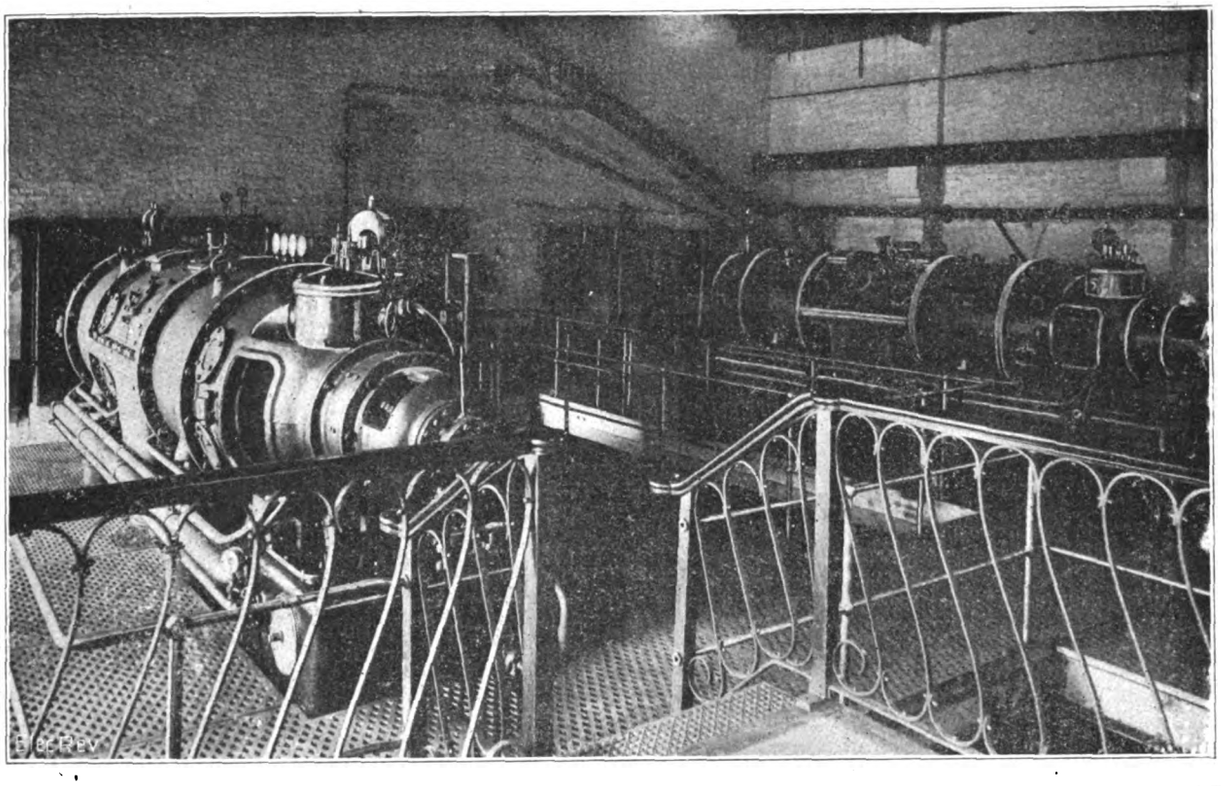

Fig. 1.—Ljungstrom Turbo-alternators at Kingston-upon-Thames.

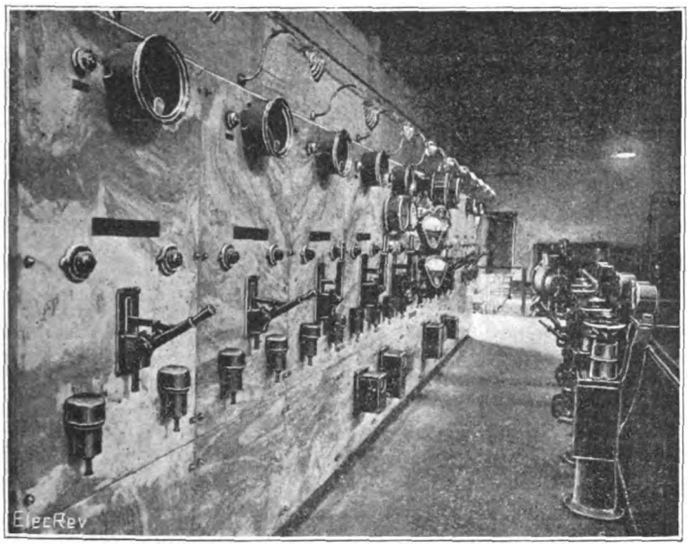

Fig. 2.—Crompton Three-phase Switchboard.

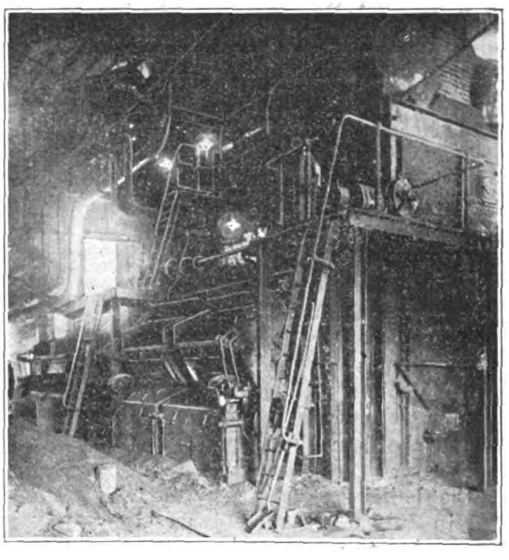

Fig. 3.—Stirling 21,000-lb. Boilers.

Following the strenuous war period, like many other undertakings of the kind, considerable trouble was experienced with the plant, and several breakdowns occurred in the latter part of 1918. Due to the heavy overload to which the plant had been subjected, a serious breakdown eventually occurred in December, 1918; to aggravate matters, some of the station employés struck work about the same time, and a total suspension of the supply seemed inevitable. However,

* Electrical Review, June 13th, 1913.

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Mr. T. A. Kingham, together with his assistant and one or two representatives of the Brush Electrical Engineering Co., Ltd., commendably set to, and by working continuously through the holidays from December 24th to January 1st, managed to get part of the new turbo-generator plant, which was then being delivered, into commission, and were thereby able to maintain the supply. Owing to the non-delivery of the E.H.T. switchboard and gear the station was for three months successfully run and controlled from the temporary 3,300-volt, 3-phase switchboard, fig. 5, which was erected during the above-mentioned holidays.

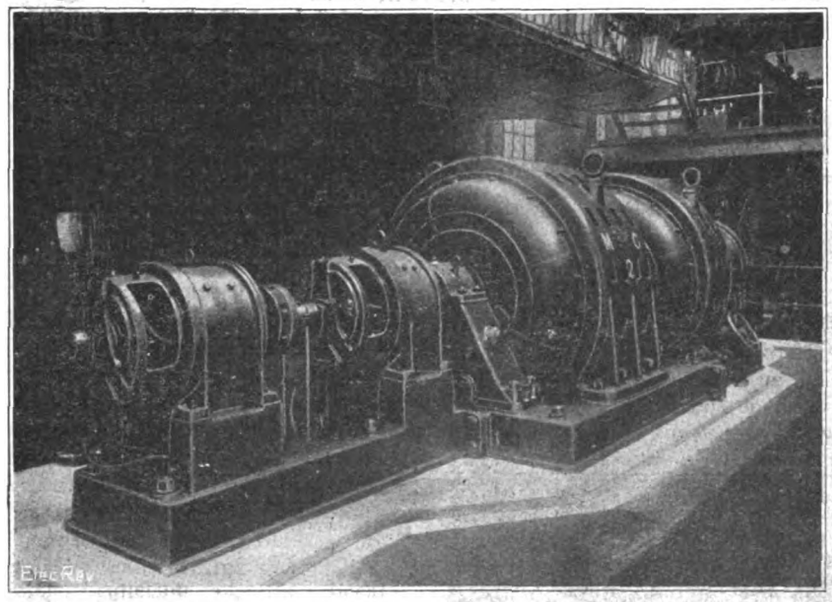

FIG. 4.—A 1,000-KW. FREQUENCY CHANGER.

In February, 1918, owing to the constantly increasing demand for power for munition works, the Town Council entered into an agreement with the Ministry of Munitions, which had approved of a 3-phase scheme prepared by Mr. J. E. Edgecombe, the then borough electrical engineer, and now consulting engineer to the Corporation, and the sanction of the Local Government Board was obtained to a loan of £25,000 for a period of 20 years at 6 per cent. for the purpose of purchasing additional electrical plant and equipment. The new installation consisted of two water-tube boilers, buildings and accessories; two 1,000-KW. steam turbo-alternators, with the necessary engine-house plant; and switchgear, distributing plant, and sub-station transforming gear. The first instalment of the new plant, consisting of a 1,000-KW. turbo-generator set, was put to work as stated above in January, 1919; a duplicate set was installed in June, and the boilers were finally completed in July of the same year. It is interesting to note that in spite of the conditions under which the first set was put into commission it ran continuously from January 1st to March 31st, 19 with but a single two hours' rest for the purpose of cleaning out the condenser.

The Kingston-upon-Thames public supply was until recently entirely single-phase, 77 periods, generation being at 2,100 volts, and the pressure at consumers' terminals, who were supplied through stepdown transformer sub-stations and pillars, was 105 and 210 volts. The single-phase generating plant consists, in addition to the two Diesel sets, of a number of Belliss steam reciprocating sets coupled to Siemens disk-type alternators. In the recent extensions, particulars of which are given in what follows, and which we recently had the pleasure of inspecting, a breakaway has been made from single-phase generation, and a 3-phase system introduced. This has necessitated a link between the two systems in the shape of two 1,000-KW. frequency-changing motor generators, which form the most interesting portion of the new plant. The new generating plant consists of two Brush-Ljungstrom turbo-alternators, fig. 1, each capable of developing 1,000 KW. The turbines, which are of the double-rotation radial-flow type, operate at a steam pressure of 200 lb. per sq. in., and 200 deg. F. of superheat. The steam consumption at full load is 12.5 lb.; at ¾ load, 13.1 lb.; and at ½ load, 14.7 lb.

The two alternators of each set, which generate 3-phase energy at 3,300 volts and 50 periods, are identical in construction, and both run at 3,000 R.P.M., but in opposite directions. From the point of view of switchgear, &c., both machines are considered as a single set, the stator windings being connected in parallel. The series-connected field windings are energised from a single exciter mounted on the end casing of one of the alternators. The rotors each consist of a solid steel forging. Axial ventilation is used throughout the machine, and both stator and rotor are mica insulated. The complete turbo-alternator is carried by its condenser, which is of the surface type, and is bolted direct to the flange of the exhaust branch of the turbine. Each turbo-generator has its own "Sirocco" air washer of the water-spray type, and its own set of Edwards air and Pulsometer circulating pumps. The condensers are on the station floor level while the turbines are on a platform on the switchboard gallery level.

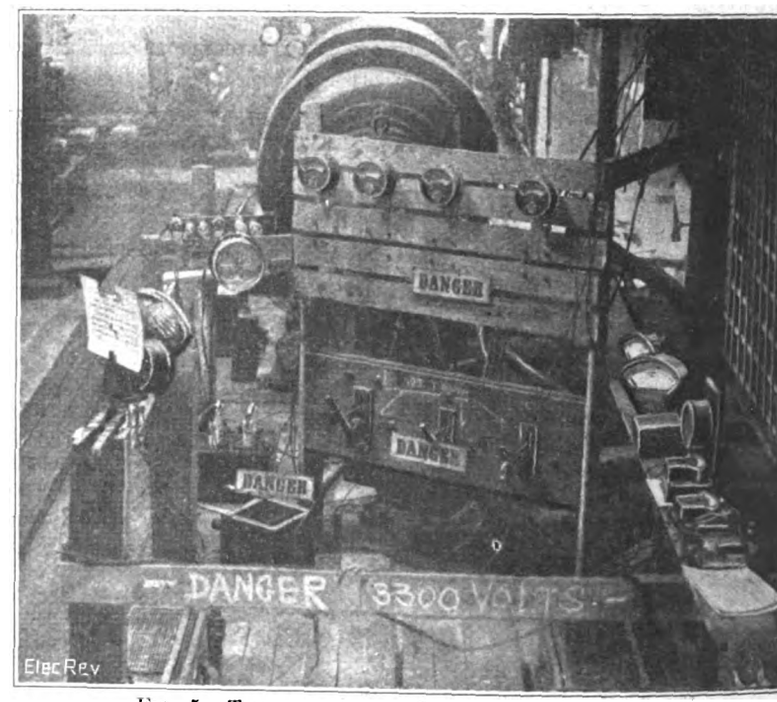

FIG. 5.—TEMPORARY E.H.T. SWITCHBOARD AT KINGSTON.

The two new Stirling boilers are each capable of evaporating 21,000 lb. from and at 212 deg. F. They are fitted with B. & W. chain grate stokers, and work in conjunction with a Green economiser. The feed pumps are of the turbine type, and their exhaust steam is used to raise the temperature of the feed water prior

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to its delivery to the boilers. All water, which passes through a Bracket rotary screening plant, fig. 7, is drawn from and returned to the river Thames. Some very excellent results are being obtained with the very low-quality fuel that is being burnt; at present coke breeze with a calorific value of 8,000 B.TH.U. per lb. is being used. This is wheeled by means of hand trucks from the stock yard over a weigh bridge, and dumped before the boilers. It is then shovelled by hand into the hoppers. It is hoped at a later date to install coal-handling plant which will greatly facilitate the stoking arrangements.

The new three-phase switchboard, fig. 2, and switch-gear was manufactured by Messrs. Crompton & Co., of Chelmsford, and Messrs. Lucy & Co., of Oxford, to the order of Mr. J. G. Statter. The new board is composed of handsome grey marble panels, the synchronising panel being placed in the centre, on either side of which are located the turbo-generator and motor-generator panels, and on the outsides the feeder panels.

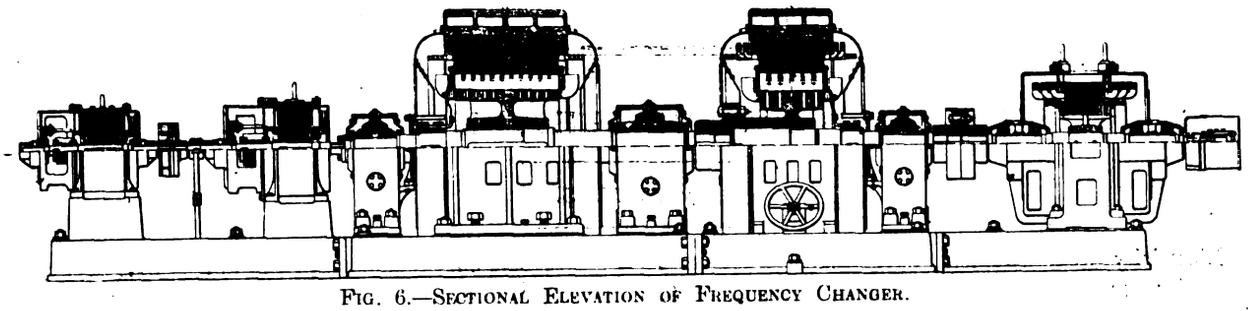

Fig. 6.—Sectional Elevation of Frequency Changer.

The 1,000-kw. frequency-changing sets consist each of five machines as follows: A single-phase alternator, a three-phase synchronous motor, a starting motor, and two exciters, one for the alternator and the other for the synchronous motor. The two exciters are provided because the voltage of each synchronous machine has to be controlled by a Tirrill regulator. The single-phase alternator has a capacity of 1,000-kw. at 2,100 volts and 75 periods, with a power factor of 0.8, and is capable of carrying a 25 per cent. overload for two hours. The three-phase, 1,450-h.p. motor, driven from the turbo-alternators, works at a pressure of 3,300 volts, 50 periods, at unity power factor. The slip-ring starting motor operates from the 3,300-volt, 50-period circuit, and is provided with a liquid starter. The complete set, figs. 4 and 6, runs at 750 r.p.m., the machines being mounted on a common bedplate with a flexible coupling between the two exciters. The three main bearings are forced lubricated, the oil being pumped by a gear pump driven from the shaft of one of the exciters; no oil cooler is fitted.

Special attention was given to the complicated problem of parallel running in connection with these sets, the conditions being as under: (*a*) The sets must run in parallel with each other on both the three- and single-phase sides; (*b*) the three-phase motors must run in parallel with the two turbo-generator sets; (*c*) the single-phase alternators must run in parallel with the Diesel and old Belliss reciprocating sets; (*d*) the load must be adjustable between the sets.

The construction of the two synchronous machines is generally the same throughout. The stator core in each case is supported between two clamping rings keyed into a cast-iron frame. It is built up of iron segments, varnished on both sides, and held in position by steel dove-tailed keys screwed to inwardly projecting ribs on the cast-iron frame. The former-wound coils were completely insulated before being placed in the core, and mica was used as the insulation between turns for the whole length of the coils; mica tubes insulate the coils on the slot portion and oiled linen and mica on the end winding. Before the outer insulation was put on the whole coils were dried under vacuum, and then impregnated with a solid compound. The mica tubes were then moulded on under pressure to ensure a solid coil and eliminate air spaces. The arrangement of the winding is such that the voltage between adjacent conductors is a minimum. A single steel casting forms the poles and hub of each rotor, the laminated pole shoes being screwed on after the coils were placed in position. A heavy amortisseur winding is provided in the pole face. Bare copper strip of heavy section wound on edge, and assembled under hydraulic pressure form the field coils. Duplicate sets of carbon brushes in box-type holders are provided for the gun-metal slip rings. In order to keep the peripheral velocity within safe limits, owing to the high speed at which the sets run, very long machines were necessary. To ensure a supply of cool air to the centres of the machines fan blades are fitted on the rotor hub with a baffle attached to the solid end shields. Further, axial holes are provided right through the stator core in addition to the usual radial vents; holes are also drilled through the rotor hub. The motor stator is carried on rollers mounted on ball bearings, and a racking gear is provided to enable the stator position to be adjusted to assist in paralleling or adjustment of load.

It was not possible to carry out exhaustive tests at the time these sets were built, as they were urgently required. They were, however, erected at the builder's works, and run for about two hours. They were then sent to Kingston, and, after erection, were put at once into service, and ran continuously day and night without any adjustment.

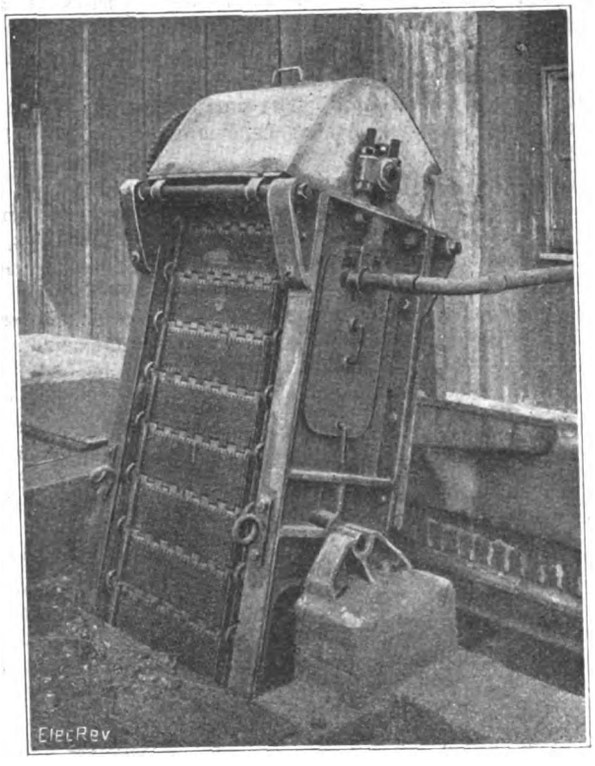

Fig. 7.—Water Screening Plant.

The whole of the turbo-generator plant, with condensers, pumps, and auxiliary plant, as well as the frequency changing sets, was constructed by the Brush Electrical Engineering Co., Ltd., of Loughborough, to

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the specification of Mr. J. E. Edgecombe, who on his resignation in September, 1918, was appointed consulting engineer. The extensions were carried on by his chief assistant and successor, Mr. T. A. Kingham, under whose management the undertaking now is.

Striking results have followed on the discarding of the old plant. Last year the units sold numbered 1,750,000, and this year it is estimated that they will reach 2,500,000. It may be pointed out that only on two occasions in the history of the undertaking has a surplus been shown on the "year's" working. It will be remembered that last year there was a deficit on the undertaking of £6,000; this year, although the whole of the new plant has not yet been in operation for 12 months, that loss has been converted to a surplus of £2,500.

The demand for power has grown to such an extent that further extensions will be necessary in the near future, and it is intended to do away with the whole of the old B. & W. boiler plant and Belliss-Siemens reciprocating steam sets, and to install in its place 3-phase turbo-generating plant. The flexibility and convenience of the 3-phase system of supply is recognised, and the old single-phase system is to be eliminated entirely from all future development.

In conclusion, we are indebted to Mr. T. A. Kingham, borough electrical engineer, for facilitating the preparation of this article.

THE LOWER SEVERN ELECTRICITY DISTRICT.

By H. M. S.

The Electricity Commissioners have taken their first action under Sec. 5 of the Electricity (Supply) Act, 1919, by issuing a notice in the terms of Sub-sec. (1) and (2) of that Section, that they have provisionally determined that the area shown on the map shall be constituted a separate electricity district, to be known as the Lower Severn Electricity District, and that it being apparent to the Commissioners that the existing organisation for the supply of the district should be improved, they intend to hold a local inquiry into the matter. They invite authorised undertakers, local authorities, and other parties concerned to forward objections or representations on account of the inclusion or exclusion of any area in or from the proposed district, and also invite such parties as are mentioned in Sub-sec. (2) to submit in writing schemes for effecting such improvement in the existing organisation, including the formation of a joint electricity authority for the district. The time limit for the receipt of the objections, representations, or schemes, is July 31st, 1920.

This first action is of considerable interest as an indication of the policy which the Commissioners have adopted, but it cannot be taken as a binding precedent, as the Section referred to permits them to take a somewhat different course to that adopted in this first case.

Sub-section (1) says that the Commissioners may provisionally determine that a district shall be constituted, and that before finally determining the area to be included, notices of the intention shall be published and given to the County Councils, local authorities, and authorised undertakers in the district, and if any objection or representation is made on account of the inclusion or exclusion of any area, the Commissioners shall hold a local inquiry with reference to the area of the district.

Sub-section (2) says that where it appears to the Commissioners that the existing organisation for the supply of electricity within a district provisionally determined should be improved, the Commissioners shall give notice of their intention to hold a local inquiry into the matter, and shall give to authorised undertakers, County Councils, local authorities, railway companies using or intending to use electricity for traction purposes, large consumers of electricity, and other associations or bodies which appear to be interested, an opportunity to submit a scheme or schemes for effecting an improvement, including proposals for altering or adjusting the boundaries of the district, and for setting up a Joint Electricity Authority.

It is provided that the area of the district shall not be finally determined until after the inquiry into the improvement of the organisation for supply has been held.

It will be seen that the notice under Sub-Section (2) cannot be given until a district has been provisionally determined, but that it need not be given at the same time, or, indeed, within any prescribed time.

The Commissioners have chosen in this case to give the two notices in one document—naturally in separate paragraphs following the wording of the Act—and to name the same date for the receipt of (*a*) objections to the delimitation, (*b*) schemes for the improvement of the supply organisation.

This may be taken as showing the disposition of the Commissioners to save time, and to meet the convenience of those interested by making one local inquiry serve the two purposes of dealing with objections and representations concerning the area, and with schemes for the improvement of the supply. As the definitive delimitation of the area can only be made after the local inquiry for the second purpose, and as objections on that matter can be brought up then, it appears that the Commissioners will be able to eliminate the local inquiry dealing only with questions of area.

This action of the Commissioners may rather startle regular civil servants and legal advisers of Government Departments as taking a liberty with an Act of Parliament, but any formal objection of that kind can be easily met by a formal division of the one inquiry into two parts, if thought desirable. As there is no limitation to the persons or bodies who may submit objections to the area, whilst there is a limitation—though one which is very wide—to those who may submit schemes, such a division may be convenient. But if there are no objections to the area, no inquiry on that is required by the Act.

Whatever views may be taken by the formalist, everyone concerned will be grateful to the Commissioners for their evident desire to concentrate and shorten the proceedings.

It may be noted that the Commissioners may (not shall) make rules to govern the holding of these inquiries and the costs thereof. No such rules have yet been published, so that little can be said about the procedure. Presumably some rules, sufficient to guide the parties interested, will be made known in good time. The Commissioners may require any person to attend as a witness, give evidence, and produce documents under penalty for failure without reasonable excuse.

To come back to the Lower Severn District, the curious may wonder why this district has been selected for the first action. No doubt the same question would have occurred to them had any other district been selected. The Commissioners have to start somewhere, and they may even have made the selection by lot. But it is perhaps not unconnected with the choice made that some of the authorised undertakers in the district, on the initiative—it is believed—of Mr. Faraday Proctor, have been getting together and discussing the formation of a joint electricity authority. The Commissioners may have thought this evidence of the spirit of co-operation a good omen for a satisfactory arrangement, which they naturally desire to achieve by their first essay. If the inquiry shows a general desire to co-operate and an absence of the jealousies which sometimes exist between neighbouring authorities, it will establish a good example which will have effects in other areas.

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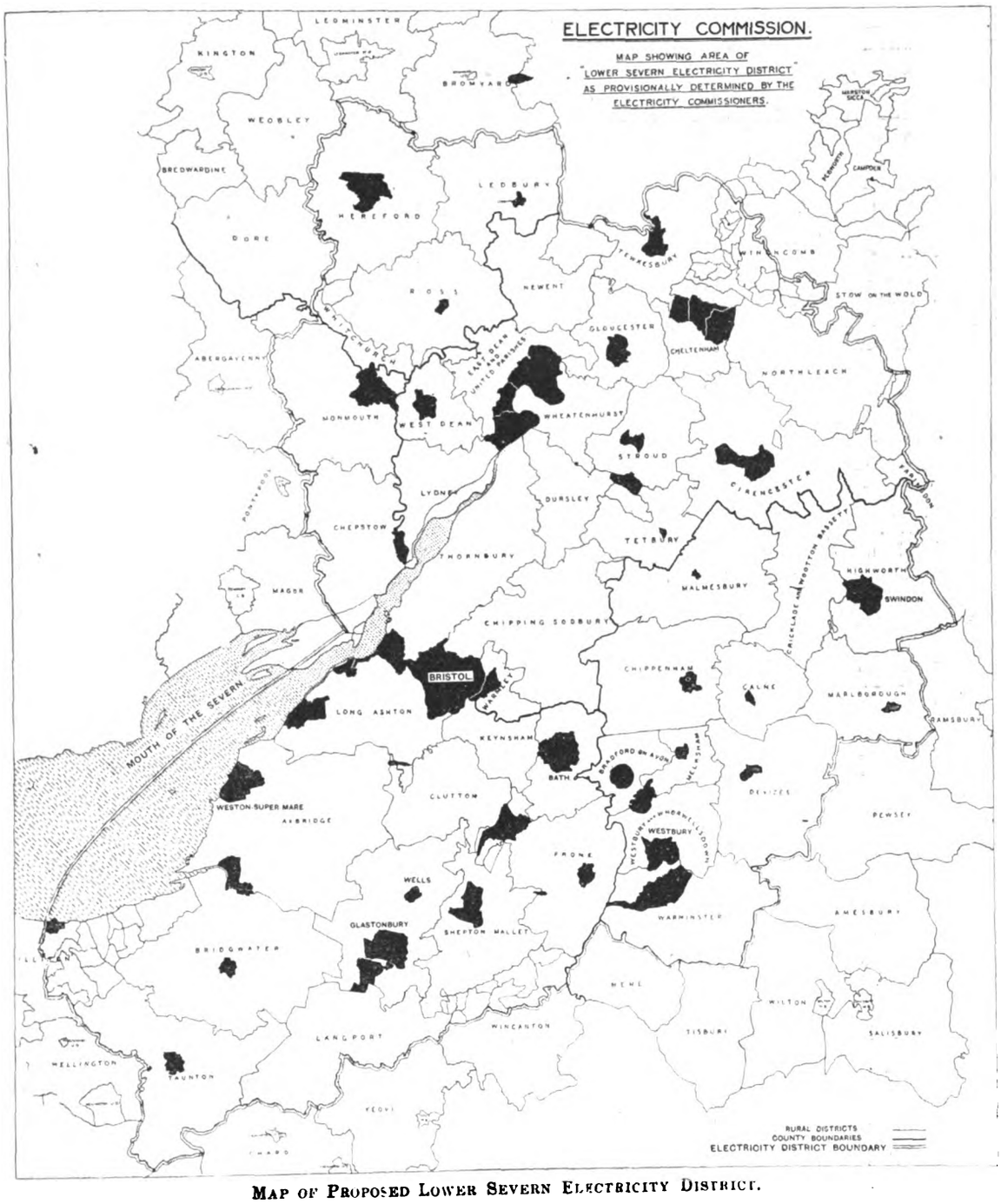
The area delimited provokes a more useful line of inquiry. Its extreme dimensions are about 75 miles, north and south, by 50 miles east and west, covering somewhat over 2,000 sq. miles. Excepting for the eastern bank of the Severn between a point about 9 miles east of Minehead, and one opposite the mouth of the Wye, which forms about half the length of the western boundary of the district, the boundaries do not coincide with any particular topographical features, or with county boundaries as a rule, though the boundary of Gloucestershire, with Worcestershire and Oxfordshire, is followed for some distance.

Gloucestershire is the only whole county in the area, which otherwise covers parts of Herefordshire, Monmouthshire, Wiltshire, Somersetshire, and some small parts of Worcestershire detached in Gloucestershire. The shape of the area also shows that it has not been determined by simple geometry. The most likely suggestion is that consideration has been given to the position of existing or projected large stations, and the distances to which they can economically supply. Colour is given to this idea by the obvious fact that the only large generating station in the area is Bristol, and that the Severn bank offers fuel and water facilities for a super-station. Bristol is not exactly central to the area, but nearly enough so to suggest that that is the vicinity contemplated for the supply centre. If one takes population as indicating potential demand, Bristol is much more central with reference to this than with reference to area.

One remarkable feature of the district is that it covers territory with a very wide range of character with respect to industries and density of population. Bristol, with its port of Avonmouth, is a busy manufacturing and shipping district. None of the other towns have any considerable industries, excepting Swindon, with its railway shops. Gloucester also has some factories. Some of the smaller towns, such as Frome, Bridgwater, and Westbury, have some old-established industries, mostly of small magnitude individually. Most of the other towns in the area are of the quiet market-town and residential type, such as Bath, Cheltenham, Hereford, Wells, and Marlborough. The anticipated development of shipbuilding in the erstwhile national yards on the Wye will change that district when the development is realised. But by far the greater part of the area is rural, much of it pastoral. Without statistics at hand, one does not care to hazard figures of population density, but has a general impression that it is a pleasant, quiet, uncrowded, country-holiday sort of territory. Weston-super-Mare is, of course, a popular seaside resort.

(To be concluded.)



MAP OF PROPOSED LOWER SEVERN ELECTRICITY DISTRICT.

The Proposed Capital Levy.—On May 12th the Executive Committee of the Federation of British Industries instructed the Taxation Committee of the Federation to oppose by all means in its power any suggestion of a capital levy on so-called war wealth.

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ELECTRICITY SUPPLY AUTHORITIES AND THE LAW OF RATING.

By W. VALENTINE BALL, O.B.E.

This being the year of the quinquennial valuation, those who are interested in the supply of electricity will sooner or later be getting into touch with the rating authorities.

Even in normal times, there are reasons why a revaluation is necessary and desirable once in five years; but much of an extraordinary character has occurred since last there was a valuation. The cost of generating electricity has gone up by leaps and bounds; special legislation has enabled lighting authorities to increase their charges; while various Acts of Parliament passed by a legislature which, in the exigency of the times, was bound to find revenue, has laid charges upon this as upon many other forms of industry. In these circumstances a brief review of the principles of the law of rating as it applies to electrical undertakings may be found acceptable.

To ascertain the rateable value of an ordinary dwelling house is a comparatively simple matter. The overseers are required, in making the new valuation list, to fix the gross value of all properties in the borough at an amount corresponding to the annual rent which the tenant might reasonably be expected, taking one year with another, to pay for the premises, if the same were let on an annual tenancy, and the landlord undertook to bear the cost of repairs.

When, however, we come to consider a highly complicated piece of property like an electricity supply undertaking, the ascertainment of the hypothetical rent is by no means a simple matter.

As such a person as an actual "tenant" of an electricity supply undertaking is a creature unknown, it has long been the practice, in rating gas companies and similar undertakings, to have regard to the profits which such a concern would bring in. Three leading principles of law are as follows:—

(*a*) In valuing the works, mains, &c., of an electricity supply company for the purposes of rating, the profits earned by the company are taken into account.

(*b*) The exercise of the right to lay down wires and send electricity through them, amounts to an occupation in law and so is rateable.

(*c*) If the electricity works belong to a municipal corporation or other local authority, that body is rateable, although the profits earned are devoted to public purposes.

Let us now examine the method by which the rating authorities endeavour to ascertain the hypothetical rent.

The first step is to ascertain the net receipts. This is done by taking the receipts of the company from every source, and subtracting therefrom the ordinary working expenses (other than the cost of repairs, insurance, &c., which come in later on). The very substantial items coal and wages would, of course, be deducted. Having ascertained the net receipts, it is necessary to inquire how much of them a tenant would be willing to pay as rent to a hypothetical landlord. He would not, of course, pay the whole receipts as rent, as he would not then have any incentive to embark on the undertaking. There must be a deduction for "tenant's profit," sometimes called "tenant's share." It is worked out as a percentage on the tenant's capital. The tenant's capital is the value of his loose stock-in-trade, and a sufficient capital sum to enable him to provide for working expenses. It would not, of course, include the value of the boilers, engines, dynamos, or other fixed machinery at the generating station, but it would include the meters on consumers' premises, and all the loose tools, &c. A percentage is then taken on the tenant's capital, and considerable difficulty is often experienced in deciding what this should be. At the London Quarter Sessions the usual practice in rating the property of a gas company is to take 5 per cent. for interest, 10 per cent. for trade profits, and 2½ per cent. for risks and casualties, making 17½ per cent. in all.

Having deducted the tenant's profit, we arrive at the gross value of the undertaking. According to the rule laid down in Statute (*supra*), the cost of repairs, renewals, and insurance sufficient to maintain the hereditament in a state to command the rent must be deducted from this, inasmuch as these charges fall on the hypothetical landlord. Making a final deduction of the rates, which the tenant has to pay, we arrive at the rateable value of the whole undertaking.

In London, as the rates are only revised once in five years, it is necessary to determine what year is to be considered for the purposes of rating.

Hitherto we have proceeded upon the assumption that the entire undertaking of the company is situated in one parish or rating area. In such a case there is no necessity to consider whether the profits, upon which the rateable value is founded, are earned at the generating station or at the premises of the various consumers. But where, as nearly always happens, the undertaking is distributed over many parishes, difficult questions arise. For instance, the generating station, which is only indirectly productive, may be in one parish, while the directly productive part of the works may be distributed over the company's whole area. How are the profits to be apportioned? The difficulty is got over by considering the claims of all the different rating areas together.

In dealing with this question, rating authorities have recognised the fact that the undertaking of a gas or a water company is very similar to that of an electricity supply company. The principle adopted in the case of a water company was laid down in 1847 in the case of R. *v.* Overseers of Mile End Old Town (1847) 10 Q.B., 208. There the works of a water company extended into several parishes. The rateable value for the purposes of poor rate, of the entire works, was £30,800. The rateable value of the reservoirs, buildings, &c., valued as land and buildings deriving value from their capacity of being applied to the objects of a water company was £6,500. It was held that the rateable value ought to be apportioned among the several parishes in the following manner: "The rateable value of the reservoirs, buildings, &c., valued as above, to be first deducted from the total rateable value, and distributed among the parishes in which this portion of the works was situate, according to the extent of such works in each parish; and the residue of the rateable value to be apportioned among the parishes containing the service pipes, in the ratio of the net profits produced in each of those parishes.

Mr. C. A. Webb, in his "Law and Practice of Rating and Assessment (1910)," p. 170, points out that revenues may be thus ascertained:—

Gross receipts—			
Sale of electricity	£74,361		
Rental of meters	4,620	£78,981	
Deduct—			
Generation of electricity (*a*)	19,053		
Distribution of electricity (*b*)	2 460		
Management and general expenses (*c*) ...	6,430	27,943	
		£51 038	

(*a*) In the item generation of electricity are included the following expenses: Coals, and other fuel, oil, waste, water, engine-room charge, proportion of salaries of manager and superintendents, wages, &c., at generating and sub-stations.

(*b*) Distribution of electricity includes the following expenses: Proportion of salaries of manager and engineers, wages, repair and maintenance of meters, and other apparatus at consumers' premises.

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(*c*) Management and general expenses include salaries and remuneration of directors, secretary, clerks, collectors, and auditors, stationary, printing, and general establishment charges and law expenses.

Tenants' capital includes meters and other appliances at consumers' premises, tools, furniture, and five weeks' working expenses.

Rating of Works which Include Plant, &c., in Excess of Existing Requirements.

It often happens that electrical undertakings have extra space, and sometimes spare plant, which is in excess of their existing requirements, and is laid down for the purpose of meeting extensions in future years. The question whether this part of the property is to be included in the rating has been considered in a number of cases, but not electric supply cases. In R. *v.* South Stafford Waterworks, 1885, 16 Q.B.D., 359, the indirectly productive works were largely in excess of the then existing requirements of the company, and had been constructed for use in future years. The rateable value of the whole system was agreed, the point in dispute being the proper amount of deduction to be made therefrom. It was found that if only so much of the permanent works as was required for the purposes of the present supply was included in the rating, the rateable value of the whole would be materially diminished. The following passage from Lord Esher's judgment in the Court of Appeal serves to show the attitude taken up by the Court:—

"There might be works of the undertaking which had not become part of the actual system, as, for instance, a reservoir or a second lot of engines not yet used at all, but constructed with the view of becoming part of the works in the future. Such could be no part of the existing system of works, but would be intended for another system, and would, of course, be rejected in making the calculation. But that is not the case, for here every part of the works is in actual use, though they are too large for the supply of water at present required. . . . But as the works in use are in excess of the present requirement, a tenant taking the whole or part of the property in a particular parish ought not in justice to be asked to pay the same rate of rent as he would if all the works were earning profit. Therefore, if the 3¼ per cent. mentioned by the arbitrator is the ordinary percentage upon the value of the capital laid out, one would think that the percentage in this case should be reduced to 3 per cent., or less." It would seem from this case that it would be perfectly proper for a rating authority to make a reduction on account of the spare space inside a generating station. The question whether there could be a reduction for a spare "set" is rather different, because prudent people would not run a large station and undertake to give a continuous supply without making provision for breakdown.

There remains to be considered an important question which has arisen in relation to excess profits duty. Is this duty to be deducted before arriving at the profit of the hypothetical tenant? It has long been recognised that income tax was not so deductable. The question arose and was decided in the case of Port of London Authority *v.* Overseers of the Parish of Chadwell St. Mary, 35 T.L.R., 84, which came before the King's Bench Division on November 13th, 1918. The Authority had been assessed by the Commissioners of Inland Revenue to pay a very considerable sum in respect of excess profits duty, which they contended should be taken into account before arriving at the profit for the purposes of rating their docks. In the course of his judgment, in which he decided that the excess profits duty should be taken into account, Mr. Justice Darling said: "I do not think that he (meaning the hypothetical tenant) could properly arrive at a good opinion as to whether he would be wise in taking the Tilbury Docks unless he did consider whether before he put anything in his pocket he would have to pay the excess profits duty; and if he said, "I will give such and such a rent without considering it," I think he is a man who might make a very bad bargain; but that is not the kind of man the Statute contemplates."

It is interesting to recall a fact noted in the Electrical Review early in 1918 that the Hendon Electric Supply Co. contested this point before the Assessment Committee at Hendon, but the decision was held over pending the decision in the above case.

THE ROYAL SOCIETY'S SOIRÉE.

On the night of May 12th a large and representative gathering of Fellows of the Royal Society and their friends assembled at Burlington House, London, on the occasion of the first of the two annual conversaziones, that confined to men only, that are held by the Society. Sir Joseph J. Thomson, O.M., D.Sc., president, received the guests. As usual on these occasions, main interest centred on the exhibition of the new scientific discoveries and developments of the year, and the keenest attention was paid to the demonstrations which took place in the course of the evening and to the inspection of apparatus, much of which was seen in operation. There were about 47 exhibits, and although few could strictly be called electrical in nature, some 13 of them employed either electricity or magnetism in one form or another. We shall confine our remarks to a brief reference to the latter exhibits.

Mr. A. A. Campbell Swinton, F.R.S., president of the Wireless Society of London, gave a short exposition (illustrated by lantern slides) of wireless telephony in connection with an experimental demonstration by Marconi's Wireless Telegraph Co., Ltd., from its works at Chelmsford. The apparatus consisted of an amplifying detector and note magnifier to which was connected a loud-speaking telephone, enabling speech to be heard all over the lecture hall. The aerial consisted simply of a 3-ft. square frame wound with a few turns of wire and placed on the lecture table in the room.

Marconi's Wireless Telegraph Co., Ltd., exhibited wireless telegraph apparatus which consisted of a marine type direction finder, transmitting and receiving valves, a double note magnifier, and auxiliary apparatus.

The Botany Department of the Imperial College of Science and Technology had on view a recording porometer which was in operation. The instrument recorded the rate at which air, under slightly reduced pressure, was drawn through the stomata (pores of a plant leaf) into a glass cup fixed on the under surface of the leaf. It thus gave a measure of the size of the pores. Each time a bubble of air so drawn in escaped from the lower tube it momentarily made contact between a column of mercury and a platinum wire; the electrical current which then passed was made to move the recording pen on the surface of a revolving drum.

Mr. A. V. Hill, F.R.S., showed thermopiles for investigating the thermal or the thermo-elastic properties of muscles. When a muscle is stimulated heat is produced in four separate stages; first, in the development; secondly, in the maintenance; thirdly, in the disappearance of the mechanical response; and lastly, in the process of oxidative recovery. The heat production is recorded by means of delicate insulated thermopiles, and a sensitive photographic recording galvanometer. When a muscle is stretched, or released after stretching, complex thermal effects are shown by the use of the thermopiles; these thermal effects throw considerable light on the mechanical and elastic properties of muscle.

Amongst the magnetic compasses illustrating recent developments that were exhibited by the Admiralty compass department were two standard types of aircraft

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compasses, and examples of aperiodic compasses for use in ships and aircraft. The aperiodic system adopted in these instruments is the result of investigations of Mr. G. T. Bennett and the late Lieut.-Com. C. Campbell.

The Meteorological Office had on view new instruments and diagrams, and amongst the latter records of the magnetic disturbance of March 23rd and 24th, 1920, were shown, together with photographs of auroræ for height measurement; also records of the frequency of thunderstorms on the route between England and Australia and at selected stations in Africa and South America.

Messrs. Adam Hilger, Ltd., exhibited a vacuum concave grating spectrograph which has been specially designed for the investigation of the Schumann & Lyman regions of the spectrum. No refractive substance is introduced, but the whole spectrum is obtained with one setting of the grating by the use of two slits. A magnetically-operated shutter is provided which enables two exposures to be made.

The apparatus for air navigation that was shown by the Air Ministry Laboratory included Capt. Weir's (Littrow projection) diagram applied to the purpose of obtaining position lines from wireless telegraphic bearings, which application was suggested by Commander Veater, R.N.

Clays treated by electro-osmosis, and photo-micrographs of raw and purified clays, together with crucibles and other refractory specimens, were exhibited by the Osmosis Co., Ltd. The phenomena of electrical osmosis, whereby matter in a very finely divided state is capable of being influenced by an electrical potential, are applied in practice to the process of purification of clays. The equipment necessary to obtain osmosed clay consists of a blunger, settling tanks, and the osmosis machine. The latter is composed of a rectangular trough in which is arranged horizontally a cylindrical metal anode, which is surrounded, beneath the surface of the slip and at a short distance from it, by a laminated cathode, through which the clay slip is driven by paddles. The cylinder is made to revolve slowly, and the dried purified clay is collected by means of a scraper.

Mr. E. A. Reeves's apparatus for showing the existence of a true north and south directive force in the electricity of the atmosphere consisted of a large glass bottle with an india-rubber stopper, from which was suspended by a fibre of unspun silk a gold-leaf paper indicator. The inner side of the stopper was covered with paraffin wax, and the bottle was coated inside and out with shellac varnish, the whole being mounted on a tripod stand. On a calm, clear day if the apparatus is set up in a high open space, and screened from the direct rays of the sun, it will be found that, after the paper has been electrified by touching it with vulcanite rubbed on dry cloth, and left for some time, it will oscillate about evenly on either side of the true North and South line, or come to rest approximately in that direction.

Mr. A. Mallock, F.R.S., showed apparatus that he used in experiments to determine the variation of rigidity with temperature. The specimen to be tested formed part of a torsion balance in which the restoring couple was supplied by the torsion of a long thin wire together with that of the specimen, the latter being in the form of a short wire or narrow strip about 2 in. long. The specimen and lower part of the balance could be immersed in a tube of fluid kept at any desired temperature. The periods of oscillation were automatically recorded electrically for various temperatures, and the ratio of these periods furnished the necessary data for determining the ratio of the rigidities. In making an experiment the oscillations were maintained continuously by an electrical device, the specimen being immersed successively in water at 100 deg., at room temperature, in carbonic acid, in alcohol and in liquid air.

Major G. W. C. Kaye's collection of radiographs illustrating some recent developments in the use of X-rays for the examination of metals and other substances was of much interest. The specimens exhibited included, amongst others, Heilbron's radiographs of paintings by old masters, from an examination of which it was clearly apparent that some of the figures depicted in the original had been painted out or modified at a later date.

The Royal Observatory at Greenwich had on view, transparencies of the May 29th, 1919, total eclipse of the sun, showing the eclipsed sun and surrounding stars, corona, and great prominence; also photographs of the sun and sun spots, together with records of the magnetic disturbance of March 22nd-25th, 1920, and a diagram showing the variation of latitude from 1912 to 1919.

Finally, Dr. J. C. Mottram and Dr. E. A. Cockayne demonstrated the presence of fluorescence in *Lepidoptera* by means of ultra-violet radiation. The beam of ultra-violet rays was produced by a quartz mercury-vapour lamp in a box with a window made of glass invented by Prof. Wood, which is transparent to radiation of wave lengths lying between 3,900 and 3,100 A.U., but opaque to light. Only a small proportion of the *Lepidoptera* examined have proved to be fluorescent, the most brilliant being geometrid months of the genus *Ourapteryx* and allied genera.

A CLOUD-BELT OF SOLAR ELECTRONS.

(Note by *Epsilon*.)

THE following letter from the Rev. Fr. A. L. Cortie Director of Stonyhurst College Observatory, recently appeared in the *Times*, and was reproduced in the *Tablet* of April 17th.

As a striking sequel and supplement to cognate matter presented in the ELECTRICAL REVIEW of December 19th and 26th, 1919, also March 5th, 1920, Father Cortie's glowing and vivid description acquires additional point owing to the electronic interest attaching to his reference to clouds of electrified particles—with all the vistas his graphic picture thus opens out.

Notwithstanding the few weeks elapsed since these events happened, this matter is by no means obsolete, or out-of-date, especially as time has been utilised to obtain from ocean cable authorities some reply to Father Cortie's final query as to the practical effect of the March 22nd-23rd disturbance upon the working of ocean cables.

Surely enough, we hear from a leading authority responsible for the working of several ocean cables laid fairly due east-west, that on March 22nd-23rd, earth-currents were heavy—at times reaching 60 volts. Practically, however, effective working was maintained almost continuously, actual stoppages having been few, and of quite short duration.

FATHER CORTIE'S *Times* LETTER.

The indisputable connection which exists between a disturbed state of the sun's surface, as evidenced by sun spots, and terrestrial magnetic storms, was strikingly exhibited in the great sun-spot group which crossed the sun's visible hemisphere, March 16th-29th, and the violent magnetic storm of March 22nd-23rd. The sun-spot group, which was easily visible to the naked eye, was the greatest that has appeared since August, 1917. It covered an area of about eight thousand millions of square miles, more than ten times the superficial area of the whole earth. When crossing the sun's central meridian it extended over 39 degrees of longitude, representing a total length of about 180,000 miles. It was six degrees below the sun's equator, almost in a line with the earth.

This same region of the sun had begun to be disturbed at the end of last December, and at the end of January a fine long train of spots had developed, extending over 25 degrees of longitude, and similar in appearance to the great group of March. In the intermediate rotation of February the region of disturbance was marked by a few small spots.

From this huge area of solar disturbance proceeded clouds of electrified particles, driven into space most likely by the pressure of the sun's light. Into this belt of invisible clouds the earth entered at a few minutes past 9 a.m. on March 22nd and instantaneously the signal of the event was given to all the magnetic observatories over the world by a sharp to-and-fro movement of the needles. The end of the storm occurred at about 8.50 a.m. on March 23rd. The earth's orbital velocity is 18¼ miles per second, and in the stated interval of time it would have travelled more than a million and a half miles,

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which number furnishes some idea of the lengthwise dimensions of the cloud-belt through which it rushed.

Meanwhile the earth was turning on its axis, and during the daylight hours the force of the earth's magnetic field was increasing, and the direction needle was swinging westward, while the opposite conditions obtained during the night hours. Upon this general movement of the needles many rapid and violent oscillations were superposed, especially between 16 and 20 hours on March 22nd, and between midnight and 4 hours on March 23rd. To give some idea of the violence of the storm, the spots of light, reflected from the mirrors attached to the delicately suspended needles, went quite beyond the limits of registration on either side of the drums carrying the photographic sheets. This means that the total range in force was at least forty times what it had been on magnetically normal days during January and February. The direction needle experienced swings of 90, 120, and 130 minutes of arc W. and E. during short intervals of time. The total range of this needle was 160 minutes of arc—that is, the compass at Stonyhurst would at times have given directions more than a degree from the true position. During this storm the swing of the needle was increased thirty-two-fold its deviations during the past two months. The supposed reception of extra-terrestial signals on the wireless apparatus of several stations, as recently announced, pales into insignificance beside such movements of the needles, controlled from a distance of nearly 93 millions of miles. The wireless signals could probably be traced to a similar solar origin. The end of the storm was marked by a rapid quivering of the needles, which was continuous during the last four hours.

The visible evidence of the passage of the earth through the cloud-belt of particles was furnished by a fine display of the Aurora Borealis. As seen by Lieut.-Col. Penny, R.A.M.C., the commanding officer of Queen Mary's Military Hospital, Whalley, in our immediate neighbourhood, it consisted of broad beams of flickering light which reached nearly to the zenith. Across these beams, near their summits, lay an oblique band of light, waning and waxing in intensity. In colour the display was mostly white, with a red tinge in parts. It lay almost symmetrically about the magnetic meridian.

It will be interesting to learn whether the earth-currents, which at times interfere seriously with the transmission of telegraphic messages, with cable-laying operations, and even with the running of the tramways, were experienced in any force on this occasion.

LEGAL.

THE IMPORTANCE OF REGISTERING UNDER THE BUSINESS NAMES ACT.

IN the Shoreditch County Court, on May 11th, before Judge Cluer, the Electrical Repair & Manufacturing Co., of 187, Goswell Road, E.C., electrical engineers, sued Hettie Anders, of 35, Darenth Road, Stamford Hill, as administratrix of the estate of Nat Anders, to recover £7 12s. 6d. When the case was called on Judge Cluer asked if the firm were registered under the Business Names Act, and ascertained that through ignorance they were not. His Honour then said he could not hear the case, as a firm could not sue under a contract unless they were registered under the Business Names Act. Their solicitor, Mr. Whitton, would tell them how to get relief if it had not been wilful. Plaintiffs' Representative: It has not been wilful. Judge Cluer: Well, he will tell you, but I cannot hear the case now; it is dismissed.

Indian Water Power.—The February issue of *Indian Industries and Power* gives a brief history of hydroelectric developments in India. It is stated that the Municipality of Darjeeling was the first authority to take advantage of this cheap form of motive power by the installation, in 1897, of two separate plants operating in parallel under heads of 275 and 650 ft. The Cauvery Falls, which is now one of the principal sources of hydroelectricity in the country, was first exploited in 1902, when the power was transmitted a distance of 92 miles to the Kolar (Mysore) goldfields. In 1903 the Government erected a plant for the production of energy for a cordite factory at Karteri Falls, Madras, obtaining an effective head of 624 ft. From the rapids of the Jhelum river power was obtained, in 1909, for dredging the river, by means of a timber flume 6½ miles long. There were several small developments up to 1914, when the Tata Hydroelectric Power Supply Co. made its first large installation at Khopoli. Obtaining an effective head of 1,725 ft., maintained during the dry season by means of extensive reservoirs filled during monsoon periods, a total development of 67,000 H.P. was made. The energy was transmitted, at a pressure of 100,000 volts, a distance of 43 miles. The Tata Co. owns the largest hydro-electric plants in India, the Andhra Valley installation, which is the largest mentioned in the article, possessing a total development of 68,000 H.P.

ELECTRICAL HAPPENINGS OF INTEREST.

[NOWADAYS the lay Press is not slow to cater for an enlightened public which appreciates technical news—especially if it relates to the latest wonder-invention. It behoves us to move with the times.]

(From our Codford Representative.)

A strange accident took place on Wednesday afternoon. It appears that P.C. Eyesharp noticed a young man perched on the roof of a tramcar, and apparently tampering with the overhead wire. He shouted a warning, and this so startled the young man that he overbalanced, and, narrowly missing a fatal shock from the wire, fell to the ground.

I called at the hospital later, and gathered from the young fellow that he is a student at the local technical college, and had been testing a certain law of Umpire, a well-known scientist of the 17th century. Armed with a compass, he had, prior to the disastrous experiment on the tramcar, already derived great practical benefit from tracing our electric mains.

He pointed out that the magnetetic energy of the tramway and other wires is sheer waste. With commendable zeal, he has already begun a revolutionary article on "Our Wasteful Electric Systems."

(By Private Wireless from Sparkeville.)

A distressing fatality occurred on Monday in the presence of a number of well-known electrical experts. The latter were investigating the claims of a local man known as "The Voltage Diviner." This worthy had found that high-tension currents did not harm him, and that he could actually calibrate himself. The Meteorological Office having announced the imminence of a thunderstorm, a demonstration before a number of experts was arranged. The Voltage Diviner was to conclude by measuring the electric pressure of a lightning flash.

After a series of startling tests on low and high voltages, and briefly finding the strength and direction of passing wireless waves, the Diviner connected himself to a lightning conductor. When the flash occurred, the assembled experts eagerly leaned forward to hear the verdict. At the inquest the Coroner touchingly commented on the fearlessness which characterises modern investigators.

In the course of his duty in Muggleton High Street, yesterday, a constable's suspicions were aroused by the arrival of a fierce-looking man with a portable electric generating set. This the man proceeded to set up on the pavement. He then placed a sheet of metal on one of the steps of No. 73 and ran a wire from it to the engine, which he started-up.

Upon the constable questioning him, he replied that he was going to take a film. The constable was satisfied, but remained nearby in the hope that he might appear on the film. Shortly afterwards the door of No. 73 opened, and a gentleman descended the steps. After a loud ejaculation of rage, the man with the engine collapsed in a fit. He was then given into custody.

It seems that the gentleman had recently dismissed the man from his employment, and the latter had, with fiendish cunning, planned to electrocute his former employer. Fortunately, the miscreant had been unaware that one of the intended victim's legs is of wood—this, of course, refusing to carry the deadly current.

Our Ketchem Correspondent writes:—During the week a number of trials with a startling new invention have been carried out here. The innovation takes the form of an original type of electric vehicle which will run at an efficiency of no less than 180 per cent. I have succeeded in gleaning a few details from the inventor. Naturally, he was a little reticent—the many patents which cover his invention not having yet been granted owing, as he tersely explained, "to the inertia of those red-tape Patent Office officials."

The car is similar to the ordinary light car, but no bonnet or wheels are visible. All the energy (electric) is generated under one of the seats, and the "magnetic repulsor" (which only weighs 10 lb., and yet develops up to 40 H.P.) is mounted at the car's centre of gravity, and by its effect on the earth currents can give speeds up to 140 M.P.H. Wireless switches are used for the various controls. As regards the source of current, the inventor would say nothing further than that he had "collared the electrons, and practically solved perpetual motion."

The inventor asserts with justifiable pride that his car will revolutionise the transport industry. As I left, the Screenit Co. was filming the modest inventor and his wonderful machine.

British Trade with Italy.—Mr. F. G. Kellaway, M.P., Parliamentary Secretary to the Department of Overseas Trade, is paying an official visit to the British Chamber of Commerce in Italy. He will be accompanied by Sir Frederick Butler, K.C.M.G., C.B., and Mr. T. D. Dunlop of that Department. He will attend the annual dinner of the British Chamber of Commerce for Italy at Genoa on May 15th, and will afterwards proceed to Rome, Milan, and Turin to study on the spot questions affecting British trade with Italy, and to inspect the work and equipment of His Majesty's commercial, diplomatic, and consular services in Italy.—*Financial Times.*

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BUSINESS NOTES.

"Coming of Age."—Congratulations to the firm of Mann, Egerton & Co., Ltd., of Norwich, on its "Coming of Age." The business was founded in April, 1899, by the present chairman and managing director. Amongst the 1,200 employés of the company, over 50 have served the firm for periods exceeding 10 years; over 20 for periods exceeding 15 years; whilst four have served 21 years.

Football.—The Hartonians Athletic Football Club, which consists of the employés of the Hart Accumulator Co., Ltd., of Stratford, London, has just concluded a most successful football season, having won the Eastern Suburban League (Div. 2, Sec. A) Shield and Medals with the following record :—

Played.	Won.	Drawn.	Lost.	For.	Against.	Points.
20	16	1	3	58	18	33

Four friendly matches were also played, three of which were won, and the remaining game drawn, with a goal record of 18 "for" and two "against." The team has been well led by the captain (J. Smith), whose play at centre forward has been marked throughout the season with splendid consistency, he himself having scored on 32 occasions. Other good records were F. Drew, who scored 20 goals, and R. Killick, who netted on nine occasions. F. Drew has been a hardworking and painstaking hon. secretary, and he was also a capable inside left forward.

Aircraft Disposal.—The Aircraft Disposal Co., Ltd., who recently took over the whole of the surplus stock of aircraft material from H.M. Government, state that their sales department is now established at Regent House, Kingsway, London, W.C. 2, for the purpose of dealing with inquiries and orders for this stock, and from time to time offers for the disposal of the various materials will be circulated. Those interested in any particular class of material should communicate immediately, when special attention will be given to their requirements. With regard to aeroplanes and engines, it is the intention of the company to maintain a fixed price list, quoting definite prices from which a rebate will be quoted to all British aircraft manufacturers, British merchants, and firms dealing in aircraft accessories and components.

Standards in Sweden.—The Swedish Electrical Standardising Committee has issued a proposal for the adoption of the Edison screw for lampholders and sockets. It is based upon the standard adopted in France. Hitherto German standards have been exclusively used in Sweden.

Graphite Electrode Production in Norway.—The directors of the Norske Elektrodeverker A.S., of Christiania, in the course of an invitation for subscriptions to an issue of preference shares, so as to provide the means for extending the number of producing furnaces, state that the company has succeeded in turning out graphite electrodes which are equal to the best American products, and the first electrodes made have been tested with very satisfactory results at a thermo-electric installation. The prospects of business are considered to be very favourable, as besides Scandinavia, the company will have a big market in practically the whole of Europe. In particular the English market, the directors remark, is open for a quantity greater than the company's present production, and on the investigation which the board recently made in England, "it was shown that a Norwegian product will be received with great goodwill."

New Engineering Union.—The new Amalgamated Engineering Union, embracing the A.S.E. and 10 other societies connected with the engineering trades, will be formally constituted on July 1st. Its membership will not be far short of 500,000, and the funds are estimated at nearly £4,000,000. The programme of the new Union is not yet complete, but its first energies will be devoted to increasing wages. The present proposal is that the Union should demand a minimum for skilled engineers of £6 10s. per week. The present average weekly wage of the members is asserted to be between £4 10s. and £5 10s.—*The Times.*

The B.E.D.A.—Among the latest publications of the British Electrical Development Association is a booklet detailing the aims and objects of the society. A list is given of the members of the council and executive committee, and the methods of publicity are fully described, examples of B.E.D.A.'s pamphlets being illustrated. A report of activities is included, setting out the various ways in which public attention has been attracted to the benefits of "doing it electrically." At the end of the booklet a form of application for full particulars of the scheme is inserted. We have also received a reprint of an article entitled "Housing Construction and Electricity Supply," which, originally published by *The World's Work*, is being circulated by the Association.

The Employment of Demobilised Men.—The Rotary Club is trying to place in employment the thousands of demobbed men unable to find work. They are unearthing some valuable men, and employers needing labour could not do better than send particulars to the "Jobs for Demobbed Committee," "Rotary Room," Horrex's Hotel, Norfolk Street, Strand, W.C. 2.

Plant for Disposal.—York City Electricity Department invites offers for two 360-H.P. Willans high-speed engines direct-coupled to 460-500-volt Crompton generators, and two 50-H.P. 460-volt E.C.C. motors. For particulars see this issue.

"Safety First."—The pioneer of the "Safety First" movement, which has gained so much ground and had such excellent results in the U.S.A., the National Safety Council has sent us a booklet dealing with its formation, methods of publicity, &c. It is illustrated by reproductions of a few of the many posters published by the Council, which are very compelling, and of definite local interest. The Society claims a great reduction of accidents to workpeople as the result of its propaganda, and, from the figures given, this would seem to be amply justified. We have also received a copy of the "National Safety News," published weekly by the organisation, as well as an application form for membership. It is of interest to note that the British Government has applied for 23 memberships of the Council for the Chief Inspectors of Mines and Factories and for Superintending Inspectors of Factories in London, Manchester, Birmingham, Glasgow, Leeds, and elsewhere.

The E.P.E.A. and the E.T.U. at Port Sunlight.—The strike of Electrical Trades Union men at Messrs. Lever Bros'. works at Port Sunlight, owing to the employment of men in the Electrical Power Engineers' Association, has resulted in a temporary agreement being reached between the two organisations, the terms of which are as follows :—

A. That the E.P.E.A. circular dated February 24th, 1919, be publicly withdrawn through the Electrical Review.

B. That the question of the *bona fides* of the E.P.E.A. as a recognised Trade Union be temporarily dealt with by the Liverpool or Birkenhead Trades Council whose decision shall be without prejudice to any final proceedings before, and shall not be submitted as evidence to, the Trade Union Congress.

C. As an alternative to Clause B the E.T.U. suggest a temporary working agreement to be restricted to Lever's on the following lines :—That the members of the E.P.E.A. employed at Lever Bros. shall in all matters connected with the firm, act in conformity in every way with the decisions of the Electrical Trades Union, Mersey District Committee, pending a joint meeting of the two executives on May 28th, 1920.

D. That where under Clause C matters affecting the position of the members of the E.P.E.A. are to be considered by the Mersey District Committee of the Electrical Trades Union, three representatives of the E.P.E.A. shall be co-opted on such Committee with full voting powers.

E. That in any case where members of the Electrical Trades Union are in dispute at Messrs. Lever Bros., members of the E.P.E.A. undertake not to do anything calculated to defeat the objects of such dispute. Further, that the E.P.E.A. are prepared to convey this in writing to Lever Bros.

The foregoing shall be a temporary agreement, and shall be valid pending the meeting of the two executives, and shall be without prejudice to the position of either one society or the other.

The E.P.E.A. representatives indicated that they preferred to adopt Clauses C and D, instead of Clause B.

Both parties agreed to recommend these proposals to their members for acceptance.

Book Notices.—Scientific Paper No. 371 of the U.S. Bureau of Standards, "A New Cadmium-Vapour Arc Lamp" (6 pp.). Washington : Government Printing Office. Price 5 cents.—This paper deals with a new method of producing a cadmium vapour arc of great brilliancy. Since gallium has a boiling point above 1,500° C., the vapour pressure relation existing between cadmium and mercury is reversed when compared with cadmium and gallium. The cadmium, therefore, acts as the energy carrier when used in combination with gallium in a quartz lamp.

"*Journal* of the Institution of Electrical Engineers." Vol. LVIII, No. 290. April, 1920. London : E. & F. N. Spon, Ltd. Price 10s. 6d.—This issue contains the following paper :—"Eddy Currents in Stator Windings"; also, the annual accounts for 1919, and the Report of the Council for 1919-20.

"*Proceedings* of the Physical Society of London." Vol. XXXII, Part 3 (73 pp.). London : Fleetway Press. 4s. net.—Includes papers on "Testing Magnet Steel," by N. W. McLachlan, D.Sc. (Eng.), and "Forces on Heated Metal Strips," by Gilbert D. West, M.Sc. (Lond.).

"Woodland Notes." (39 pp.).—This well-produced and illustrated magazine is described as "a brief account of Fuller's United Electric Works, Ltd. The social activities of the employés, those they work with, where they work, and what they make," and the object is very well accomplished in this publication, which may be obtained by any member of the electrical industry from Messrs. Fuller's.

"Rotary Converters : Their Design, Construction and Use." By C. Sylvester. Pp. 59; 26 figs. London : S. Rentell & Co., Ltd. Price 2s. net.

"Electric Oscillations and Electric Waves." By G. W. Pierce. Pp. ix + 517; figs. 133. London : Hill Publishing Co., Ltd. Price 30s. net.

"Year Book of Wireless Telegraphy and Telephony, 1920." London : Wireless Press, Ltd. Price 10s. 6d. net.

The issue of *Conquest* for May contains an article by K. Robertson on "Power from Waste," explaining how the waste gases from blast furnaces are used for generating electricity, in addition to heating the blast. Prof. Sir Chunder Bose's remarkable work on plant life, and his magnetic crescograph, are described by K. K. Chatterjee, and there is a variety of extremely interesting articles on other subjects related to science.

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Brazil. — STEEL WORKS AND ELECTRIFICATION IN MINAS GERAES.—A telegram from Rio de Janeiro dated April 27th, received by the *Times* through the *Agencia Americana*, states that the terms of the contract between the Government and the Itabira Iron Ore Co. have been published. They provide for the construction of high power coke furnaces for the production of steel with a guaranteed minimum production of 150,000 tons of steel sheets, ingots, &c. This telegram is of particular interest when read in connection with the report which has been made by the American Commercial Attaché at Rio de Janeiro of the arrival in Brazil at the beginning of the year of representatives of a syndicate to reorganise and electrify the Victoria Minas Railway from the port of Victoria, State of Espirito Santo, to the mineral section of the State of Minas Geraes. The State of Minas Geraes has always contended that its immense iron deposits should be utilised to the fullest advantage of the State, and therefore has maintained a somewhat indifferent attitude toward any proposals regarding the exportation of iron and manganese ores. In fact, one of the greatest handicaps to the exportation of the latter has been the heavy taxes imposed by the State; the inadequacy of transportation facilities has likewise been a drawback. It is understood that the syndicate proposes first to extend its railway to the mineral region, to install works for reducing sufficient ore to meet the iron and steel requirements of the country, and to develop the mines and transportation facilities to permit the exportation of ore in large quantities. Steamers carrying the ore will return loaded with coke and combustibles for the local mills, as it is evidently the opinion of the syndicate's engineers that domestic coal cannot be used because of the large percentage of ash—over 30 per cent. Electrical furnaces, too, though used to some extent in converting iron to steel, have not been found economical for the reduction of ore to iron. One of the problems involved in this study of the exportation of Minas Geraes ore is the distance of the deposit from the coast, some 550 kilometres (342 miles); whereas deposits found in Spain, Sweden, or northern Africa, whence British supplies are at present taken, are only 180 to 200 kilometres distant. In order to overcome this difference the syndicate intends to improve the Victoria Minas Railway by reducing the grades and lessening the curves. A second problem, that of obtaining return freight for the ore shipped, might well be solved by bringing back coke and fuel for the national industries. One of the technical directors engaged to install the proposed steel plant recently arrived on the ground for studying the problem with a view to selecting the best site for the plant.

Association of German Industries.—The German Press has paid considerable attention of late to the formation of the above association, particulars of which are forwarded to the Department of Overseas Trade by the British Commercial Commissioner in Cologne. The association was formed in 1919, and has as its purpose the representation and development of the German industries and the determination of uniform policy of each separate trade and common action in dealing with labour questions. The association has a council and directorate, the latter consisting of at least 30 and not more than 60 members, who either occupy or have occupied a leading position in an industrial undertaking, or have held a position on a board of directorate. The council is empowered to nominate a further 10 members to the directorate. The council, consisting of 7 to 15 members, is elected from the members of the directorate. The chairman of the council is Dr. Ingenieur Kurt Sorge, Berlin; first representative of the chairman is Abraham Frowein, Elberfeld; second representative of the chairman is C. F. v. Siemens, Berlin-Siemensstadt; managing director, Privy-Councillor Dr. W. Simons. A Main Committee is nominated, states the *Deutsche Bergwerks Zeitung*, and consists of representatives of each of the 25 industrial branches into which the association is graded. The total number of representatives is 140, distributed as follows:—

Mining 15, iron producing 10, metal works and metal semi-products 8, machines 5, railway wagons 2, hardware 4, iron and steel goods 5, electrotechnical precision instruments and optics 3, boilers and fittings 2, automobile and bicycles 3, timber 5, leather and leather manufactures 4, stone and earth 6, building 3, pottery 3, glass 4, chemical 10, oils and fats 3, paper 8, textiles 23, clothing 3, breweries and flour and malt mills 3, sugar and foodstuffs 4, provisions 3, shipping and transport 3.

In addition to the 140 members of the industrial groups the Main Committee is further composed of 10 representatives of agricultural associations, 10 representatives of home industries elected by members meeting at the suggestion of the directorate, and 10 representatives of members of the association nominated at the suggestion of the directorate. The Main Committee nominates special committees, and elects from year to year a Committee of Investigation. The following special committees have been formed:—

(1) Committee for the carrying out of the Articles of the Treaty of Peace.
(2) Tax Committee.
(3) Economic Committee.
(4) Social-political Committee.
(5) Press Committee.
(6) Committee of Investigation.

Mutual Discussion.—For the first time since its inauguration in 1916, the National Alliance of Employers and Employed is holding its annual meeting in the provinces. Hitherto, members of the Alliance have met in London, but this year it was decided that, in view of the important Joint Committees of employers and Trade Unionists which the organisation has established in many important provincial centres, the Annual Conference should take place on June 1st in a great industrial area. For this reason, Birmingham, the headquarters of the West Midland Federation of the National Alliance, has been chosen. Extremists in Labour ranks, reactionaries among employers, believe in the policy of force. The Alliance stands for forbearance, and the work it has accomplished is an assurance that steadily increasing numbers of employers on one side, and representatives of organised Labour on the other, are massing themselves with this movement, and striving for agreement over industrial problems—with goodwill. The National Alliance takes a grave view of the present spirit of unrest manifested in every section of the community. The price of commodities still increases, and with every rise in wages there is a corresponding increase in the cost of living. Labour blames Capital, and Capital blames Labour, but there is no whole-hearted effort on the part of either side to grapple with the problem in that spirit of unity which won us the war. The National Alliance claims to be the only organisation which can provide the machinery for a round table conference of employers and employed *of all trades*, who can discuss dispassionately the vital problems which touch intimately their very lives, and strike at the root of the trouble. In the great industrial centres where Alliance Committees are established, problems such as housing have been profitably discussed by local employers and Trade Unionists, and at such discussions the barriers of mutual suspicion and recrimination between Capital and Labour have been broken down.

Trade Announcements.—THE BENJAMIN ELECTRIC, LTD., of Tottenham, have been appointed sole selling agents by the Moto-Meter Co., Inc., for the Boyce Moto-Meter device, intended for use on motor cars, which indicates the temperature of the water in the radiator, thus notifying the driver of any undue overheating 15-20 minutes before he would otherwise be aware of the fact by engine trouble.

MR. J. HARRISON announces that he is continuing the business of MESSRS. HARRISON & WYLDE, electrical engineers, of Rotherham, under the style of Harrison & Co.

THE JACKSON ELECTRIC STOVE CO., LTD., are removing to 143, Sloane Street, London, S.W.

In order to cope with the increased business of their Cardiff branch, the BRITISH THOMSON-HOUSTON CO. have acquired, and now occupy, much larger premises at 7, Park Place, Cardiff, a few doors from the old address. Telephone number as before:—"Cardiff 4392." At the new office considerably larger stocks will be held, especially of the company's many forms of lighting appliances.

Catalogues and Lists.—THE DELTA ELECTRICAL CO., Temple Courts, Temple Row, Birmingham.—Pamphlet No. 100, illustrating and describing a new patent dolly-operated watertight tumbler switch.

BUILDING PRODUCTS, LTD., Columbia House, 44-46, King's Road, Sloane Square, S.W. 3. A leaflet illustrating the "Benquic" bar-bending machine for steel rod of any section, up to 1¼ in. diameter circular.

AUTOMATIC AND ELECTRIC FURNACES, LTD., 281-283, Gray's Inn Road, W.C. 1.—"Heat Treatment Bulletin" No. 21, describing the construction and advantages of Wild-Barfield patent electric furnaces. Includes a photograph of a typical radiation furnace installation.

MESSRS. SIEMENS BROS. & CO., LTD., Palace Place Mansions, Kensington Court, W. 8.—Pamphlet S 535 (15 pp.) giving a fully illustrated description of "Autophone" No. 2 automatic telephone system. The major portion of the pamphlet is devoted to a description of the ingenious switching apparatus and photographs of the component parts.

MESSRS. BROOKES, LTD., Lightcliffe Works, Halifax.—"Science, War and Commerce" (36 pp.), a booklet describing the firm's war-time activities; and "Dreams and Realities" (16 pp.), transcription of an interview with the managing director.

MESSRS. IMESON & FINCH, Empress Works, Stockton on-Tees.—A 12-page catalogue, illustrating and describing controllers, armature coils, brush-holders, trolley heads and wheels, commutators, fuse-holders, &c.

Italian Companies.—There has been formed in Milan a company styled Officine Elettromeccaniche Monteggia, with a capital of 1,600,000 lire.

At Montaldo has been launched the concern Segheria di Montaldo Dora, with a capital of 180,000 lire, for the dual purpose of sawmilling and the production and distribution of electrical energy.

The Società Anonima Radiotelegrafica Italiana has been established at Milan (Via Cavallotti 3), with a capital of 2,000,000 lire, for the manufacture of wireless telegraphic and telephonic apparatus.

With headquarters at Milan (Via Carlo Alberto 4) Zanni e Pirini have been incorporated as a company, with a capital of 150,000 lire, to conduct an electro-galvanoplastic laboratory.

Allocchio, Bacchini e Ca. have been formed into a company at Milan (Via Rasori 14), with a capital of 400,000 lire, for the manufacture of electrical measuring apparatus.

Electrical Wages at Liverpool.—The Mersey District Committee have given three months' advance notice of an application for an advance in wages from 2s. 1½d. per hour to 2s. 6d. per hour for all electricians employed in the Liverpool area. Application is also being made for a 10s. advance for youths over 18 years, and 5s. a week for those under.

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Bankruptcy Proceedings.—ALBERT EDWARD CHANNON, HUMPHREY STANTON NADIN, and CYRIL GEORGE CHANNON (trading as A. E. Channon & Co.), electrical engineers, 8, Orrisdale Terrace, and 425, High Street, Cheltenham, Gloucestershire.—In this matter the receiving order was made on April 26th, 1920, on the debtors' petition. The liabilities in the partnership statement of affairs amount to £1,363, and the assets to £387. The separate liabilities of Albert Edward Channon amount to £22, and assets £25, thus showing a surplus of his separate estate of £3. The liabilities of the debtor Nadin amount to £8 15s. 6d., and he has no assets. The separate statement of C. G. Channon show liabilities amounting to £4 10s. 6d., and he also has no assets. The causes of failure alleged by the debtors are want of capital, losses on contracts, pressure by creditors, and ill-health of A. E. and C. G. Channon. The debtors were adjudged bankrupt on the same date as the receiving order was made. An execution was levied on February 8th last, and the debt and costs, amounting to £97, were paid. Two creditors have issued writs for sums amounting to £103, and there are several small judgments outstanding. The debtors, who are father, son-in-law, and son, state that they commenced business as electrical engineers at 425, High Street, Cheltenham, on January 1st, 1912. Their joint capital did not exceed £10, but stock-in-trade to the value of £200 was then obtained on credit. The books of account kept were sold ledger, day, invoice, order, and estimate books. The debtors further state that they took stock in February last, and, according to a statement given to one of the creditors, at that time they valued the assets at £647, and estimated the liabilities at £613. Having regard to the debts now scheduled in the statement of affairs, it would appear that the liabilities must have been greatly under-estimated. The debtors state that they became aware of their position in February last, and they have since contracted debts in the expectation of being able to retrieve their position. The unsecured liabilities on the separate estates of the debtors are for domestic debts. The following are creditors :—

Baxendale & Co.	£94	Metallic Electric Co., Ltd. ..	£12
Braulik, G.	44	Olivant	39
Bill & Berry	25	Simplex Conduits, Ltd.	45
Callender's Cable Co., Ltd. ..	25	Simpson, Baker & Co.	113
Drake & Gorham, Ltd.	123	Sharp, Fisher, Ltd.	502
Elco Manufacturing Co. (Bristol)	54	Fisher, John, & Sons	12
Export Loose Letter Sign Co. ..	11	Separate estate of A. E. Channon:	
Ediswan Co., Ltd.	58	The Cheltenham and Gloucester Building Society, Cheltenham (Sec. £350)	320
Falk, Stadelmann & Co., Ltd. ..	42		
Henley's, W. T., Ltd.	48		

The first meeting of creditors herein was fixed to be held on May 14th at the County Court Buildings, Cheltenham, but no creditors attended. The Official Receiver stated that he had received several proxies, one of which was a special proxy for £55, with directions that he should continue as trustee. There were, however, he stated, two points which would require investigation. One was in respect of the removal, by one of the largest creditors of goods, to the value of about £200, on 16th and 17th ult., and application had already been made for their return. The other point was with reference to the house and furniture. The affairs will remain in the hands of the Official Receiver.

LEWSLEY, J. W., electrician, lately trading at 103, Mansfield Road, Nottingham.—June 5th is the last day for the receipt of proofs for dividend. Trustee, Mr. E. W. Humphreys, 4 Castle Place, Park Street, Nottingham.

G. F. KIVEBON, electrical engineer, Sheffield.—First meeting. May 21st; public examination, June 10th; both at Sheffield.

Quain Electric Co., Ltd.—In the Companies Winding-Up Court on Tuesday, the petition of R. & A. Main, Ltd., of Gothic Works, Edmonton, for a compulsory order to wind-up Quain Electric Co., Ltd., came before Mr. Justice Astbury. Mr. Jolly, for the petitioners, said the petition had stood over for a fortnight in view of negotiations for a compromise. The only parties opposing the petition were the debenture-holders, and Mr. Bennett, who appeared for them, had agreed with him that the petition should be withdrawn without any order as to costs. Mr. Bennett: I agree. His Lordship allowed the petition to be withdrawn, without costs.

Capital Expansion of the German Siemens Co.—As a result of the great advance in the prices for raw materials and in wages, together with the reduction in the working shift, and the decreased efficiency of the workmen which have prolonged the time of manufacturing as compared with former years, the directors of the A.G. Siemens & Halske, of Berlin, have prepared a scheme for doubling the spare capital and making alterations in the company's statutes so as to prevent foreign interests from acquiring control over the undertaking. It is proposed to increase the present share capital of 63 millions of marks to 126 millions by the issue of new bearer shares for 63 millions, which are to be offered to existing shareholders at the price of 125 per cent., and to be entitled to participate in the dividend for 1920 for one-half of the year, and one new share can be subscribed for each existing share. It is recognised in Germany that the influence and co-operation of the Siemens family in connection with the company have answered the purpose during the course of decades, and it is now intended to convert a large number of the old shares into preference shares, with a manifold right of voting, namely, each preference share will be endowed with 30 votes. It is assumed that the raising of further capital in the future, and, if necessary, of obtaining capital from abroad will be facilitated in this way without losing the existing control and the German character of the undertaking. Thus, the ordinary shares ranging from No. 1 to 9,500, now held by the Siemens family, and representing a nominal amount of 9,500,000 marks, will be transformed into registered preference shares, and with the manifold voting power mentioned will be equal to 285 millions of marks.

The special voting power conferred upon the preference shares is only to be exercised in the case of decisions of vital importance, as, for instance, alterations in the company's statutes increases or decreases in the share capital, changes in the object of the undertaking, amalgamation or dissolution of the company, elections to the board of directors, and voting in regard to the dividends. On the other hand, limitations are to be imposed on the transfer of the preference shares. For instance, the transfer of shares to other persons is made dependent upon the sanction of the president of the Berlin Chamber of Commerce, and can only be granted if the prospective purchaser gives a guarantee that he will protect the rights of the company as German, and if he is a German residing permanently in Germany or in German Austria. It is also intended to modify the statutes so that the majority of the directors must be Germans. The directors believe that the scheme, without materially prejudicing the rights of the ordinary shareholders, will prevent the company from passing under foreign control. As bearing on this point it is mentioned that frequent inquiries from abroad have already been made for ordinary shares in the company. If the directors may think of taking advantage of those offers for the future financing of the company, they at the same time have considered it necessary already now to adopt the measures referred to, in order to obviate undesirable consequences.

It is assumed that a considerable portion of the proposed new capital is intended for the Siemens-Schuckert Works, either by way of an increased loan or additional ordinary capital. If this assumption should prove to be correct, there is no doubt that the other joint partner in the Siemens-Schuckert Works—the Schuckert Co., of Nuremberg—will have to undertake a new financial transaction if the respective capital investments in the Siemens-Schuckert Works are to remain on an equality.

The F.B.I. Abroad.—We have received a summary of the report prepared by Sir Charles Mandleberg on one year's achievements of the Federation of British Industries Commissioner Service. The following is a list of Commissioners and Representatives abroad :—

Place.	Name and address.	Status.
Near East ..	Major E. Kennard, Athens	Commissioner.
Greece ..	Capt. R. C. Cumberbatch, Athens ..	Sub-Commissioner.
Turkey ..	Capt. Lafontaine, Athens (temporarily)	Sub-Commissioner.
East Indies ..	Mr. G. O. Blacker, Singapore	Commissioner.
Spain	Col. C. Thoroton, C.M.G., Madrid ..	Commissioner.
Algiers	Mr. D. Thoroton, Algiers	Sub-Commissioner.
Brazil	Mr. P. J. McKellen, Rio de Janeiro ..	Commissioner.
Scandinavia ..	Mr. Montagu Villiers, Copenhagen ..	Commissioner.
Denmark ..	Mr. Paul Christensen, Copenhagen ..	Correspondent.
Australia ..	Mr. R. H. Butler, Melbourne	Correspondent.
Italy	Mr. E. H. Kapp, Milan	Representative.
Holland ..	Anglo-Dutch Committee, Amsterdam ..	Committee.
Canada	(1) Canadian Manufacturers' Association, Toronto.	Correspondents.
	(2) Canadian Association of British Manufacturers and their Representatives, Toronto.	Correspondents.
New Zealand ..	New Zealand Association of British Manufacturers and their Agents, Wellington.	Correspondents.

In addition to the foregoing, representation of a temporary nature was arranged during the period under review in Portugal and in the Occupied Area of Germany.

Arrangements have also been made for honorary Correspondents in the following countries :—Denmark, Finland, U.S., Cuba, Mexico, Egypt, France, China.

Applications for British Trade-Marks.—Appended is a summary of the recent applications for British trade-marks in respect of goods connected with the electrical industries and trades :—

Atmos. No. 393,544. Class 8. Electric lamps and galvanometers. No. 393,545. Class 13. Electric bells and fittings. No. 393,546. Class 18. Lighting contrivances and electric bell systems.—General Electric Co., Ltd., 67, Queen Victoria Street, London, E.C. July 23rd, 1919.

Solanti. No. 400,762. Class 39. Goods manufactured from india-rubber and gutta-percha.—India-rubber, Gutta-percha and Telegraph Works, Ltd., 106, Cannon Street, London, E.C.

Triangle (design). No. 399,244. Class 8. Resistance rods, coils, contact blocks and bearings, all parts of electrical apparatus.—The Morgan Crucible Co., Ltd., Church Road, Battersea, S.W. January 7th, 1920.

P.N. (design). No. 400,524. Class 13. Electric lamps.—The Pyle National Co., 1534, Kostner Avenue, Chicago. February 2nd, 1920.

Isco. No. 400,650. Class 13. Electric fittings.—W. T. Henley's Telegraph Works, Ltd., 13-14, Blomfield Street, London, E.C. February 11th, 1920.

Busy Bee. No. 396,862. Class 6. Electric motors and dynamos.—W. J. Allen & Wallace D. Vick, 73½, Coleshill Street, Birmingham. November 5th, 1919.

Bi-Spineflex. No. 401,312. Class 16. Electric insulators made of porcelain.—Taylor, Tunnicliff & Co., Ltd., Eastwood Works, Hanley. February 28th, 1920.

Majestic. No. 401,673. Class 13. Metal filament lamps, being ordinary electric lamps.—General Engineering Co. (Salford), Ltd., 74, Broad Street, Pendleton, Manchester. March 10th, 1920.

Morite. No. 400,239. Class 50. Electric insulators made of one of the phenol formaldehyde condensation products or syntheses of same.—Arthur S. Gush, 5, Clifton Terrace, Edinburgh. January 30th, 1920.

Blackcap-Ediswan (lettering combined with design). No. 400,164. Class 8. Electric lamps for philosophical purposes.—Edison Swan Electrical Co., Ltd., 123-5, Queen Victoria Street, London, E.C. January 29th, 1920.

Kalecore. No. 400,948. Class 8. Paper-insulated electric cables.—Callender's Cable and Construction Co., Ltd., Hamilton House, Victoria Embankment, London, E.C. February 19th, 1920.

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French Company Notes.—Under the title of Le Téléphone Moderne, Société d'Installations Téléphoniques, a company has been formed at Paris (12, Rue du Port Mahon), with a capital of 150,000 fr., for the installation of telephones.

The Société Générale de Force et Lumière have raised their capital from 30,000,000 to 50,000,000 fr. Eventual increase to 75,000,000 fr. is also authorised.

The capital of Le Fil Dynamo is to be raised from 500,000 to 3,000,000 fr., for the building of a new works.

The Société Hydroélectrique du Verdon has raised its capital from 1,000,000 to 2,500,000 fr. in order to secure rights on falls on the upper Verdon River.

There has been formed at Paris (Rue de Londres 29), the company Lignes Télégraphiques et Téléphoniques, with a capital of 10,000,000 fr., for the planning, manufacture and working of all kinds of electric lines and cables. This company is a trust of French cable and wire makers, embracing all the important firms except the Société Alsacienne, Jeumont, and the Société Industrielle des Téléphones. On its board of management are representatives of the Thomson-Houston, the Tréfileries et Laminoirs du Hâvre, the Canalisation Electrique, the Berthoud-Boret, and the Matériel Téléphonique companies.

The Electrodes de la Savoie is the style of a company launched at Paris (2, Rue Blanche), with a capital of 2,000,000 fr., for the manufacture of electrodes.

The Société Française de Lamps à Incandescence "Luxor" (Floret et Cie.) has been constituted at Levallois-Perret, Seine (8, Rue des Frères Herbert), with a capital of 375,000 fr., for the manufacture of glow lamps.

The Etablissements André Dauphin has been formed into a company (14, Rue St. Claude, Paris) for the manufacture and trade in electric material. Its capital is 100,000 fr. in 100 fr. shares, 100 of which are allotted to the Société Dauphin et Cie. for assets taken over.

Under the style of the Ateliers de Construction et Installations Electromécaniques has been formed at Rouen (52, Rue St. André), a company with 200,000 fr. capital, for the objects shown in its title.

The Compagnie Electro-Industrielle has been constituted at Levallois, Seine (Rue Jean Jaurès 32), with a capital of 3,000,000 fr., for the manufacture and trade in electrical material of all kinds, including metal working and mechanical.

The Etablissements Métallurgiques Rhône-Isère has been established at Lyons with a capital of 1,000,000 fr., for the objects set out in its title.

The Auxiliaire Industriel is the style of a company established at Paris (5, Rue d'Athènes), with a capital of 600,000 fr., for the study, manufacture, sale, and representation of all kinds of electrical material.

With a capital of 200,000 fr., Le Matériel has been constituted a company at Paris (21, Rue d'Edimbourg), for the trade in and manufacture of electrical material for public works, especially hydraulic, mechanical, and heating.

Under the title of Le Moteur Electrique has been formed at Lyons (18, Route de Crémieux), a company for the manufacture, purchase, and sale of motors, dynamos, and transformers; also their erection and repair. The capital is 1,000,000 fr.

Annual Outing.—No doubt there will be quite a marked revival of the annual outing this year, notwithstanding the high cost of everything. The first of the season, so far as reports have reached us, is that of the London branch of Messrs. Malcolm & Allan, Ltd., electrical engineers and contractors. A party of just over a hundred, including ladies, went to Maidenhead and district by the steam-launch *Empress of India*, on Saturday, May 15th. The company boarded the launch at Windsor. Luncheon was served on board. The sports events were very successful; football, three-legged and other races, occupied so much time and created such interest that there was not time for the cricket match. On the return to Windsor a successful concert and dance were held. The prizes for the sports were distributed by Mrs. H. S. Davidson.

The E.T.B.I.: Local Commitees at Newcastle.—A meeting for the purpose of appointing a local Advisory Committee of the Electrical Trades' Benevolent Institution for Newcastle and District, was held at the Mining Institute, Newcastle-on-Tyne, on May 10th. Mr. W. C. Mountain, who presided, briefly explained the objects of the Institution, and said that the Committee of Management was in London, but he thought they should have a Local Advisory Committee in the North-Eastern Area, which was very naturally, from the Tyne to the Tees. Mr. Mountain said it would not be very long before the present fictitiously prosperous times would come to an end. He did not want to be pessimistic, but there was no doubt that we were in for bad times before we were very much older, and if they were ready to help those who were unable to get employment, and who possibly might fall into bad luck and in a position where this Institution could help them, they would be promoting a very good object. Mr Hawes, the secretary, then outlined the work of the Institution, and gave typical examples of cases that had come before the Institution for aid. After a number of questions had been asked and answered, Mr. Clothier proposed, Mr. Anns seconded, and it was unanimously resolved, to elect a Committee for the district. Mr. Mountain is the chairman of the Committee; Mr. T. W. Anns, honorary secretary; Mr. J. Gledson, honorary treasurer; and the following are on the Committee:—Messrs. W. F. T. Pinkney, Newcastle Electric Supply Co.; D. Patterson, Newcastle and District Electric Lighting Co.; W. Dalton, Newcastle Corporation Tramways; J. W. Dodds, Electric and General Stores Co., Ltd.; Alan Robson, Simplex Conduits, Ltd.; H. P. Devereux, Devereux Moodie & Co.; R. Robson, Robson & Coleman; H. Barkes, British Electrical and Manufacturing Co.; J. Spence, General Electric Co., Ltd.; W. Fletcher, Fletcher Bros.; Mr. Clothier, Reyrolle & Co.; Mr. Stephens Holmes, Messrs. J. H. Holmes & Co.; Mr. Raw, Mining Electrical Engineers; Mr. Wyand, Sir W. G. Armstrong, Whitworth & Co.; Mr. Thompson, Cleveland and Durham Electric Power Co.; Mr. Sloan, Newcastle Electric Supply Co.; and one nominee from each of the following: Messrs. Clarke, Chapman & Co.; Messrs. Sunderland Forge and Engineering Co.; Society of Technical Engineers; Electrical Power Engineers' Association.

Liquidations and Dissolutions.—GRATZ, LTD.—Winding up voluntarily for reconstruction purposes. Liquidator, Mr. E. V. Hayes-Gratze, Elidia, Woodstock Avenue, Hendon, N.W. 4.

HYDRO-ELECTRIC CONCESSIONS, LTD.—Winding up voluntarily. Liquidator, Mr. W. Gain, 3 and 4, Great Winchester Street, E.C. Meeting of creditors at 3 and 4, Great Winchester Street, E.C., May 25th. Claims to be sent to the liquidator forthwith.

BRITISH EVER-READY CO., LTD.—Winding up voluntarily for reconstruction purposes. Liquidator, Mr. W. T. Walker, 53, New Broad Street, E.C. Meeting of creditors at Hercules Place, Holloway, May 25th.

BRITISH ELECTRICAL ACCESSORIES, LTD.—Meeting of creditors at 3, Cheapside, Bradford, May 21st.

ELECTRICAL AND MECHANICAL TRADES SUPPLY, Russell Buildings, St. Mary Street, Swansea.—Mr. W. A. Roderick and Mr. R. Scott have dissolved partnership. Mr. W. A. Roderick will attend to debts and continue the business.

ECONOMIC ELECTRIC CO., automobile and electrical engineers, 63, Knutsford Road, Warrington.—Messrs. B. Nadin, W. Wright and P. J. Dell have dissolved partnership. Debts will be attended to by Messrs. B. Nadin and P. J. Dell, who will continue the business under the same style.

PARKER & PARKES, electric welders, &c., Union Street, Newport.—Mr. W. G. Parkes and Mr. R. S. Parker have dissolved partnership. Debts will be attended to by Mr. W. G. Parkes.

NORTHAMPTON PLATING CO., electro-metallurgists and enamellers, 71, St. Giles Street, Northampton.—Mr. W. F. White and Mr. E. H. Nichols have dissolved partnership. Debts will be attended to by Mr. E. H. Nichols, who will continue the business.

SIMMS MOTOR UNITS, LTD.—Winding up voluntarily, in view of the sale of the undertaking to a new company. Liquidator, Mr. D. R. Duncan, Percy Buildings, Gresse Street, Rathbone Place, W. 1. Meeting of creditors at Percy Buildings, May 27th.

SPANISH AND GENERAL WIRELESS TRUST, LTD.—Particulars of claims must be sent to the liquidator, Mr. S. Pears, 14, George Street, Mansion House, E.C., by June 22nd.

Socials.—The third of the Mazda House series of staff entertainments took place at Slater's Cannon Street Restaurant, on May 7th. At 6.30 p.m. the party of 100 sat down to progressive whist, and for upwards of 90 minutes played with relentless fervour for the prizes, which were distributed by Mr. F. Shaw, the chairman, at supper. During the meal a collection was taken for the waitresses, which, when counted, was found to include one farthing. It was returned to the only Scotsman in the room. After supper the company engaged in terpsichorean exercises, interspersed with songs rendered by various members of the B.T.H. staff.

Exeter Agricultural Show.—The Devon County Agricultural Association held their exhibition at Exeter during May 12th, 13th, and 14th. The exhibition generally was a huge success. On the electrical side were the following stands:—Austin Motor Co., Ltd., showing their 75-KW. autoplant; Studebaker, Ltd., Lalley light and power plants; R. A. Lister & Co., Ltd., Lister-Bruston plant; Brooking & Co. The last-named firm appeared to be the only electrical contracting and installation company exhibiting, with the result that they had a free run of inquiries, plus a very satisfactory order book, not only for their particular goods on show, but also for the goods shown by the manufacturers at the other stands. Brooking & Co. had on show the Madstrong set, also the Ingeco set by Worthington of pump fame. The Hoover vacuum cleaner was to be seen in operation, a special demonstrator being in attendance. A particular feature of the stand was the prominence given to Callender's Kaleeco wiring system, which is meeting with great success in the West of England. At their stand, Messrs. Wood & Ball represented the manufacturers with the idea of doing all that is possible to popularise the use of electricity in agriculture and like industries, and to render direct assistance to electrical contractors. They will be showing at Salisbury Show. Their various exhibits included the plants made by the New-Pelapone Engine Co., Ltd., of Leeds; St. Helens cab tires, C.T.S. cables and anti-corrosive fittings; lighting fittings, by Electrical Supplies Co.; electric self-starting switchboards, by Mr. T. Burgoyne, of Kingsbridge, Devon; batteries, by Pritchett and Gold and E.P. Storage Co., Ltd.; and motors, by Bruce Peebles and Co., of Edinburgh. We are informed that a particular feature of the Exeter Show was the mutual good feeling between the manufacturer and the contractor.

Important Armstrong-Whitworth Development.—It is announced that MESSRS. SIR W. G. ARMSTRONG, WHITWORTH AND CO., LTD., have entered into arrangements with an old-established Christiania firm of hydraulic engineers (Messrs. Jensen & Dahl), under which they will take up the manufacture in this country of water turbines to Jensen & Dahl designs. Messrs. Armstrong, Whitworth have opened a hydro-electric section at their offices at 8, Great Georgel Street, Westminster, S.W. Messrs. Jensen & Dahl have been responsible for many important Norwegian and other hydro-electric enterprises. The British company referred to has the exclusive rights for the British Empire and South America.

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A New Electric Heater. — The efficiency of electric heaters is limited by the melting point of the heating units and the lack of intimate contact between the heating units and the material to be heated. If the heaters are laid inside the containing vessel, there is no material of which they can be constructed that will not be attacked by electrolysis when saline or other solutions are being heated. A new form of heater for A.C. circuits, described in *Electrotechnische Zeitschrift*, consists of a vessel provided with a vertical channel through its interior, through which the magnetic circuit of a transformer passes. The energy is supplied to a coil wound around the magnetic circuit, and the heat is generated in a metal cylindrical wall interlinked with the magnetic circuit and forming the side or bottom of the vessel and acting as a secondary circuit to the transformer. The efficiency of a vessel of this type is nearly unity.

Liverpool Exhibition.—An interesting feature of the Liverpool Health and Homes Exhibition held at St. George's Hall, was the useful display of domestic electrical contrivances, for lighting, motive power, heating, &c. The exhibition was visited by thousands of people, who paid special attention to such exhibits.

Patent Application.—On June 16th, Mr. Justice Sargent, in the Chancery Division, will hear the petition of the Reason Manufacturing Co., Ltd., of Brighton, for an extension of the term of Patent No. 20,500, of 1905, for "Improvements in mercury electrolytes for electrolytic cells," and of Patent No. 20,770, for "Improvements in cathodes," both granted to H. S. Hatfield and the Reason Manufacturing Co.. Ltd.

New Indian Companies.—Among the new companies recently formed in India are the Indian Enfield Cable Co., 4, Fairlie Place, Calcutta, capital 2,500,000 rupees, to manufacture and deal in electric wires, cables, &c.; and the Coal Fields Power Co., Calcutta, capital 1,500,000 rupees, to establish plant to generate electric energy for lighting and power purposes.

LIGHTING AND POWER NOTES.

Argentina. — COMPANY REPORT. — According to the recently-issued report of the Société d'Electricité de Rosario, the company is now supplying power to the extent of 25,230 KW. to 21,630 clients, as compared with 23,820 and 20,074 respectively a year ago. The output of the generating station during 1919 reached a total of 22,899,989 KW.-hours, an increase of 15 per cent. over 1918. The boilers at the generating station have been converted to use coal and petroleum as fuel in place of wood.

Australia. — MELBOURNE. — The recently-published abstract of the accounts of the City Electricity Supply undertaking, for the year ended December 31st last, shows that the total revenue amounted to £240,081, and the total expenditure to £134,854, leaving a gross balance of £105,227, apportioned as follows:—Interest on capital, &c., £23 885; depreciation and renewals account, £37,999; and appropriations, £43,343.

Ayr. — PROPOSED EXTENSIONS. — The Corporation is seeking authority from the Electricity Commissioners to install additional plant or build new works. An alternative scheme is to take a bulk supply from Kilmarnock.

Barnsley.—CHARGE FOR METERS.—The Electricity and Lighting Committee recommends that a rental of 1s. 6d. per quarter be charged on all electricity meters installed in premises the net rateable value of which exceeds £10, the rental to come into force as from June 1st.

EXTENSIONS APPROVED.—The Electricity Commissioners have sanctioned proposed extensions to the present electricity works. The Electricity Committee has received a report from the electrical engineer in connection with the progress of such extensions.

Blackpool.—FUTURE DEVELOPMENTS.—The Electricity Committee has authorised the electrical engineer to seek an interview with the Electricity Commissioners, to place before them the local position with regard to electricity generation and distribution, and to ascertain, if possible, their proposals for the future development of the electricity supply business on the West Coast. This followed the Committee's adoption of the recommendation to install additional boilers at the electricity works.

Bradford.—NEW CONDITION OF SUPPLY.—The Electricity Committee has announced that in future applicants for electricity must sign a special condition which provides that the Corporation reserves the right to suspend the supply if it is found necessary when the total demand for power exceeds the effective capacity of the plant at the works. The condition is the outcome of the difficulties which arose during the recent long breakdown period at the generating station.

Bury.—LOAN.—The Town Council is applying for permission to borrow £4,341 in order to carry out extensions to mains, services, and public lighting.

Burnley.—PROPOSED EXTENSIONS.—The demand for electric power for mills and workshops has increased to such an extent, that steps will shortly have to be taken to provide additional generating plant. The Town Council has been recommended to seek borrowing powers for £150,000 to provide this, although under the new scheme for the Mid-Lancashire area it is probable that at least two large generating stations will be erected at approved centres.

Canada.—HYDRO-ELECTRIC DEVELOPMENT.—An estimate of £3,400,000 has been submitted to the Ontario Legislature for the requirements this year of the provincial hydro-electric system, over £2,000,000 being for power development at Chippewa and Queenstown.—*The Times.*

Clacton-on-Sea. — PROPOSED PRICE INCREASE.—The Urban District Council has applied to the Electricity Commissioners for power to increase the price of electricity by not more than 50 per cent., to enable the undertaking to be run without loss. A new Diesel engine is to be installed at the works.

Continental.—FRANCE.—One of the greatest industrial regions in France is formed by the suburbs of Paris, where the Union d'Electricité has undertaken the task of providing a supply of light and power on terms favourable to the consumers. The company has already purchased the works of the suburban undertakers, and intends to retain as auxiliaries those which are able to work on an economical basis, whilst the others will be disposed of so as to redeem the purchase price. It has been decided to substitute for these old works a super-station with a total capacity of 200,000 KW., and equipped with steam turbo-alternator sets of from 35,000 to 40,000 KW., which sets will be, it is said, the largest in France down to the present time. The primary network will have a pressure of 60,000 volts, and it is expected that the company will be able to dispose of 500,000,000 KW.-hours on the completion of the station. The company's share capital was recently increased to 125,000,000 fr., and the issue of a loan of 80,000,000 is now in contemplation.

The new station which the Compagnie Hydroelectrique et du Gaz de Lyon has been building on the Gorges du Fier will shortly be working; it will have a capacity of 40,000 H.P.

The French Minister of Agriculture has just created an Upper Council of Water and Rural Engineering entrusted with the examination of all questions—technical, economic, financial, and judicial—relating to the development of water resources, control of water courses, and the application of electricity to agriculture. It is divided into three sections—water, rural engineering, legislation, and litigation.

SWEDEN.—Great strides have been made in Sweden in late years in the use of electricity in agriculture. Three great hydro-electric installations exist, which place at the disposal of farmers a considerable amount of energy. One of these is situated near Trollhattan, a second is near Hjemsjö, and the third belongs to the Southern Sweden Electric Co. The energy, in the first of the above installations, is transmitted to sub-stations, where the pressure is stepped down from 70,000 to 20,000 volts; to these sub-stations are linked others, which supply at from 1,500 to 3,000 volts, available for use within a radius of three or four miles, the subscribers themselves forming a distributing company and providing the capital for the construction of their own local network. The State gives help to companies of this kind by means of loans on favourable terms. The distributing companies unite together into district or central companies, with their own appointed engineers, who carry out inspections and schemes of improvement, and, on demand, give advice. The largest of these companies buys its own materials, at a considerable saving of expense and with the best guarantee of the type and quality of the purchases. The electric energy serves the most varied uses and operations; besides lighting, it is used to drive threshing machines, straw-presses, winnowers, straw-cutters, forage-cutters, lifts, cheese-churns, milkers, &c.—*Bolletino d'Informazioni Agrari.*

Among the new companies recently formed in Sweden, in connection with the utilisation of water-power in the generation and distribution of electrical energy are the Nasums Elektriska Kraft Aktiebolag, organised at Osby, and the Vikbolandets Elektriska Aktiebolag, formed at Norrkoping.

SWITZERLAND.—The recently issued report of the North-East Swiss Power Works Co. gives interesting information regarding the large new stations for which a general meeting is being asked to sanction an outlay of 114,000,000 fr. In the year 1916-17 the output totalled 149,000,000 KW.-hours; in 1918-19 it rose to 222,000,000 KW.-hours; for 1924-5 the requirements will reach 346,000,000 KW.-hours, which cannot be supplied by the existing stations at Beznau, Löntsch and Eglisau, the last-named only completed this spring, as their total output only amounts to 186,000,000 KW. for 3,000 hours. The deficiency cannot be met permanently by resort to outside supplies, which are both increasingly difficult to procure and ever rising in cost. Hence the company is planning the building of three new power stations, namely, the Etzelwerk, the Wäggitalwerk and a station on the Aare, near Gippingen. The first-named station will be built near Megglen, on the Sihl River, and will have a capacity of 70,000 KW. and a yearly output of 135,000,000 KW.-hours. Its estimated cost, 2·5 fold the outlay before the war, is 94,000,000 fr. The second-named station will be built at Siebnen, on the Wäggital River, and will have a capacity of 60,000 KW., and a yearly output of 80,000,000 KW.-hours. Its cost is estimated at 60,000,000 fr. The third station will be situated on the Aare, near Koblenz, and will have a capacity of 30,000 KW., and its output will bring the

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aggregate up to 260,000,000 KW.-hours. The estimated cost of this station is 65,000,000 fr. To defray the outlay on these several stations to the extent of 114,000,000 fr., shares to the amount of 34,000,000 fr. will be created, and 80,000,000 fr. of bonds issued, raising the capital of the company to 70,000,000 fr., and the bond indebtedness to 105,000,000 fr. Cantons interested in the undertaking will take up the new shares in the following ratio :– Zurich, 42 per cent.; Argau, 32 ; Thurgau, 14 ; Schaffhausen, 9 ; Glarus, 2 ; and Zug, 1 per cent.

BAVARIA.—A new limited liability company is being floated in Mellrichstadt, whose object is the construction of a long-distance power transmission station for the uniform supply of the Rhön, Dernbac, Mellrichstadt, Königshofen, and Meiningen districts. The electricity works in each district are to be affiliated to the new company. To meet the excess costs of construction, the communes are paying a subsidy—amounting to 100 marks per head of the population—which is non-redeemable, and carries no interest.—*Economic Review.*

TURKEY.—La Société Ottomane d'Electricitè, of Constantinople, has recently secured from the Turkish Government an extension of 33 years of its concession, the Government's right of purchase having also been delayed until 1943. The number of clients of the company increased during the past year from 12,137 to 12,894 ; the output of the generating station during the past year amounted to 25,696,500 KW.-hours, as against 28,111.150 KW.-hours in 1913.

ITALY.—In order to meet the increasing demand for electricity, the Società Bolognese di Elettricità has decided to considerably enlarge its steam-operated generating plant, no further available water power for the hydro-electric station being available.

Deal and Walmer.—TIME EXTENSION.—The Minister of Transport has extended, to September 30th, the time under the Deal and Walmer Gas and Electricity Act for the extension of mains.

Douglas (Isle of Man).—ELECTRICITY SUPPLY.—The Douglas Electric Light and Power Co., Ltd., and the Town Council have asked leave from the Tynwald Court to introduce Bills for the supply of electricity in the borough, and a committee has been deputed to recommend that the petition be granted.

East Ham.—LINKING UP.—Writing to the Corporation, the secretary of the Electricity Commission says :—

"Applications for the extension of generating plant have been received from the local authorities of East Ham, Barking and Ilford respectively, and the Electricity Commissioners are of opinion that it is inexpedient and contrary to the public interest that any further extensions of generating plant should be made at the above-named three places.

"A Conference of the Electrical Engineers of the three boroughs and districts and also of the Borough of West Ham was, therefore, summoned, and the engineers were invited by the Commissioners to state their views, it being understood that the Conference was to be without prejudice to the interests of any of the Councils whose engineers were present.

"As a result of this Conference, and at the request of the Commissioners, the engineers have inquired into the matter very fully in order to ascertain the further demands that are likely to arise in each district during the next three or four years, and an estimate of the cost of laying a transmission line to interconnect these three districts and the West Ham electricity undertaking has been prepared.

"A comparison of the cost of energy in each district if the further supply required be taken wholly from West Ham, with the cost of generation from an extended local station, shows that East Ham, Barking and Ilford would all benefit by such an arrangement.

"For the immediate additional supply of Barking and East Ham, the Ilford Council's station, now being extended and approaching completion, would be available, that is, for next winter's load, and afterwards the West Ham undertaking would find a further increase required."

Exeter.—NEW PLANT.—The Town Council has applied to the Commissioners for consent to install an additional turbo-alternator of 1,000 to 1,500 KW. capacity, for the winter load of 1921, at a cost of from £22,057 to £30,426.

EMPLOYES' WAGES.—The City Council, at a recent meeting, decided to adopt the award to electrical workers of the National Joint Industrial Council. A proposal to disregard this and withdraw from the Board was defeated.

Holmfirth.—PRICE INCREASE.—The price of electricity has been advanced to 9d. per unit on account of the continued increases in the prices of materials.

Hove.—BULK SUPPLY.—The Town Council has decided to adopt the Brighton Corporation's terms for a bulk supply. This is being taken as an alternative to extending the Hove plant, which has become out of date.

Iceland.—WATER POWER.—The exploitation of Iceland's waterfalls is a matter of great importance. The latent power is estimated at 1,000 million H.P., but has been very little utilised. The Icelandic Waterfall Commission is at present considering the granting of a concession to a Danish-Norwegian company which wishes to exploit some of the falls. It is intended to use the power for the manufacture of nitrogen, and for an extensive scheme of electrification. Among other schemes is one for the construction of a 200-km. electric railway, running from Reykjavik, east and south through the agricultural district, which, if carried out, would be Iceland's first railway.—*Economic Review.*

Leeds.—STRIKE.—About 200 labourers employed by the Electricity Department in laying cables, struck work because they had not been brought within the scope of the wages award as applied to the engineering and allied trades. The Corporation refused to negotiate on the matter till the men resumed work. The men decided to go back to work on May 11th, and negotiations were at once begun. The strikers are also claiming £5 per week, alleged arrears in wages since December 1st last.

Midlands.—JOINT ELECTRICITY AUTHORITY.—It is understood that it is proposed to form a joint electricity authority to include Stafford, Wolverhampton, Walsall, Wednesbury, West Bromwich, and the area covered by the Midland Electric Corporation, but eventually the authority will be extended to bring in also the Potteries and Shrewsbury. The inclusion is also suggested of a portion of the County of Cheshire, so that Crewe and Nantwich can be supplied from the proposed power station at Stoke. The area as outlined will comprise 2,100 sq. miles. It is considered that sites at Rugeley on the Trent, and Ironbridge on the Severn, offer the best facilities for the necessary supplies of water and fuel. At the former place an area of 45 acres can be obtained, sufficient to provide for a station of over 200,000-KW. capacity. The river will give condensing water by direct circulation for 75,000 KW. at a minimum, but by means of a dam the working capacity can be raised to 125,000 KW., or even higher. The station at Rugeley will be limited by the quantity of water available for condensing purposes, and the proposal is that the plant shall not be of a greater capacity than 60,000 KW. The covering of this wide area with a network of supply mains, it is considered, will create a bigger demand for electricity for many purposes, industrial and domestic. The total plant capacity of existing stations is something under 100,000 KW. The first portion of the new scheme to supplement, and in some cases to supplant, present sources of supply, is the erection of the new station at Stoke, the suggested capacity being at the outset 20,000 KW. produced by four turbo-alternators. The first section of the new station at Rugeley will also be undertaken, its initial capacity to be 30,000 KW. As these stations come into commission all plants other than those of the three-phase 50-cycle turbine type will be closed down. The capacity of the Stoke and Rugeley stations will be extended in accord with the demand, and not until they have fully developed will the Ironbridge station be built. In the initial stages the capital expenditure will probably be between three and four millions, but the cost of the completed scheme will be approximately 15 millions.

Stafford.—YEAR'S WORKING.—The annual report of the municipal electricity undertaking shows that after debiting loan charges and income-tax, and crediting dividends and rents, the result of the working for the year ended March 31st, 1920, was a net deficit of £302, which added to that of £562 brought forward, made a total deficit of £864. The sum of £1,000 out of the gross profits of £3,818 had been placed to the depreciation fund. For the year ending March last, the total sales amounted to 1,999,200 B. of T. units, as compared with 731,800 units for the 12 months ending March, 1913.

TRAMWAY AND RAILWAY NOTES.

Burton-on-Trent. — YEAR'S WORKING. — The tramway manager's recently-presented report states that, unless fares are substantially increased or a subsidy is granted from the rates, the undertaking will show a loss of £11,700 on the coming year. The chairman of the Tramways Committee states that the deficiency on the past year's working was £3,294, without the transfer of anything to the depreciation and renewals funds. A suggestion to substitute motor-omnibuses for the tramways met with no support owing to the initial cost and greater running expenses.

Canada.—RAILWAY ELECTRIFICATION.—One of the first sections likely to be converted to electrical operation in the proposed electrification of Canadian trunk lines will be the double-track line of the Grand Trunk Railway between Toronto, Hamilton, and Niagara Falls, a distance of 82 miles, says the *Electrical News*. The coal shortage has been very threatening for several seasons, making it urgently necessary to reduce the coal bill just as soon as the required additional electric power is available. Very important undertakings are now in hand, and well advanced for the supply of electric power. High-voltage D.C. operation is now beyond the experimental stage, and firmly established on other trunk lines, offering increased capacity and economy in operation beyond the most optimistic views of 10 years ago. The electrification of Toronto terminals, covering 15 miles, will require much study to overcome the many difficulties likely to be met with, following with the Hamilton terminals, a length of five miles. With these two terminals converted, the trunk lines connecting could be electrified early, including also the Niagara Falls terminal of two miles.

Continental.—ITALY.—In order to meet the excessive cost of coal for steam-raising purposes, the Société des Tramways de Turin proposes to electrify the branch provincial lines at

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present worked by steam. In connection with the scheme an application has been made to the Italian Government for an annual subvention.

Sweden.—Railway Electrification.—The Swedish Committee of State has approved the Government proposal for the allotment in 1921 of a first instalment of 23,000,000 kroner in connection with the projected conversion of the State railway between Stockholm and Gothenberg to electric traction. The Committee expresses the expectation that the railway and hydro-electric administrations will co-operate in solving the question of the methods of transmitting power from the power network to the railway system.

East Ham.—New Equipment.—The Town Council has applied for a loan of £8,331 for 10 new sets of equipment for reconstructed tramcars.

Ilford.—Electric Vehicles.—An unopposed inquiry was held on May 13th into the application of the Urban District Council for a loan of £8,050 for the purchase of six electric vehicles for the collection of house refuse.

Liverpool.—Derailment.—Owing to a train being derailed on the electrified part of the L. & Y. Railway between Liverpool and Southport on May 14th, several hundreds of city workers were unable to get home until late in the evening.

Electric Vehicles.—An order for the supply of certain electric vehicles has been cancelled by the Liverpool Health Committee, and the city engineer has been instructed to make fresh inquiries.

London.—Railwaymen's Wages.—The Industrial Court, in an award governing the wages of employés in power and sub-stations and electrical grades on railways in the London district, issued on May 11th, gives an advance in time or day rates of 6s. per full ordinary week, or 1½d. per hour, according to the custom of payment on the various railways. The advance applies to male workers of 21 years and over who are in receipt of a war wage of 33s. 6d. per week and a bonus of 12½ per cent. on earnings. Half of the advance will be retrospective to March 31st, and the remainder payable on May 31st. The case of the workers was put to the Court by the Electrical Trades Union, which claimed an advance of 15s. per week for those of 18 years of age and over, and 10s. for apprentices and boys under 18. Where the practice before the war was to pay those under 21 years of age who were in receipt of the full rate for labourers the same advances as were granted to those over 21, the Court decided that that practice should be continued. A claim by the N.U.R. for an advance of 15s. per week for all men and women in the railway shops and 7s. 6d. for boys and girls, including all those employed in electric generating stations on railways in the United Kingdom, has also been decided by the Industrial Court, which held that the workers who were in receipt of a war wage of 33s. 6d. a week and the bonus of 12½ per cent. on earnings should receive the advances granted on March 23rd to workers in railway shops. The general alteration then made was similar to that reported above for electrical grades.—*The Times.*

Underground Fares.—The Bill promoted by the London Electric Railways seeking powers to increase the maximum fares came before a Select Committee of the House of Commons, on May 11th. Mr. E. Honoratus Lloyd, K.C., on behalf of the promotors, applied for an adjournment. He said that at the last moment they had received from the Minister of Transport a report on the Bill. The points raised by that report were very serious. He had not had an opportunity of placing the report before any one of the boards of directors of the companies. The report suggested that the Committee should not deal with the Bill as a whole, but that, at the most, some temporary powers should be granted, and that the whole matter should be referred to the Minister of Transport, so that he might decide on the actual rates to be charged. The report, Mr. Lloyd added, differed materially from what was said by the Minister in the House on the second reading of the Bill. Counsel for the local bodies which are opposing the Bill assented, and the Chairman adjourned the Committee until after the Whitsun holiday. The Bill as it stands proposes to increase the fares for first-class passengers to 3d. a mile, with a minimum fare of 4d., and for other classes to 1½d. a mile, with a minimum of 2d. Higher rates are also proposed for the conveyance of parcels. —*The Times.*

Accidents.—Traffic on the Victoria Embankment was held up on Wednesday, last week, owing to the derailment of a tramway-car.

Traffic on the Central London Railway was delayed for half an hour, early on the same day, between the Bank and Liverpool Street stations, owing to signal trouble.

Twenty minutes' delay was caused by a tramcar failing to take the points in Holborn on Thursday, last week.

As the result of a collision between a steam lorry and a tramcar at Streatham, on Saturday last, the latter was badly damaged and traffic was held up for a time.

Car-designing Competition.—The London County Council is contemplating a scheme for awarding a prize of £1,000 for what is considered the best design of car for the London services.

New Rolling Stock.—The Highways Committee of the London County Council recommends the purchase of 125 new cars of the "E. 1" type, having seats for 78 passengers each.

Middlesbrough.—New Stock.—The Corporation has sanctioned the purchase of nine new electric cars at a cost of £3,420 each.

Nelson.—Loan.—The Town Council has decided to seek borrowing powers to the extent of £36,000, the estimated cost of a new car-shed, workshops, machinery, and equipment for the tramways. The original estimated cost was £25,000.

Oldham.—Arbitration.—Arbitration proceedings in connection with the purchase of the Oldham, Ashton and Hyde Electric Tramway Co.'s undertaking by the local authorities, will take place in London next month.

Sunderland.—Converted Cars.—On the Corporation system a new all-enclosed car has been put into service. It is the first of six bogie-cars which are being converted at the local car sheds under the direction of the general manager, Mr. A. R. Dayson, and the rolling stock superintendent, Mr. R. Haswell. A new truck is used, which ensures smoother running, the motors are each of 30 h.p., and there are front exit gates. The upper deck is of the saloon pattern, with seats for 40 persons.

Taunton.—Price Dispute.—As the Tramway Co. will not consent to pay more than 2d. per unit for electricity for power (1·2d. per unit was paid under the agreement with the Corporation) the Town Council has decided to apply for the agreement to be set aside under the Courts (Emergency Powers) Act, 1919. The Town Council had asked the company to pay an increase of 100 per cent.

United States.—Monorail Traction.—A monorail system of the type built in Germany 18 years ago has been offered to Chicago's City Traction Commission as a solution of the traction problem, says *Electric Traction*. A model was set up for demonstration by the National Suspended Monorail Co., and, according to the promoters, the system can be operated at a saving of 65 per cent. over the systems now in use. It is claimed that 70 per cent. of the accidents would be eliminated, and that the time of journey would be reduced 50 per cent. There would be no grade crossings, and noise would be eliminated by fitting to the wheels tires made of vulcanised wood fibre. With regard to cost, it is claimed that the system would cost only $100,000 per double-track mile; it is estimated that the cars would have a speed of 130 m.p.h., but in actual service would make 42 m.p.h. with one stop per mile, and 82 m.p.h. in local service. The cars would weigh 12 tons each, and would contain 60 seats per car. The structure, from which the cars would be suspended without the use of under wheels, would be supported every 50 ft. by supports erected on one side of the street only.

TELEGRAPH AND TELEPHONE NOTES.

Bradford.—Wireless Telephony.—The newly-formed Bradford Wireless Society is proposing to erect a wireless station, if permission can be obtained from the Postmaster-General. On May 12th, at a meeting of the Society held at Heaton by the kindness of the President of the Society (Mr. Charles Wood), whose apparatus was used, the members were able to enjoy a concert which took place at the Chelmsford Marconi station, 170 miles away.

Lerwick.—Wireless Station.—The early closing of the wireless station is foreshadowed in an Admiralty order stating that all outstanding demands for stores from this station are to be considered as cancelled. The naval base was closed down on December 13th last, and the Nab Port war signal station was closed on December 18th.—*The Times.*

London.—Wireless Telephony.—The efficiency of wireless telephony as a means of communication between the scenes of fires and the Brigade headquarters in the City was tested at a demonstration in London on Friday, last week. The transmitting and receiving apparatus was carried on the back of a tender, and as soon as it came into position at a pre-arranged spot at Clapham Common, S.W., a pole was hoisted on the tender bearing one end of the aerial wire, the other end being run out and attached to the top of the nearest lamp-post. At the spot chosen for the demonstration there was no ordinary telephone within reasonable distance.

Post Office Employés' Wages.—The Union of Post Office Workers at its annual conference at Morecambe on May 11th accepted the Government offer on the claim made by the Union for a flat wage increase of 10s. per week. The Government offered an immediate increase of 3s. 6d. a week to men and 2s. 6d. to women. This increase is for the main classes only—namely, outdoor postmen, telegraphists and telephonists, and indoor sorting clerks. The usual increments continue, and such a reduction in office classification is arranged as ensures earlier attainment of the maximum. Apart from the money offer, there is secured a reduction of provincial scales from five to three, an extension of the London area to a 12 miles radius from Charing Cross, the existing London area to be Division I, and the new outer area Division II. The wage increases indicated date back to January 1st, and are proportionately extended to overtime worked since that date. The increases secured by the main classes will be the basis of settlement for other classes, and will date back to January 1st.

Telegraph Rates.—The daily Press announces that the new telegraph rates are to be dealt with in a Parliamentary Bill, and will not come into operation on June 1st as was suggested.

Underground Cables.—Underground telephone cables are now being laid by the General Post Office in most of the business centres of the country with the object of improving the stability of the service. One of the ducts now under construction runs from London to Manchester, and is reported to be nearing

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completion. A start has been made in drawing in the cables. A duct has also been made for the greater part of the distance between London and Bristol, while good progress is reported with that which will connect London with Southampton. The cables between Glasgow and Coatbridge, Dumbarton and Motherwell will soon be ready, while on the short distance between Ormskirk and Preston the arrangements are practically complete. Schemes for linking up Manchester and Liverpool, Bolton and Rochdale, and for connecting Liverpool and Chester are well in hand; and preparations are being made for the underground linking-up of business towns in the Midlands, particularly in the Birmingham district. *The Times* says that it is expected that the whole scheme will be nearing completion towards the end of the present year.

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the ELECTRICAL REVIEW *in which the "Official Notice" appeared.)*

OPEN.

Australia.—MELBOURNE.—May 31st. Victorian Railways Department. Four 4,500-KW., 1,500-volt traction converter sets, and eight 1,000-KW., 1,500-volt ditto. (April 30th.)

SYDNEY.—August 4th. N.S.W. Government Railways and Tramways. Two 1,000-KW. sub-station units. Chief Electrical Engineer, 61, Hunter Street, Sydney.

August 3rd. Department of Public Works. Turbines and generators for the Barren Jack hydro-electric development scheme. Department of Public Works, Sydney.

July 18th. City Council. Maximum demand indicators. Electric Lighting Department, Town Hall, Sydney.

PERTH.—July 14th. P.M.G.'s Department. Telegraph and telephone instruments (various parts). Schedule 674.

June 16th. P.M.G.'s Department. Telegraph and telephone instruments (various parts). Schedule 680. (May 14th.)

ADELAIDE.—June 23rd. P.M.G.'s Department. Telephone parts (schedule 541). (See this issue.)

Barnes.—June 7th. Urban District Council Electricity Department. Coal-handling plant and overhead steel or ferro-concrete bunkers. (May 14th.)

Belgium.—June 18th. The municipal authorities of Verlaine (Province of Liége) are inviting tenders for the concession for the supply of electrical energy for lighting and power purposes in the district. Particulars can be obtained from the Maison Communale.

Dublin.—June 7th. Electricity Supply Committee. 12 months' supply of single-phase and three-phase meters.

June 1st. Electricity Supply Committee. 22 direct-current magazine flame arc lamps. (See this issue.)

Edinburgh.—June 19th. Electricity Supply Department. E.H.T. and L.T. switchgear, &c., for Portobello station. (See this issue.)

Lincoln.—May 24th. Electricity Department. Coal-handling plant. (April 23rd.)

Leeds.—June 14th. Electricity Department. 12,000-KW. steam turbine, alternator and condensing plant. (May 14th.)

London.—HACKNEY.—June 9th. Electricity Department. Four water-tube boilers, each 33,000 lb. per hour capacity, with superheaters, mechanical stokers, &c.; four induced-draught plants; four fuel economisers; one 10,000-KW. turbo-alternator and exciter, with ventilating fan and air filter or cooler; one surface condensing plant; two circulating water motor-driven pumps; E.H.T. switchgear; two 20,000-KW. coupler panels; one 10,000-KW. generator panel; six 2,000-KW. and one 4,000-KW. feeder panels. (May 7th.)

BETHNAL GREEN.—June 7th. Electricity Supply Department. Two 500-K.V.A. transformers; one E.H.T. and one L.T. panel; L.T. feeder cables; section pillars and road work. (See this issue.)

Manchester.—June 7th. Electricity Department. Main and auxiliary switchgear; Section A, 33,000-volt and 6,000-volt main switchgear; Section B, pressure-testing switchgear; Section C, 420-volt A.C. auxiliary switchgear; Section D, 240-volt D.C. auxiliary switchgear. (April 30th.)

New Zealand.—WELLINGTON.—June 30th. Tender Board. Public Works. Electrical equipment for the Arthur's Pass section of the Midland Railway. Particulars from the Department of Overseas Trade, 73, Basinghall Street, E.C.

AUCKLAND.—September 1st. Harbour Board. For the supply of electric capstans and spares. Messrs. W. & A. McArthur, Ltd., 18-19, Silk Street, Cripplegate, London, E.C. 2.

Salford.—June 5th. Electricity Department. 12 months' supply of D.C. and A.C. meters. (See this issue.)

Trimdon.—May 25th. Parish Council. Overhauling and repairing the whole of the electric lighting in the villages of Trimdon Grange and Trimdon Colliery. Mr. T. W. Wilkinson, Clerk to the Council, 24, Booth View, Trimdon Grange.

CLOSED.

Bradford.—Electricity Committee:—

Steelwork for firing floor of new boilers.—Redpath, Brown & Co., Ltd.
19 feeder and fuse pillars.—B. I. & Helsby Cables, Ltd.
Steel gangways for pump room at Valley Road works.—F. Fox.

London.—Metropolitan Water Board. Works Committee. Recommended:—

Electrical water-level indicators at 12 reservoirs in Kent, £1,721 approx.—Glenfield & Kennedy, Ltd.

Margate.—Town Council:—

Renewal of electric light installation, pavilion and winter gardens, outside arena.—W. J. Cannon, £190.

Pontefract.—Town Council:—

Electric light installation, assembly rooms.—A. Brook, £52.

Sunderland.—Electricity Committee. Accepted:—

J. Hewdins & Co.—Parts for A.E.G. turbine.
Elliott Bros.—Test-room instruments.
General Electric Co., Ltd.—Seven circuit breakers.
B. I. & Helsby Cables, Ltd.—Cable wagon, E.H.T. cable, 4-core L.T. network cable.
C. C. Wakefield & Co.—Turbine oil.
Ferranti, Ltd.—House-service meters.

Wolverhampton.—Tramways Committee. Recommended:

5,000-gallon petrol storage tank, complete, £471.—Alexander & Steer.
One spare engine and spare back axle for motor omnibuses, £300.—Tilling-Stevens Motors, Ltd.
The Committee recommends the Council to agree to the payment of £896, being 7½% increase in the price of omnibuses, under the emergency clause of the contract with Tilling-Stevens Motors, Ltd.
Two sets of Crellin's patent car body lifting apparatus, £304.—C. Booth and Co.

Electricity Committee. Recommended:—

Three self-balance current transformers; one Fawsett-Parry relay; three 33,000-v. M.P. feeder-current transformers, £472, plus £66 cost of erection.—Reyrolle & Co., Ltd.
Two 500-KW. converters, £8,782 each (revised tender).—Met. Elecl. Co., Ltd.
One 22-KW. mercury arc rectifier equipment, £2,577.—Power Rectifiers, Ltd.

FORTHCOMING EVENTS.

Royal Institution of Great Britain.—Friday, May 21st. At Albemarle Street, W. At 9 p.m. Lecture on "The Thermionic Valve in Wireless Telegraphy and Telephony," by Prof. J. A. Fleming, F.R.S.

Friday, May 28th. At Albemarle Street, W. At 9 p.m. Lecture on "Crystal Structure," by Prof. Sir W. H. Bragg.

Junior Institution of Engineers.—Friday, May 21st. At 39, Victoria Street, S.W. At 7.30 p.m. Social evening.

Friday, May 28th. At 7.30 p.m. Lecturette on "Two Years as an Engineer in the Grand Fleet," by Mr. A. Arnold.

Royal Society of Arts.—Friday, May 28th. At John Street, Adelphi, W.C. At 4.30 p.m. Paper on "Lignite," by Prof. W. A. Bone, F.R.S.

Electrical Power Engineers' Association (Southern Division, London Industrial Section).—Friday, May 28th. At Anderton's Hotel, Fleet Street. At 7.30 p.m. Open meeting.

Physical Society of London.—Friday, May 28th. At the Imperial College of Science, South Kensington. At 5 p.m. Discussion on "X-Ray Spectra," to be opened by the President, Sir W. H. Bragg, F.R.S.

NOTES.

British Oil.—In reply to a question in the House of Commons, Mr. Kellaway stated, on May 11th, that of the 11 wells which had been drilled, one had been abandoned owing to the difficulty of eliminating large quantities of water encountered. Traces of oil had been found in five wells, and one well at Hardstoft, Derbyshire, had a natural flow of 50 barrels per week. An experiment had shown that it would be possible to increase the yield to 250 barrels per week. The total oil produced to date was about 2,800 barrels, or 100,000 gallons. The oil was being stored pending a decision concerning oil rights in this country. Drilling was proceeding in nine other wells.

Mr. Bonar Law, in Parliament on May 13th, stated that the Government had reached a decision regarding the ownership of royalties on oil deposits in Great Britain. A Bill had been drafted, and was receiving the consideration of the Government.

Industrial League and Council.—The half-yearly dinner is to be held in the Wharncliffe Room, Hotel Great Central, Marylebone Station, N.W., on Wednesday, May 26th, at 7 p.m. Mr. H. E. Blain, C.B.E., will take the chair, and the speakers will be Sir Allan M. Smith, K.B.E., M.P., and Mr. W. H. Hutchinson (A.S.E. Executive).

Inquiries.—Addresses of makers of the Stuart centrifugal pump, and Kitching's Crownall shade carrier and light diffusing globe, are asked for.

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Mr. F. Ayton and the Electric Vehicle Manufacturers.—On Monday last, at the Restaurant Frascati, the electric vehicle manufacturers gave a dinner in honour of Mr. Frank Ayton, M.I.E.E., chairman and hon. secretary of the Electric Vehicle Committee of Great Britain and Ireland, and chief engineer and manager of the Electricity Supply and Tramways Department of the Corporation of Ipswich. Mr. W. H. L. Watson, of Edison Accumulators, Ltd., presided over a gathering of some 60 members of the electric vehicle industry, representing manufacturers of vehicles, batteries, switchgear, and other components. After the toast of "The King" had been honoured, the Chairman proposed the health of Mr. Ayton, recalling the early days when things used to look very black in the electric vehicle industry; at that time Mr. Ayton joined hands with him, and was responsible for the formation of the Electric Vehicle Committee of the I.M.E.A. Since then Mr. Ayton had never relaxed his efforts, in spite of his many onerous duties. Presenting him with a draft for 250 guineas and a silver rose bowl, the Chairman expressed the hope that they would continue to have his assistance in the future. The toast was drunk with musical honours, and Mr. Ayton, in responding, said he could find no words adequately to thank them for their splendid appreciation of his work, which would have been of no avail had he not had the wholehearted support of the committee. He paid a special tribute to the work of Mr. R. A. Chattock, the first chairman of the committee. They were on the threshold of a very big development in the use of the electric vehicle not only of the commercial but also of the pleasure type.

Major WHITTINGTON, proposing "The Electric Vehicle Committee," said he had had experience with horse, petrol, and electric vehicles; the horse drivers, by the adoption of the 8-hour system, had reduced the mileage of a horsed van to 20 or 25 miles a day, there was a prospect of great scarcity of petrol, and the electric vehicle therefore had a great future at hand. Mr. SHRAPNELL SMITH responded, pointing out that the electric vehicle had had to make headway here as a newcomer, whereas in the United States it was in extended use before the petrol truck was developed.

Mr. A. S. MAYS-SMITH (of Motor Manufacturers & Traders, Ltd.) proposed "The Electric Motor Industry," and Mr. E. C. RANSOME (of Messrs. Ransomes, Sims & Jefferies, Ltd.) responded, referring to the high esteem in which Mr. Ayton was held in Ipswich. Mr. E. W. CURTIS also replied with a humorous speech. Mr. V. W. BONE proposed "The Chairman," suggesting that the gathering should become an annual event, and Mr. WATSON, in responding, said that an Electric Vehicle Manufacturers' Association was in course of organisation to co-operate with the Electric Vehicle Committee. Mr. KEMP, proposing "The Visitors," said that in and around Birmingham there were electric vehicles worth £250,000 in use. Charging facilities were the greatest need of the time. Mr. W. E. WARRILOW responded, referring to the hard times in the past and the brilliant prospects for the future of the electric vehicle. At a later stage Mr. AYTON stated that in the past municipalities had met with great difficulties in getting sanction to loans for providing garages and charging facilities; those troubles were now at an end. Applying to the Electricity Commissioners for such powers for Ipswich Corporation, he was assured that the Commissioners were anxious to encourage the use of the electric vehicle, and such applications would receive favourable consideration.

An excellent concert was provided, Mr. S. G. Trehearne being the musical director; amongst the performers were Messrs. Deverill, A. J. Makower, and Kemp, and a novel feature was introduced in the form of two charming dances in costume performed by Miss Mildred Challenger and Miss Thelma Trehearne, which were highly appreciated by the spectators.

Charges for Electricity Supply and Wages of Employes. The following resolution was passed at the last meeting of the Home Counties Industrial Council:—

Resolved: That the Minister of Transport be asked to receive a deputation from the Home Counties Industrial Council for the Electricity Supply Industry with a view to pressing that the statutory charges authorised for electricity supply undertakings be increased where necessary to such degree as to enable them to pay such wages as agreed upon by the Industrial Councils as proper and reasonable for the electricity supply industry, and that the Minister of Transport embody an instruction that such increase shall be devoted primarily to such purposes and that such increases should be given only to such undertakings carrying out the recommendations of the Industrial Councils.

The deputation, fully representative of both the employers and Trade Unions, were received by the Electricity Commissioners, Sir John Snell, Sir Harry Haworth, and Mr. Harry Booth, on Wednesday.

Alderman Wilkinson, of Luton, explained the position generally. He said that the Industrial Councils were charged with the care of all matters concerning the relation of employers and employés, and that nothing could be more pertinent in this connection than the request in the resolution, namely, that the Minister of Transport should afford relief where necessary to undertakings, so that they should be in a position to pay wages as recommended by the Industrial Council. Many claimed that they could not do this at present, and for these he asked that an increase in their maximum prices should be accorded. But he specially emphasised that each such increase should have a proviso that it was conditional upon wages being paid as recommended by the Industrial Council.

Mr. G. W. Spencer-Hawes supported the case by a detailed statement on the financial position of the undertakings in question.

Mr. J. Meakins, of the Enginemen's Union, explained the position of the Trade Union, followed by Mr. Morton and Mr. W. T. Webb, of the Electrical Trades Union, who emphasised the fact that the Union most strongly urged that the wages question should be tied up with any increases granted, as that was the only ground on which the Unions supported the deputation. It was suggested that in future whenever applications from undertakings were made to the Minister of Transport for increase of charges, the Ministry should notify each case to the Industrial Council concerned and if necessary give it power to attend to oppose.

Sir John Snell, after dealing with the legal difficulties involved, expressed himself as appreciating the points at issue, and said that the matter would receive the immediate and most careful attention of the Electricity Commissioners.

Appointments Vacant.—Shift engineer (£223), for the Farnworth Urban District Council Electricity Department; works superintendent (£260 to £300), for the Aylesbury Urban District Council Electricity Works; cable jointer, for the Barrow-in-Furness Corporation Electricity Department; temporary draughtsman (£350), for University College, London; meter tester (86s. rising to £5), for the Hull Corporation Electricity Department; working assistant engineer (£200), for the Hants County Asylum; mains engineer (Rs. 540 per month), for the Calcutta Electric Supply Corporation; sub-station attendant (77s. 9d.), for the Stalybridge, Hyde, &c., Electricity Board; shift engineer (£229), for the City of York Electricity Department; electrical foreman (Rs. 360 per month), in the Locomotive Carriage and Wagon Department, of the South Indian Railway Company. See our advertisement pages to-day.

L.C.C. Appointments.—The Highways Committee of the L.C.C. proposes to invite applications by public advertisement for the three undermentioned vacancies, it being provided that members of the Council's staff will not be precluded from applying:—

(i) Electrical branch. Technical assistant, Grade I.—Salary, based on pre-war conditions, £300 to £400 a year. Total remuneration, including present temporary additions, £480 to £600 a year.

(ii) Electrical branch. Technical assistants, Grade II.—Salary, based on pre-war conditions, £210 to £300 a year. Total remuneration, including present temporary additions, £420 to £480 a year.

(iii) Permanent way branch. Technical assistant, Grade III.—Salary, based on pre-war conditions, £200 to £250 a year. Total remuneration, including present temporary additions, £320 to £385 a year.

Italian Agricultural Machinery Exhibition.—Under the auspices of the Ministero per l'Agricoltura and various societies, including the Unione Esercenti Imprese Elettriche, there is to be held at Rome in August and September, an International Exhibition of Agricultural Machinery. Complementary applications of electricity in subsidiary agricultural operations will also be represented.

The "Lyto" Dry Cell.—Messrs. T. E. Slaughter & Co. ask us to say that their correct address is 172, Church Road, Mitcham, London, S.W.

Service Notes.—Orders have been issued by the Admiralty to the effect that the greatest possible economy is to be exercised by the ships which take electrical power and lighting from Dockyard mains.

Commissioned Electrician F. B. Etherington has been appointed to H.M.S. *Centurion*, from the 6th inst.; Warrant Electrician A. E. Griffin, to H.M.S. *Vernon*, for the Mining School, from the 6th inst.; Warrant Electrician R. Brimacombe, to H.M.S. *Sandhurst*; Captain G. F. Bone, Devon Fortress Engineers (Electric Lights), who recently ceased to do duty with the Machine Gun Corps, has been restored to the establishment of his regiment, with which he has served since 1915; Lieutenant N. W. L. Stafford, Lancashire Fortress Engineers, has been restored to the establishment of his regiment on ceasing to be employed on the staff.

Educational.—UNIVERSITY OF LONDON.—A course of four Advanced Lectures on High-Frequency Alternators for Radio-Telegraphy, by M. Marius Latour, will be given at the Institution of Civil Engineers, Great George Street, S.W., on May 26th and following days, commencing at 5.30 p.m. Admission is free to the lectures. For further particulars see our advertisement pages to-day.

The Kinema in School.—Ealing is considering the extension of its school kinema enterprise by the purchase of film-making apparatus.

Fatalities.—An inquest was held at South Shields last week upon the body of Robert Henderson (37), an electric crane driver, who was killed while following his employment at the shipbuilding yard of Messrs. John Redhead & Sons. Henderson, it was stated, was cleaning the electric crane in the engine works, and had been warned by the foreman and another man that the current was on. He was engaged on the upper part of the crane when he was heard to give a loud groan and seen to fall off the crane. He struck some shafting and fell upon some boxes 25 ft. below. When he was picked up, life was extinct. The foreman of the jury expressed the opinion that deceased, instead of going towards the permanent ladder, had been taking a short-cut under the live wires to another ladder which was standing against the crane.—A verdict that death was the result of an electric shock and fracture of the skull was returned.

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INSTITUTION NOTES.

Institution of Electrical Engineers.—Western Centre.—At Cardiff, on April 12th, Prof. F. Bacon lectured before this Centre on "Thermionic Valves." The lecture was followed by a discussion, and various types of valves and valve apparatus were exhibited. The lecture was illustrated by lantern slides, and a number of experimental demonstrations were made by the lecturer.

Recapitulating the main points of the lecture, there was, said the lecturer, first, a broad division between two-electrode valves, or thermionic rectifiers, and three-electrode valves, in which a grid, spiral, or other form of "control" electrode was interposed between the filament and the plate. Then there was a fundamental physical difference between the present-day hard valve, in which the vacuum was so high that the pure electronic discharge from the incandescent filament was not perceptibly interfered with by the molecules of the residual gas, in contradistinction to the "soft" or "gas" valve, in which the molecules of the residual gas played an essential part by supplying positive ions, which carried the bulk of the current and largely neutralised the space-charge effect. Considering a mechanical analogy, hard valves were like hydraulic valves of small size closed by a stiff spring; soft or gas valves were like pneumatic valves of large area and closed by a very weak spring. Next, one could draw distinctions between the material nature of the cathode and the method employed for causing it to emit electrons. By calling a valve "thermionic," they limited themselves to the employment of cathodes in which thermal agitation was used for provoking the emission of electrons. In a broad review of the subject, however, it seemed legitimate and desirable to include mercury rectifiers and Pointolites as special forms of soft thermionic valves, in which the hot spot on the cathode was maintained by bombardment of positive ions assisted by high current density. The standard form of cathode for the ordinary thermionic valve was a filament of tungsten heated by a separate source of low-tension supply, which might be either D.C. or A.C. For valves employed in reception circuits, which included telephones, every precaution had to be taken to avoid coupling to sources of supply containing ripples of audible frequency. For instance, the telephones would scream if filament heating or plate voltage was obtained from ordinary supply mains. In such cases it was imperative that only batteries of primary or secondary cells be used. In other cases, however, it was quite satisfactory, and generally preferable, to heat the filaments with low-tension A.C. obtained from the secondary of a special heating transformer. The only alternative to the tungsten filament that had been used to any extent in thermionic valves was the Wehnelt cathode, consisting of a filament of platinum coated with lime or other oxides. Such filaments had high efficiency in that they emitted a great number of electrons per watt expended in heating; but they rapidly disintegrated, and were not suitable for the modern hard valve. Perhaps the very rapidity and completeness with which the three-electrode valve had fulfilled every requirement and surpassed every expectation of the wireless engineer had tended to distract attention from the useful possibilities of the two-electrode valve, both of the hard and soft varieties, to the electrical power engineer. In this connection, the lecturer had attempted to draw attention to certain modest yet useful functions which it could already discharge. The mercury rectifier already bade fair to oust the rotary converter, and the practical difficulties which stood in the way of building thermionic valves in steel containing vessels, suitable for heavy currents, were to a great extent the same as those which had just been surmounted in the case of the mercury rectifier. It would be rash to pooh-pooh the idea that they might be on the eve of great things due to the introduction of some improved, enlarged, and robust type of thermionic valve into the main distribution schemes of heavy electrical engineering.

It will be remembered that a small deputation of members of the Institution, representative of the various branches of the industry, visited Holland in September, 1919, at the invitation of the Dutch Association of Electricity Works' Managers. Arrangements are being made for a return visit of Dutch engineers to this country in July next. It is hoped that the visitors will also take part in the summer meeting of the Institution at its Western Centre.

Association of Mining Electrical Engineers.—Developments in the application of electrical machinery in mines were foreshadowed in a paper read before the Yorkshire branch of the Association at Wakefield on April 16th, by Mr. J. R. Haigh, engineer at the Lofthouse Colliery, who said that the first requisite was to pass an electrical wave of enthusiasm through the management, and remove the bias from the minds of the majority of engineers at most collieries. It could be proved that by the application of electricity, £200 per week had been saved in the boiler fuel consumption alone. The whole training of a colliery engineer needed drastic revision; it was the worst policy to install valuable plant and then advertise for the cheapest man to look after it. The first step towards reducing the cost of working on the surface was to remove that most prolific source of waste—the steam exhausted into the atmosphere. This exhaust from the winding engines could be made to generate sufficient electricity to drive the whole of the auxiliary plant and leave a surplus for further extension. Scrapping the old wasteful steam winding engines was too drastic a policy, but by removing the old cylinders and replacing them with Corliss valve gear, a few more tons per shift could be wound. From 20 to 25 per cent. could be easily saved by housing the boilers and lagging the steam ranges, instead of leaving them exposed to the elements. By the introduction of stokers designed to burn unsaleable coal, 200 to 250 tons per week could be burnt upon the grates of Lancashire boilers. Every steam engine on the surface, and all steam pumps in the shaft, should be superseded by electric motors. With regard to new collieries, the author advocated still more complete electrification. Electric winders would be employed; there was a limit to the depth from which coal could be wound by steam plant, whereas by electric winders it would be possible to win coal from depths not yet dreamt of. In the future when the seams near the surface had been worked out, seams of thicker sections than those at present worked would be found, and the only means to win these seams would be by the electrical energy raising the coal from the lower levels to those already worked out, by a succession of winding gears, the tubs being electrically transferred from one cage to the other. The system of ventilation could be carried on in the same way. Electric winders gave smoother acceleration, and the ropes lasted longer; they gave easier methods to secure safe working and freedom from over-winding, and automatic arrangements were easier to adopt. Decking arrangements could also be made more cheaply by electrical appliances. The screening plant should also be electrically-driven, wagons under the screens propelled by electric capstans, and any other haulage should be by electric locomotives in preference to the expensive steam locomotives. The rest of the surface plant should be electrically-driven, and the provision of an electric welding shop, Mr. Haigh showed, would effect great economies in the production of tubs, as one man could weld the plates together and make a good strong tub in three hours; repairs to the various plant could also be effected more economically and expeditiously by electric welding. No animal should be allowed underground in the colliery of the future; the whole of the haulage should be accomplished by electric battery locomotives getting right up to the coal face. Finally, Mr. Haigh urged the need of a school at each mine where all the workers could see scientific experiments carried out and hear lectures, so that they might intelligently understand the mechanism which they were called upon to manipulate. Nothing hindered production like ignorance; the miner should be educated to understand the possibilities of the mysterious power which had come to his assistance, and to treat it in a manner which could only lead to the end in view—increased production.

At a meeting of the Association at Leeds, on May 8th, the following officers were elected for the year 1920-21:—President, Mr. J. W. Harbottle (Fryston); vice presidents, Mr. J. W. Mitchell (Barnsley) and Mr. J. T. Lee (Featherstone); hon. secretary and treasurer, Mr. W. Winter (Castleford); auditor, Mr. H. Green; council, Messrs. R. Holiday (Ackton Hall), A. R. Clayton (Dewsbury), F. Mawson (Wakefield), Major F. Mellor (Leeds), Mr. J. H. Haigh (Lofthouse), Mr. E. A. Moorhouse (Nostell) and Mr. T. Crossley (Barnsley).

Royal Institution.—On Saturday, May 29th, Prof. J. H. Jeans commences a course of two lectures on "Recent Revolutions in Physical Science." (1) "The Theory of Relativity"; (2) "The Theory of Quanta." The Friday evening discourse on May 28th, will be delivered by Prof. Sir W. H. Bragg on "Crystal Structure," and on June 4th by Sir Ronald Ross on "Science and Poetry."

Wireless Society of London.—At a meeting of the Society held on April 30th, a paper was read on an automatic call device by Major Basil Binyon, O.B.E. By means of an aerial which had been erected, Major Binyon was able to give a practical working demonstration of the mechanism. Pre-arranged messages were received from his wireless station at Slough, and the selector mechanism proved beyond doubt that it would respond only to signals which it was set to receive. By the use of this apparatus it is, therefore, possible to make use of only one operator on board ship, so that during the less busy hours of the day the automatic call device may be left to take incoming signals, and on the receipt of a message giving the call signal of the ship in which it is installed, or the distress signal S.O.S., a relay is put in action, a bell rung, and the operator called to his instruments.

Twenty new members and associate members were elected, including the Society's first lady member.

The Institute of Metals.—The annual autumn meeting will be held at Barrow-in Furness, on September 15th and 16th next. Particulars can be obtained from the Secretary, Mr. G. Shaw Scott, M.Sc., 36, Victoria Street, S.W. 1. The annual May Lecture will be delivered by Prof. C. A. F. Benedicks, Ph.D., at 8 p.m., on June 10th, at the Institution of Mechanical Engineers, Storey's Gate, Westminster, the subject being "Recent Progress in Thermo-Electricity." Prior to the lecture a ballot for the election of members and students will take place. Persons so elected will be entitled to be present both at the lecture and at the Barrow meeting, whilst their first annual subscription will cover the extended period ending June 30th, 1921. Membership forms can be obtained from the above address.

Edinburgh Electrical Society.—At the annual meeting held on May 12th, Mr. T. S. Munnoch, chairman, referred to the excellent progress made by the society during the first year of its existence. The treasurer submitted a gratifying account of the financial condition of the society, which, without calling on the support of patrons, was more than paying its way. Prizes were presented to three apprentice members for papers which they had submitted for competition, and president and secretary were thanked for their good services during the year.

The office bearers for next session were elected as follows:—Chairman, Mr. Donald Macintosh; vice-chairman, Mr. D. S. Munro; committee, Messrs. Law, McLean, Stark, and Bee; hon. secretary and treasurer, Mr. W. S. Johnson, 11, Comely Bank Street, Edinburgh.

It was decided to open next session with a social function, to be held during September, and the secretary is now open to receive papers to be included in the new syllabus.

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North-East Coast Institution of Engineers and Shipbuilders.—At Newcastle-on-Tyne, on April 30th, Mr. J. S. Watson read a paper on "A Modern Power Station and Its Development," and discussed the subject by tracing the development which had taken place in connection with the generating plant installed by the Newcastle-on-Tyne Electric Supply Co., Ltd. The historical aspect of the subject was dealt with by dividing the period of 29 years into four stages. Before dealing with the various stages in detail, Mr. Watson mentioned the important fact that plant in the various stages was superseded and scrapped, not because it was worn out, but because in the march of science, other plant so much more efficient had been developed that it no longer paid to run the old plant. During the gradual development of Carville "A" station, the utilisation of waste heat in connection with the working of coke ovens and blast furnaces received the special attention of the company, and the third, or waste-heat, stage of development was entered. The location of the waste-heat stations was decided by the position of the coke-oven and blast-furnace plant from which the waste power could be obtained. The turbines consisted of either high-pressure, or exhaust-steam, plant depending on the class of power available. The object in view being to utilise to the full the waste power available at the lowest possible labour cost, no spare plant was provided, and the station ran at the maximum capacity possible, any variation being met by larger coal-fired stations. The waste-power stations ran continuously, except for the period of overhaul necessary from time to time. Continued demands necessitated the provision of further plant with the result that the fourth stage was arrived at. It was then decided to erect another station now known as Carville "B," having a capacity of 50,000 KW. As this was the last station to be brought into commission, and as it showed a further marked improvement in economy, the author gave a more detailed description of the plant.

It was claimed that the station described was the most efficient, not only in this country, but probably in the world. The returns issued by the Coal Mines Department of the Board of Trade showed that on the North-East Coast where coal was relatively abundant, and of a low price, the most economical generating plant was in operation. The author emphasised the fact that the characteristic changes which had taken place in all stages had been:—The increase in boiler pressure, increase in steam pressure, the higher speed of plant (consistent with the periodicity of the system), the larger individual size of the generating units, and the more complete utilisation of labour-saving appliances. The principal features referred to were summarised as under:—Total capacity of the system was 186,450 KW., which was contained in 18 stations, of which four operated by means of coal firing; three by coal firing and coke-oven gas; three by waste heat from coke ovens; and eight by exhaust steam from blowing engines, &c. The capacity of individual stations had increased from 2,400 to 50,000 KW., and the average capacity of boilers from 6,000 to 45,000 lb. Boiler pressure had risen from 120 to 270 lb., and the steam temperature from 350 to 675° F. Average capacity of machines increased from 267 to 10,000 KW., and the speed from 85 to 2,400 R.P.M. The steam consumption had decreased from 28·5 lb. to 10 lb. per KW.-hour. The KW. capacity per sq. ft. of area occupied had increased from 0·3 to 15 KW., and the KW. capacity per man engaged in operation from 141 to 633 KW. A discussion followed the reading of the paper, and Mr. Watson, in replying, said average cost of coal to the company had gone up by over 200 per cent., wages and other items had gone up by 145 per cent., but the average receipts, as a result of the extra costs incurred, had only increased by 54 per cent. He strongly advocated the development of waste-heat supplies.

South-Eastern Union of Scientific Societies.—The twenty-fifth annual Congress will be held at the Town Hall, Eastbourne, on June 2nd, 3rd, 4th and 5th. The proceedings mainly relate to biological and geological subjects, and include several visits to places of interest. The hon. general secretary is Mr. H. Norman Gray, 334, Commercial Road, London, E. 1.

Physical Society of London.—At the meeting held on April 23rd, 1920, the fourth Guthrie Lecture was delivered by M. Charles Edouard Guillaume, who lectured on "The Anomaly of the Nickel Iron Alloys: Its Causes and its Applications" He showed and explained curves showing the variation of magnetic properties, and of the coefficients in the expansion equation for alloys, and showed from the curves how it was possible to obtain alloys with any desired coefficient. The chief weakness of the alloys, from the point of view of the metrologist, was instability. With increasing carbon content the instability very rapidly increased. The curve connecting the instability and the carbon content passed through zero, showing that the instability was due to the carbon. It was, therefore, possible to get an invar of perfect stability. Among the applications to which invar had been put, the speaker instanced pendulum rods, leading-in wires for electric lamps (an alloy being chosen from the curves, so as to have the required coefficient of expansion, wire standards for base measurements in surveying, &c. Another important application of those alloys was in chronometer construction. The temperature coefficient of the rate of a watch was due to variation of the elasticity of the hair-spring. It was possible to compensate the elasticity variation over the whole range. Sir R. T. Glazebrook, in proposing a vote of thanks to the lecturer, said that it was largely to the work of M. Guillaume in the early days of the Bureau at Sèvres that they owed their knowledge of mercurial thermometry. The lecturer had illustrated the important connection between science and industry, and how, if that connection were to be strong and productive of the best results, it was necessary that scientific investigations should be carried out to their fullest extent. They had seen how, in the first place, the various physical properties of these steels had been examined, and how the results so obtained had subsequently been of the highest value in solving problems of great practical importance.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

At an investiture held in Newcastle by Prince Henry on 7th inst., Capt. L. E. MOLD, of Messrs. A. Reyrolle & Co., Ltd., Hebburn-on-Tyne, was decorated with the O.B.E. (Military Division) for services in France.

On May 7th the staff engineers of the York Corporation electricity department held their first annual dinner at the New White Swan Hotel. In the unavoidable absence of the chief engineer, Mr. E. J. NICHOLS took the chair. After dinner a musical programme was given by Messrs. J. P. Wood, T. Gowland, E. J. Nichols, and other members of the staff. The chairman, on behalf of the staff, presented a suit case to Mr. E. M. Pearson, mains superintendent, who is about to take up a similar post at Stepney.

Mr. A. B. MUIRHEAD, who has been identified with the business of D. Selby Bigge & Co., consulting engineers, of 53, Bothwell Street, Glasgow, for 20 years, has become a partner in the firm, which will continue under the same title.

Mr. E. MORGAN, Assoc.M.Inst.C.E., A.M.I.E.E., who for the past ten years has served with the Yorkshire Electric Power Co. (latterly as operation engineer), has been appointed technical and engineering assistant to the chief engineer and general manager of the Wolverhampton Corporation electricity undertaking.

The salary of Mr. T. B. MOSELEY, chief clerk of the Bradford Corporation tramways department, has been increased from £400 to £425.

Weymouth T.C. has appointed Mr. G. NICHOLSON, assistant electrical engineer, as borough electrical engineer, at a salary of £500 a year, with free residence, the question of salary to be reconsidered at the end of six months.

Mr. H. ENGLAND, the convener of the Yorkshire and District Tramway Managers' Association, Leeds, was recently presented by the members with a silver rose bowl in recognition of services rendered to the Association since its formation in 1904.

Faversham T.C. has increased the salary of the electrical engineer (Mr. G. SOMMERVILLE) to £430 a year, plus £20 for special services rendered at the sewage works.

Whitehaven T.C. has increased the salary of the borough electrical engineer (Mr. HOGARTH) from £450 to £500.

It is proposed to increase the salaries of the Accrington Corporation electrical engineer and tramways manager respectively from £500 to £650 as from April 1st last, with an additional increase of £50 each from April 1st, 1921.

The *Times* states that General Sir Arthur William Currie, G.C.M.G., K.C.B., who formerly commanded the Canadian Corps in France, has been appointed Principal of McGill University, Montreal, in succession to the Rt. Hon. Sir Auckland Geddes.

Mr. E. S. BARRALET, who has been manager of Messrs. Pinchin, Johnson & Co.'s insulating varnish department for the last 18 years, has been appointed a director of the company.

The *Times* states that Dr. DEUTSCH, head of the A.E.G., arrived in Paris on Tuesday to take part in the forthcoming economic negotiations between German and French business men.

The Highways Committee of the L.C.C. recommends the following appointments in connection with the reorganisation of the Council's tramways department: Mr. J. R. WIGNAL to be principal technical assistant in the permanent way branch (as from August 1st, 1921); Mr. F. H. Wigner, senior technical assistant in the electrical branch; Messrs. A. W. Leech, F. Cook, J. J. Harding, and C. W. Fourniss, technical assistants, Grade II. in the rolling stock branch; Mr. E. H. Beel, technical assistant, Grade II, in the permanent way branch; Messrs. W. Press, C. E. Wheeler, and A. Pearce, technical assistants, Grade III. in the electrical branch; Mr. H. S. Sellar, motor school superintendent; Mr. A. F. Bentall, rolling stock inspector; and Mr. J. R. Walker, assistant power station engineer, to be inspecting engineer in the electrical branch.

Mr. C. C. VALDER has been appointed supplies manager of Messrs. Siemens Brothers & Co., Ltd. (Sheffield branch), 23, Filey Street, Sheffield. He has been employed with the firm since 1910, originally in the fittings department, and since demobilisation in the estimating department of the lamp and supplies department, Upper Thames Street, London, E.C. He served with the forces all through the war, and his military record was particularly good. In 1914 he was a sapper in the London Electrical Engineers, after which he was gazetted second lieutenant in the King's Own Royal Lancashire Regiment. Later he became captain in charge of Divisional Artillery Signals, and was eventually temporarily in command of the 66th Division Signal Company of the Royal Engineers from July, 1915, to June, 1919. While in this position he was awarded the M.C. for meritorious service at Landrecies.

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NEW COMPANIES REGISTERED.

Dunblane and District Electricity Supply Co., Ltd. (11,193).—Private company. Registered in Edinburgh May 5th. Capital, £500 in £1 shares. To carry on the business indicated by the title. The first directors are: H. J. Osborn, Wynthorpe, Baxter Road, Sale, Cheshire, engineer; W. Sharp, Hillside of Keir, Dunblane, farmer. Registered office: 213, West George Street, Glasgow.

Falkesley Electrical and Kinema Supplies, Ltd. (167,214).—Private company. Registered May 7th. Capital, £5,000 in £1 shares. To take over the business of film renters, agents and producers, electrical contractors, patentees of a curtain controller, cinematograph agents, &c., carried on by F. E. Clipstone at Thurland Street, Nottingham. The first directors are: F. E. Clipstone, Highbury Avenue, Keyworth, Notts; S. H. Brown, J.P., 92, Noel Street, Nottingham; B. Smith, 7, Sussex Street, Nottingham. Qualification, £25. Solicitor: A. F. Neane, Burton Street, Nottingham. Registered office: 6, Thurland Street, Nottingham.

New Process Electric Lamp Co., Ltd. (167,268).—Private company. Registered May 8th. Capital, £5,000 in £1 shares (3,000 preference). To take over the business of electric lamp manufacturers and agents carried on by S. Coxon and W. A. Williams at Canning Place, Liverpool, under a similar title. The first directors are: S. Coxon, 20, Catton Avenue, Liverpool, electrical engineer; W. A. Williams, 56, Canterbury Road, Wallasey, Cheshire, electrical engineer. Solicitor: Eskrigge, Roby & Carr, 5, Cook Street, Liverpool.

Goodall Electric, Ltd. (167,261).—Private company. Registered May 8th. Capital, £2,000 in £1 shares. To take over the business of electricians carried on by T. J. Stapley, W. J. Mills and T. C. Jones at 17a, South Castle Street, Liverpool, as the "Standard Electric Co." The first directors are: L. Jackson, 47, Saxonia Road, Walton, Liverpool; T. R. M. Chetter, 64, County Road, Liverpool. Solicitor: E. B. Driffield, 20, Castle Street, Liverpool. Registered office: 64, County Road, Walton, Liverpool.

H. A. Bryce, Ltd. (167,372).—Private company. Registered May 12th. Capital, £5,000 in £1 shares. To take over the business of an electrical engineer carried on at 69, Middlewood Road, Sheffield, by Herbert A. Bryce. The first directors are: H. A. Bryce, 69, Middlewood Road, Hillsbrough, Sheffield, electrical and mechanical engineer; J. Enock, 3, Seaside Road, Sheffield, builder; J. R. Marsh, 1, Swaledale Road, Sheffield, electrical engineer. Registered office: 69, Middlewood Road, Hillsbrough, Sheffield.

Lester & Browne (London), Ltd. (167,288).—Private company. Registered May 10th. Capital, £5,000 in £1 shares. To carry on the business of manufacturers of and dealers in electrical accessories, apparatus and appliances, electrical, chemical and general engineers, &c. The first directors are: G. W. Lester, 71, Carlton Road, Tufnell Park, N.; G. E. Lea Wynne, 58, Hilldrop Crescent, N.7; E. H. Bonney, 11, Sunninghill Road, Lewisham, S.E. Solicitor: H. Borradaile, Old Serjeants' Inn Chambers, E.C. Registered office: 44 and 46, Surbiton Road, Kingston.

T. E. Slaughter & Co., Ltd. (167,338).—Private company. Registered May 11th. Capital, £7,500 in £1 shares. To take over the business of manufacturers of and dealers in "Lyto" dry cell and other electric batteries carried on by T. E. Slaughter and others at 172, Church Road, Mitcham. The first directors are: Mrs. E. A. Dollar, 13, Hyde Park Square, W.; W. H. Edridge, 24, St Mary Abbott's Terrace, W.14; T. E. Slaughter, 5, King's Road, Wimbledon, S.W.; E. E. G. Boite, 13, Portland Street, Cheltenham. Solicitors: Edridge, Son & Marten, 4, High Street, Croydon. Registered office: 172, Church Road, Mitcham, Surrey.

Taylor & Kay, Ltd. (167,339).—Private company. Registered May 11th. Capital, £2,000 in £1 shares. To carry on the business of manufacturers of lamp shades and electrical accessories, electrical engineers, &c. The subscribers (each with one share) are: W. M. Groom, 49, South Croxted Road, West Dulwich, S.E., surveyor; L. Wheeler-Taylor, 37, Essnedine Road, Maida Vale, W.9; H. Kay, 29, Colville Terrace, Bayswater, W., motor engineer. The first directors are: W. M. Groom, L. Wheeler-Taylor, H. Kay, H. E. Rainbow. Secretary: F. P. James. Registered office: 327, Edgware Road, W.

Western Anglo-Swedish Electric Welding Co., Ltd. (167,396).—Private company. Registered May 12th. Capital, £25,000 in £1 shares. To carry on the business of electric and other systems of welding, engineering, dealing in plant, machinery, ships, vessels and hardware, &c. The subscribers (each with one share) are: H. J. Richards, 133, The Exchange, Cardiff, consulting engineer; E. H. N. Moxon, 101, Leadenhall Street, E.C., shipbroker. The subscribers are to appoint the first directors. Solicitor: P. J. Nicholls, 17, Farringdon Street, E.C. Registered office: 25, Mount Stuart Square, Cardiff.

John Porter Engineering Co., Ltd. (167,411).—Private company. Registered May 13th. Capital, £10,000 in £1 shares. To take over the business of a general electrical and motor engineer carried on by J. Porter at North Shields. The permanent directors are: W. Lilburn, Netherton, Heaton Road, Newcastle; J. C. Patterson, 4, Churchill Gardens, Jesmond; J. H. Richardson, 37, Linskill Terrace, North Shields; J. Porter, 117, Chirton, West View, North Shields; A. Melrose, 22, Northumberland Square, North Shields; R. Saunders, 46, Park Crescent East, North Shields;; R. W. Stranghan, 155, Grey Street, North Shields. Solicitor: F. C. Chitt, 34, Grey Street, Newcastle-on-Tyne.

T. Emery's Automatic Power Generating Motors, Ltd. (167,337).—Registered May 11th. Capital, £10,000 in 5,000 preference shares of £1 each and 100,000 founders' shares of 1s. each. To take over from T. Emery certain inventions and patent rights, and to carry on the business of manufacturers of self-starting automatic power generating motors for power stations and factories, and for generating light and heat in public buildings, hotels, theatres, kinemas and private buildings, high-speed motors for trains and electrically-driven agricultural machinery, high-speed turbines for ships and battleships (instant reverse motion), motor cars, motor cycles and scooters, high-speed light motors for aeroplanes, timepieces, town clocks, watches, musical instruments, such as organs, gramophones and mechanical toys, &c. The memorandum of association as originally printed contained a clause as follows: "In view of the world-wide importance of Mr. Emery's inventions, the company shall have power to increase its capital to £25,000,000. Upon any such increase of capital such new shares shall be issued in the same terms, in the same proportions as the original share capital of the company," but this clause has been deleted and the deletion initialled by all the subscribers. Another extraordinary clause appears (*i.e.*, remains in) the articles of association, to the effect that Mr. T. Emery "intends to devote" not less than 50 per cent. of the net proceeds he receives by way of dividends "towards relieving the temporary distress that may result from the introduction of this invention, and any surplus to any other more needy and deserving cases, or education of the poor." The subscribers (each with one preference share) are: Dmitri Tchernine, 25, Windsor Court, Bayswater, W., journalist; W. T. C. Lock, "Totteridge," Temple Road, Epsom, director of companies; Major C. E. New, O.B.E., The Limes, Kingston Hill, Surrey; D. Jenkins, Bryntirrion, Aberporth, South Wales, shipowner; T. Emery, 26, Marsham Street, S.W., British and foreign patentee; W. W. Coltart, Tower House, Epsom, surgeon; S. C. Robertson, 14, Disraeli Gardens, Putney, S.W., engineer draughtsman. The first directors are: Dmitri Tchernine, W. T. C. Lock and T. Emery, all of whom are permanent. T. Emery is managing and technical director. Remuneration of T. Emery, £5,000 per annum; chairman, £2,500 per annum; ordinary directors, £1,000 per annum. The purchase consideration for the inventions is £5,000, payable wholly in founders' shares, of which the vendor directs 20,000 to be allotted to Mr. Cole Lock and 15,000 to the International Exchange and Banking Corporation, Ltd. The papers were filed by the last-named company. Solicitor: C. B. Lumley, 130, Strand, W.C. Registered office: 392, Strand, W.C.

B. Young & Co. (Birmingham), Ltd. (167,254).—Private company. Registered May 8th. Capital, £3,000 in £1 shares. To carry on the business of electrical and mechanical engineers, &c. The subscribers (each with one share) are: S. F. Outon, 1,246, Pershore Road, Stirchley, Birmingham, engineer; B. Young, Mignon Cottage, Jordan Road, Four Oaks, Warwick. B. Young is the first director. Registered office: 100, Leek Street, Birmingham.

British Electric Lamps, Ltd. (167,205).—Private company. Registered May 7th. Capital, £20,000 in £1 shares. To take over (1) the business of manufacturers of and dealers in electric lamps carried on by E. R. Grote at 173, Hartfield Road, Wimbledon, and (2) the business of manufacturers of and dealers in electric candles, lights and stoves carried on by the Lux Candle Co., Ltd. The first directors are: E. R. Grote, Lynwood, Church Lane, Merton, Surrey; A. A. Barren, Headlands, Berkhamsted (director, Lux Candle Co., Ltd.). Holders to be appointed by subscribers. Solicitor: E. A. Davidson, 2, Gresham Buildings, Basinghall Street, E.C. Registered office: Spencer Hill Road, Wimbledon, S.W.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

J. C. H. Martin, Ltd.—Equitable mortgage on The Bear Yard, dated April 29th, 1920, to secure all moneys due or to become due from company to Barclay's Bank, Ltd.

Thermo Electric, Ltd.—Sir Arthur F. Whinney, K.B.E., of 46, Fredericks Place, Old Jewry, E.C., as Receiver on April 29th, 1920, under powers contained in certain debentures.

Coatbridge and Airdrie Electric Supply Co., Ltd.—Charge on the company's undertaking and property, present and future, including uncalled capital and the Coatbridge and Airdrie undertakings, benefit or certain agreements, contracts, &c., dated December 20th, 1919 (supplemental to mortgage dated March 1st, 1904), to secure £7,000. Holders: County of London Electric Supply Co., Ld.

Brompton and Kensington Electricity Supply Co., Ltd. (28,919).—Capital, £300,000 in 20,000 preference and 40,000 ordinary shares of £5 each. Return dated April 1st, 1920. 5,662 preference and 34,338 ordinary shares taken up. £195,000 paid on 5,662 preference and 33,338 ordinary. £5,000 considered as paid on 1,000 ordinary. Mortgages and charges, nil.

British L.M. Ericsson Manufacturing Co., Ltd. (79,061).—Return dated March 31st, 1920. Capital, £200,000 in £1 shares (99,990 preference and 100,010 ordinary). All shares taken up. £170,000 paid (being £1 per share on 50,010 ordinary and 99,990 preference and 8s. per share on 50,000 ordinary). £30,000 considered as paid on 50,000 shares (being 12s. per share). Mortgages and charges, £50,000.

Burgess Hill and District Electrical Supply Co., Ltd.—Return dated March 19th, 1920. Capital, £6,000 in £1 shares (3,000 ordinary and 3,000 preference). All shares taken up. £5,900 paid. £100 considered as paid. Mortgages and charges, £1,200.

City of London Electric Lighting Co., Ltd.—Return dated April 7th, 1920. Capital, £1,200,000 in £10 shares (80,000 ordinary and 40,000 preference). 70,595 ordinary and 40,000 preference shares taken up. £1,105,950 paid. Mortgages and charges, £800,000.

County of Durham Electrical Power Distribution Co., Ltd. (61,591).—Return dated March 30th, 1920. Capital, £425,000 in £1 shares. 400,000 shares taken up. £400,000 paid. Mortgages and charges, £250,000.

Kensington & Knightsbridge Electric Lighting Co., Ltd. (26,193).—Capital, £350,000 in 50,000 ordinary, 10,000 1st preference, and 10,000 2nd preference shares of £5 each. Return dated March 25th, 1920. 21,000 ordinary, 10,000 1st preference, and 10,000 2nd preference shares taken up. £179,840 paid on 15,968 ordinary, 10,000 1st preference, and 10,000 2nd preference. £25,160 considered as paid on 5,032 ordinary. Debt due from company in respect of mortgages and charges at date of return, £115,000; ditto guaranteed jointly by this company and Notting Hill Electric Lighting Co., Ltd., £225,000. Registered since date of return. Issue on April 13th of £25,000 debenture, part of a series already registered.

CITY NOTES.

Oriental Telephone and Electric Co., Ltd.

The gross earnings during 1919 were £124,648, plus £11,502 brought forward. Working expenses, maintenance, &c., absorbed £70,909; debenture interest and redemption charges have been provided for. The dividend on the ordinary shares is 10 per cent., and the bonus 2 per cent., both free of tax; £5,000 is put to general reserve; £2,000 to staff pension fund; and £11,013 carried forward. The operations of the branches and subsidiaries have continued to show increased revenues. The great obstacle to further expansion has been the difficulty in procuring supplies of material and their shipment to the East. An improvement in this direction is already apparent, with the result that it should soon be possible to overtake arrears and give facilities to intending subscribers whose names are now on the waiting lists. For this purpose several technical assistants were sent to the East during 1919. The reconstruction of the Singapore exchange building has been completed, and the new switchboard equipment is now being brought into use. At December 31st, 1919, the company had, in all, 8,020 exchange and private lines in operation, a net increase of 730. The following dividends have been declared by the Indian local companies, viz.: 18 per cent. by the

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Bombay Telephone Co., Ltd., as against 16 per cent. for the year 1918; and 8 per cent. by the Bengal Telephone Co., Ltd., as against 7 per cent. At December 31st, 1919, the Bombay Co. had 7,880 exchange and private lines in operation, being a net addition of 830 during the year, and the Bengal Co. 6,846 exchange and private lines, being a net addition of 547. The gross revenue of the China and Japan Telephone & Electric Co., Ltd., has been increased, but the net result of the working is rather less favourable than that of the previous year on account of the high price of material and labour and the adverse effect of the continued rise in exchange. At December 31st, 1919, the company had 5,575 exchange and private lines in operation, a net addition of 804. The previous rate of dividend, viz., 10 per cent., free of income tax, has been maintained. The liquidation of the Telephone Co. of Egypt, Ltd., has not yet been completed. A distribution of £29,632 announced by the liquidator on December 24th, 1919, and the receipt by this company of that sum on January 1st, 1920, has enabled a further amount of 2s. 6d. per share to be distributed as capital amongst the ordinary shareholders, and the capital reserve account has thus been reduced to £173,464 since the close of 1919.

General Electric Co. (U.S.A.).

The report of this company for 1919 shows that the value of the orders received was $237,623,932, as compared with $234,134,037 for 1918. For some months succeeding the armistice, the volume of business booked was much curtailed; but during the last eight months of the year orders steadily and rapidly increased, so that the present demand for the company's products is greatly in excess of the capacity of its factories. At the close of the year the amount of orders unfilled was $98,880,000, compared with $80,000,000 at the end of 1918. The great increase in orders for all classes of apparatus manufactured by the company makes it necessary to add substantially to its manufacturing capacity. This is being accomplished partly by enlarging its present plants and in part by purchasing, or leasing with option to purchase, factories already constructed which offer immediately available facilities, thus enabling the company to secure an earlier output than would be possible by erecting and equipping new factories of like capacity. The total factory floor space has been increased from 19,581,000 sq. ft. in 1918 to 20,681,000 sq. ft. in 1919.

The company has for several years been engaged, in its research laboratories and factories, in the development and manufacture of apparatus and devices essential to the transmission and reception of wireless communications. Its inventions have had a far reaching effect on the entire radio art. The Marconi Wireless Telegraph Co. of America is also the owner of valuable patents, rights, and licences, and it has seemed wise to the boards of directors of both companies that their research and engineering resources should hereafter be used in closest co-operation. To this end, and in order to secure the benefits of the long and varied electrical manufacturing experience of the General Co. on the one hand, and the operating experience of the Marconi Co. on the other, a new company has been formed, known as the Radio Corporation of America, in which both the G.E. Co. and the Marconi Co. have accepted a considerable participation.

In the report of the company for the year ending December 31st, 1918, reference was made to the incorporation of the International General Electric Co., Inc., for the purpose of taking over the assets, investments, and activities of the company in foreign countries, covering manufacturing, selling, engineering, utility enterprises, &c. In accordance with that announcement the company subscribed for the entire capital stock of the International General Electric Co., Inc., consisting of $10,000,000 of 7 per cent. preferred stock at par and $10,000,000 of common stock at 110, paying therefor the sum of $21,000,000 cash (part before December 31st, 1919, and the balance in January, 1920), and sold to the International General Electric Co., Inc., securities and accounts of like value.

The widespread and diversified interests involved have prevented the completion, at December 31st, 1919, of all of the transfers and therefore this report combines, for the sake of convenience, the assets and liabilities of the International Co. with those of this company.

The Swedish Ericsson Co.

The report for 1919 of the directors of the Allmänna Telefon Aktiebolog L. M. Ericsson states that the reserve which was manifested on the cessation of the war continued during a large part of last year, and the demand for manufactures only increased in the second half, when orders arrived in greater abundance. As a result of the keen competition in the world's markets, it was impossible to keep sale prices on the level demanded by the high costs of production in Sweden. The company had orders on hand at the beginning of 1920 for 10,000,000 kr., and orders had been plentiful since, whilst in the matter of prices the changed conditions in the most important foreign labour markets seemed recently to have reduced the difficulties of the Swedish export industries to some extent. Work at the Stockholm shops proceeded without disputes during the year, the number employed there having risen from 1,296 to 1,359 at the end of the year; and a total bonus of 1,146,000 kr. was paid to the personnel to meet the increased cost of living. The value of the deliveries from the workshops amounted to 15,770,000 kr., as compared with 12,750,000 kr. in 1918; 10,840,000 kr., or 68.7 per cent. of the former represented exports, as against 7,550,000 kr. and 59.2 per cent. in 1918.

A new subsidiary company had been formed in Holland which, together with the Dutch colonies, had become one of the company's principal markets in recent years. The largest customers were composed of State and municipal authorities, who had set up a strong demand that at least some of the telephone material should be manufactured in the country, having regard to the increased purchases which were being made. In order to meet this demand the directors accepted an offer made by a competitive undertaking in Holland to take over the business, and for this purpose a Dutch company was constituted with the Swedish company holding the majority of the share capital. The decision to this effect was reached last autumn, but the business was only taken over at the beginning of 1920. The factory could not occupy more than 150 workmen, but it would be able advantageously to carry out some of the work which formerly involved high freight and Customs charges, and good possibilities existed for its future extension. Coming to consider the South American markets, the report mentions that the importance of sales there had considerably increased during the war, and the directors considered that the markets ought to be worked in a more direct and energetic manner than could be done through local agents. For this purpose a branch was established in the middle of last year at Buenos Ayres with the object partly of carrying on direct sales, and partly of undertaking the construction of telephone installations and acquiring telephone concessions. During the short time of its existence the branch had not been able to show big results, but judging from everything South America would become a specially good market for the company's manufactures. The activity of the branch had hitherto been limited to Argentina and Uruguay, but the intention was also to cover the remainder of South America, particularly Chile and Brazil.

After dealing with the subsidiary companies in Petrograd, London, Austria, Hungary, Buffalo, U.S., Paris, and Finland, the report returns the net profits at 3,750,000 kr., as against 3,740,000 kr. in 1918. The directors recommend a dividend at the rate of 5 per cent., this contrasting with 6 per cent. in the previous year, when the share capital participating was 61,500,000 kr., as compared with 73,250,000 kr. at the end of 1919.

The Austrian Cable Works and Wire Industry Co.

The directors of the Kabelfabrik und Drahtindustrie A.G., of Vienna, reporting on the year 1919, state that it was only possible partly to utilise the capacity of the works, as was also the case in recent years; raw materials were more difficult to obtain owing to the separation of the individual States in Customs and transport matters, and even some departments had temporarily to cease working altogether. At the end of the year the stocks in Vienna showed an increase as compared with the close of 1918, as it had been possible for the company to acquire various materials in connection with the demobilisation, for which payment was made in war loan, which was also utilised for the payment of the war tax. Relatively favourable results were obtained both by the Zoptau & Stefan Mining & Ironworks Co., and the Corinthian Iron & Steel Works Co. The authority given a year ago to raise the share capital to 10,000,000 kr. by the issue of 9,000 shares of 200 kr. was exercised in January, 1920, and the result of the issue, through which the company's own funds were increased by approximately 9,000,000 kr., would be brought into the accounts for the new financial year. After writing off 986,000 kr. for depreciation, the net profits are returned at 3,815,000 kr., which sum is reduced to 3,606,000 kr. by a payment made to the Pressburg Cable Works Co. under the joint profit equalisation contract between the two companies. The balance forward from 1918 brings the total amount available for disposal to 4,005,000 kr., and the dividend is at the rate of 18 per cent., or 36 kr. per share, on a share capital of 8,200,000 kr.

Arbroath Electric Light & Power Co., Ltd.—The profits for the year amounted to £3,628, plus £484 brought forward. The directors recommend a dividend of 7 per cent. on the ordinary shares, which carries an increase of 1 per cent. on preference shares. The year was a prosperous one for the company. A large number of new consumers have been connected up within the last few months, and at the present time the demand is greater than the present installation can supply. It will be necessary to lay down additional mains before next winter, and further engine power and other plant will also be required soon. The expenditure will necessarily be heavy, but the prospects are excellent, and it is proposed by the directors to increase the capital to £100,000, divided into 10,000 £1 5 per cent. preference shares, participating up to 6 per cent., and 90,000 £1 ordinary shares.

Lancashire Dynamo & Motor Co., Ltd.—Dividend 10 per cent. on the ordinary shares, tax free.

West India & Panama Telegraph Co., Ltd.—Interim dividends were paid in November last on the first and second preference shares at 6s. per share, leaving £10,033, which the directors think should be carried forward to the current year's account. According to the *Financial Times* the year 1919 was the most disastrous in the company's history, the primary cause being the unprecedentedly long delay of the cable-steamer, the *Henry Holmes*, at Trinidad in undergoing her third survey. In the first three months of this year the loss of traffic is estimated at £18,000. Every effort has been made to obtain the services of cable-steamers of other telegraph companies, and on three occasions the efforts were successful, but for short periods only. An opportunity having recently offered, it was decided, notwithstanding the expense, to charter a cable-steamer for five months, and it is hoped in that time to restore several, if not all, of the most important sections.

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Stock Exchange Notices.—Application has been made to the Committee to allow the following to be officially quoted:—

English Electric Co., Ltd.—1,431,509 ordinary shares of £1 each, fully paid (Nos. 1 to 1,431,509); and 552,528 6 per cent. cumulative preference shares of £1 each, fully paid (Nos. 1 to 552,528), and £1,000,000 5½ per cent. sinking fund first mortgage debentures.

Submarine Cables Trust.—4,200 coupons of reversion (Nos. 1 to 4,200).

The Committee has specially allowed dealings in the following under temporary regulation 4 (3):—

Callender's Cable & Construction Co., Ltd.—400,000 ordinary shares of £1 each, fully paid (Nos. 1 to 400,000); and 400,000 6½ per cent. cumulative preference shares of £1 each, fully paid (Nos. 1 to 400,000).

Greenwood & Batley, Ltd.—96,000 7 per cent. cumulative preference shares of £1 each, fully paid (Nos. 1 to 96,000); 168,000 ordinary shares of £1 each, fully paid (Nos. 1 to 168,000); and 174,195 new ordinary shares of £1 each, fully paid (Nos. 180,391 to 354,585).

Para Electric Railways & Lighting Co., Ltd.—5,000 6 per cent. cumulative preference shares of £1 each, fully paid, (Nos. 320,001 to 325,000).

The Committee has ordered the undermentioned to be officially quoted:—

Para Electric Railways & Lighting Co., Ltd.—5,000 6 per cent. cumulative preference shares of £1 each, fully paid (Nos. 320,001 to 325,000).

West London & Provincial Electric Supply Co., Ltd.—Mr. H. Kahn presided at the annual meeting last week. He said that the balance at profit and loss of the West London showed an increase of £1,151 over that of last year, chiefly due to the fact that they received 7½ per cent. dividend on their shares in the Chiswick Corporation, as against 6 per cent. last year. Out of £4,716 available for distribution, they proposed to pay a dividend on the cumulative preference shares of 6 per cent., less tax, and the interest in arrear for the years 1914, 1915, and 1916 of 4½ per cent. per annum on the funding certificates, the balance of £251 being carried forward. He had reason to hope that, barring unforeseen circumstances, this time next year they would be able to wipe out the remaining arrears of interest on the funding certificates. The results both at Chiswick and Aberystwyth had shown an improvement. The outlook for the year 1920 seemed quite good, in view of the results already obtained, but, naturally, with the uncertainty of prices both for fuel and labour, it would not be safe to be to optimistic.

Altrincham Electric Supply Co., Ltd.—A dividend of 7 per cent. per annum on the ordinary shares is announced.

Submersible Motors, Ltd.—Mr. B. T. Rumble presided at the annual meeting held at Southall on May 12th. He said it was not possible to lay the accounts before the meeting as they were being audited. The negotiations with the Admiralty as to prices had been completed, and the meeting would be adjourned until the amount of the company's liability for excess profits was known. In the meantime an interim dividend of 5 per cent. for the year ended March, 1919, was being paid. In the fire of November last they lost the whole of the records of the work in progress in the shops at the time. Until the whole of the amount of the loss on all items was known the insurance companies refused to deal with any part of the claim.

Prospectus.—*Aster Engineering Co. (1913), Ltd.*—This company is offering for subscription (May 28th is the closing day) 100,000 8 per cent. cumulative participating preference shares of £1 each at par. The capital is being increased to provide funds for the purpose of additions which are now being made to the existing works and equipment for the execution of the increasing volume of profitable business. Over 30,000 Aster engines are already in use, and many of them have been at work for 12 to 15 years; a considerable and increasing business is now growing up in the manufacture of spare parts and renewals.

Fellows Magneto Co., Ltd.—The report for 1919 states that, after allowing £4,615 for depreciation, &c., there is a net profit of £22,644. The 8 per cent. dividend on the cumulative participating preferred shares for 1918 has been paid, absorbing £9,255. The directors recommend a participating dividend at the rate of 1½ per cent. per annum, less tax, on the preferred shares, making 9½ per cent. for 1919, and a dividend of 25 per cent., less tax, on the ordinary shares. £5,772 is to be carried forward, subject to excess profits tax.

Tramways (M.E.T.) Omnibus Co., Ltd.—According to the *Financial Times*, the accounts for 1919 show that, after providing for the service of the debenture stock and for income tax, &c., and including £15,000 transferred from reserve, the credit balance of £1,055 brought forward is converted into a debit of £7,265.

Rhondda Tramways Co., Ltd.—Dividend 8 per cent., less tax, on the preference shares on account of arrears (from 1914 onwards); £8,000 to reserve and renewals; £25,694 for repairs and maintenance; £1,280 carried forward.

Loughrea, Co. Galway, Electric Power & Lighting Co.—Dividend at the rate of 5 per cent., free of tax, for the past year.

Submarine Cables Trust, Ltd.—The report for the year ended April 15th, 1920, states that the revenue amounted to £26,259 and the expenses to £1,820, leaving a balance of £24,438. After providing £12,372 to meet payment of the coupons, the sum of £12,066 has been transferred to the redemption fund; £66 is carried forward.

Puebla Tramway, Light & Power Co.—A meeting of holders of the first mortgage 35 year 5 per cent. gold bonds is called for June 15th, in London, to consider proposed modification of their rights.

Dudley, Stourbridge & District Electric Traction Co., Ltd.—Dividend of 4 per cent. on the ordinary shares for 1919. £1,000 to reserve; £2,000 to renewals; £65 carried forward.

Johnson & Phillips, Ltd.—The financial Press states that the recent issue of 87,500 £1 ordinary shares was largely oversubscribed.

Siemens Bros. & Co., Ltd.—Final dividend of 1s. per share, free of tax, making a total dividend of 10 per cent. per annum, free of tax, for 1919.

Oldham, Ashton & Hyde Electric Tramway, Ltd.—Dividend of 6 per cent. for the year 1919 on the ordinary shares.

Nairobi Electric Power & Lighting Co., Ltd.—Final dividend of 2 per cent., making 10 per cent. for 1919.

STOCKS AND SHARES.

TUESDAY EVENING.

THE course of the Stock Exchange markets never runs smoothly when politics interfere with it. The Chancellor of the Exchequer is accused of not knowing his own mind sufficiently to make him definite on the point of what taxation shall be imposed, and what dropped. Flirtation with the question of a War Wealth Levy is one of the factors which make, at the present time, for hesitation and uncertainty in the Stock Exchange markets. The effect of this is felt all round. The man of wealth, not knowing where he is to be attacked, sells a little stock by way of precaution. The Stock Exchange man, fearing that War Wealth taxation will bring a lot more securities to market, puts down prices in case this may happen. The whole of the House is affected by these considerations, while amongst industrials, the outlook is darkened by the new difficulties which seem likely to spring up in Labour circles as one result of the rise in coal.

Electricity Supply shares are heavy by reason of this latter cause. Charing Cross, City Lights, Westminster, Kensington and County of London ordinary shares are down ⅛ to ¼. The preference shares remain unchanged. Amongst manufacturing issues the same tendency prevails. Electric Constructions and Cromptons are both lower. In the cable group, Henley's lost 1/16. Elsewhere, Castner Kellner developed flatness on selling from the North, and the price dropped to 3¾.

Eastern Extensions and Eastern Telegraph ordinary are quoted ex dividend, and the former at 15 offer a yield to 6¾ per cent., dividends being paid free of tax. A Bill giving the U.S. Secretary of State the right to license all cables landing on American shores has been introduced at Washington. Its sponsor claims that American cable communications with South America were being hampered by a Brazilian grant of exclusive rights to an English company to operate cables in its territory. The Stock Exchange market views the matter without concern. Oriental Telephones have eased off to 2⅞; the dividend is raised from 10 per cent. to 12 per cent., tax free, of which 2 per cent. is declared by way of bonus. West India and Panama ordinary have fallen to 12s. 6d., and both classes of preference weakened. The recent report is not relished. Marconis went back to 3 before rallying to 3⅛. Marconi Marines are flat at 37s. 6d.

Urban Electric preference were not immediately affected by the passing of the dividend, as mentioned here last week, but shares came to market later on at 22s. 6d., at which price they were taken. The ordinary are quoted about 6s., and could perhaps be bought for rather less. Edmundson's ordinary stand at the same level, and the 6 per cent. preference last changed hands at 43s. 1½d. These, like the Urban preference, are of the nominal value of £5, and are fully paid. The ordinary of both companies are £3 shares, also fully paid. River Plate Electricity ordinary stands at 105 ex dividend and bonus. Victoria Falls preference are better at 20s., the 5 per cent. first debentures are 94½, and the Seconds 102¾, while the ordinary, in which there is not much market, stand at 12s. English Electrics remain fairly steady at 20s. 9d. British Aluminium new ordinary are a pound, General Electric new ordinary 29s. 6d., the 7½ per cent. B preference 19s. 3d., and the 6½ per cent. preference have gone back to 17s. 6d.

The Underground Railway group is weak because of the unsettlement—up to the time of writing—amongst the omnibus men. Central London preferred at 45½ is 2 lower. Of other traction issues, Mexicans have improved, on the assumption that any Government other than that of Carranza might make an agreeable change from the chaotic conditions prevailing under his régime. Bombay Electric preference have started to mount again, and are 15s. up at 13½. Brisbane

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Electric Tramways 4½ per cent. debenture stock is quoted higher at 94. Under the Trust Deed the stock becomes repayable at 100 on January 1st next, and a full year's interest will have become due by then. This would look a "dead-snip" for the investor were it not for the lurking doubt as to the redemption being carried out at due date.

Metropolitan-Vickers ordinary are firmer at 27s. 6d., and the preference retain their last week's advance at 25/16. Armament and engineering shares show a dwindling tendency. A fall of 2s. 6d. lowered Babcock & Wilcox to 2¼. The rubber market went down sharply in company with the raw material, but recovery from the worst ensued.

Before the war, one of the best reference books available in connection with electric lighting and traction was Atkin's "Manual," privately published by a well-known Stock Exchange firm for circulation amongst their friends and fellow-members. The volume has made a welcome reappearance, and is a power-house of information. How up to date it is may be exemplified by the details of the British Electric Transformer's new issue of 137,500 7 per cent. preference (at 17s. 6d.) and 162,500 ordinary shares (at 24s.) made last month. The English Electric Company's figures for 1919, which were announced in April, are duly shown, the ordinary receiving 8 per cent. dividend, £100,000 going to capital reserve account, £133,045 expenses written off, and £45,301 being carried forward. Mention is made of the General Electric's offer, in March last, of 400,000 new ordinary at 28s. and £1,600,000 new 7½ per cent. B preference shares at 20s., existing holders being offered at the same time the right to subscribe for one new ordinary share at 28s. in the proportion of one new for every three old shares held. The "Manual" is in other respects fully up to date, and is admirably produced.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1918.	Dividend 1919.	Price May 18, 1920.	Rise or fall.	Yield p.c.
Home Electricity Companies.					
Brompton Ordinary	8	12	6⅜	—	£9 8 2
Charing Cross Ordinary	4	7	8½	− ½	9 6 8
do. do. do 4½ Pref.	4½	4½	2½	—	8 8 8
Chelsea	8	4	8	—	6 8 4
City of London	8	10	11⅜	− ½	8 12 0
do. do. 6 per cent. Pref.	6	6	9	—	6 18 4
County of London	7	8	8½	− ½	9 2 10
do do. 6 per cent. Pref.	6	6	8⅝	—	6 17 2
Kensington Ordinary	6	7	4⅜	− ½	7 11 5
London Electric	Nil	2½	1⅜	—	5 2 6
do. do. 6 per cent. Pref.	6	6	8½	—	9 4 8
Metropolitan	5	6	8	—	10 0 0
do. 4½ per cent. Pref.	4½	4½	2½	—	8 0 0
St. James' and Pall Mall	10	12	6½	—	8 16 10
South London	5	6	2½	—	9 12 0
South Metropolitan Pref.	7	7	18/9	—	7 0 0
Westminster Ordinary	8	10	5	− ½	10 0 0
Telegraphs and Telephones.					
Anglo-Am. Tel. Pref.	6	6	77½	—	7 14 10
do. Def.	33/6	1½	18⅜	—	8 0 0
Chile Telephone	6	6	6½	—	*4 18 2
Cuba Sub. Ord.	7	7	9½	—	*7 7 4
Eastern Extension	8	10	15xd	—	*6 13 4
Eastern Tel. Ord.	8	10	158½xd	—	*6 10 4
Globe Tel. and T. Ord.	8	10	15½	—	*6 7 0
do. do. Pref.	6	6	8½	—	7 1 2
Great Northern Tel.	22	—	21½	− 1	9 15 6
Indo-European	13	10	40	—	6 5 0
Marconi	25	—	8½	− ¼	8 0 0
Oriental Telephone Ord.	10	12	12⅜	− ⅛	*4 11 5
United R. Plate Tel.	8	—	7¼	− ¼	*5 5 0
West India and Panama	1/3	—	⅜	− ⅛	—
Western Telegraph	8	10	15½	—	*6 7 0
Home Rails.					
Central London Ord. Assented	4	4	41½	—	8 19 9
Metropolitan	1	1½	19½	− ½	5 8 2
do. District	Nil	Nil	15¼	−1⅛	Nil
Underground Electric Ordinary	Nil	Nil	1⅞	− ⅛	Nil
do. do. "A"	Nil	Nil	4 6	−/d.	Nil
do. do. Income	5	4	60½	· 8	6 12 8
Foreign Trams.					
Anglo-Arg. Trams. First Pref.	Nil	Nil	8⅛	—	—
do. do. 2nd Pref.	—	—	8	—	—
do. do. 5 Deb.	5	5	57¼	—	8 18 10
Brazil Tractions	—	—	49½	− ⅜	—
Bombay Electric Pref.	6	6	18½	+ ⅜	4 11 3
British Columbia Elec. Rly. Pfce.	5	5	55½	—	9 2 0
do. do. Preferrred	2½	5	48½	—	10 6 2
do. do. Deferred	Nil	3	44⅛	—	6 14 10
do. do. Deb.	4½	4½	52	—	8 3 6
Mexico Trams 5 per cent. Bonds	Nil	Nil	28½	—	Nil
do. 6 per cent. Bonds	Nil	Nil	20	—	Nil
Mexican Light Common	Nil	Nil	12½	—	Nil
do. Pref.	Nil	Nil	2⅛	+ 5	Nil
do. 1st Bonds	Nil	Nil	59	+ 8	—
Manufacturing Companies.					
Babcock & Wilcox	15	—	2⅞	− ½	*5 4 4
British Aluminium Ord.	10	10	1⅛	—	9 8 2
British Insulated Ord.	12½	15	1⅛	—	7 14 8
Callenders	25	—	8	—	7 16 8
6½ Pref.	6½	6½	4⅜	—	6 16 10
Castner Kellner	20	—	8⅜	− ½	—
Crompton Ord.	10	—	21/6	−6d.	9 6 0
Edison-Swan, "A"	10	—	1½	—	8 17 10
do. do. 5 per cent. Deb.	5	5	79½	—	6 5 9
Electric Construction	10	—	21/-	−1/-	9 10 6
Gen. Elec. Pref.	6½	6½	17/6	—	7 8 7
do. Ord.	10	—	1⅜	—	*6 8 1
Henley	25	15	2⅛	− ⅛	7 5 8
do. 4½ Pref.	4½	4½	8½	—	6 18 6
India-Rubber	10	—	13½	—	*7 11 0
Met.-Vickers Pref.	—	8	2⅛	—	6 18 6
Siemens Ord.	10	10	26 6	—	*7 11 0
Telegraph Con.	20	20	22½	—	*5 6 8

* Dividends paid free of Income Tax.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Tuesday, May 18th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Oxalic	per lb.	2/10	...
a Ammoniac Sal	per ton	£100	...
a Ammonia, Muriate (large crystal)	,,	£52	...
a Bisulphide of Carbon	,,	...	...
a Borax	,,	£42	...
a Copper Sulphate	,,	£49	£3 dec.
a Potash, Chlorate	per lb.	1/-	...
a ,, Perchlorate	,,	1/3	...
a Shellac	per cwt.	£24	...
a Sulphate of Magnesia	per ton	£18	...
a Sulphur, Sublimed Flowers	,,	£28	...
a ,, Lump	,,	£25	...
a Soda, Chlorate	per lb.	6d.	...
a ,, Crystals	per ton	£12	...
a Sodium Bichromate, casks	per lb.	...	...
METALS, &c.			
g Babbitt's Metal Ingots	per ton	£118 to £345	...
c Brass (rolled metal 2" to 12" basis)	per lb.	1/3½	...
c ,, Tubes (solid drawn)	,,	1/6½ to 1/6½	...
c ,, Wire, basis	,,	1/3½	...
c Copper Tubes (solid drawn)	,,	1/8½	...
g ,, Bars (best selected)	per ton	£165	£2 inc.
g ,, Sheet	,,	£165	£2 inc.
g ,, Rod	,,	£165	£2 inc.
d ,, (Electrolytic) Bars	,,	£114	...
d ,, ,, Sheets	,,	£156	...
d ,, ,, Wire Rods	,,	£129	...
d ,, ,, H.C. Wire	per lb.	1/4½	...
f Ebonite Rod	,,	3/-	...
f ,, Sheet	,,	2/6	...
n German Silver Wire	,,	3/-	...
h Gutta-percha, fine	,,	13/-	...
h India-rubber, Para fine	,,	2/3	½d. dec.
i Iron Pig (Cleveland Warrants)	per ton	Nom.	...
l ,, Wire, galv. No. 8, P.O. qual.	,,	£57	...
g Lead, English Pig	,,	£10 to £41	...
g Mercury	per bot.	£22 to £25	...
e Mica (in original cases) small	per lb.	6d. to 4/6	...
e ,, ,, ,, medium	,,	5/- to 10/-	...
e ,, ,, ,, large	,,	12/6 to 25/- & up	...
g Phosphor Bronze, plain castings	,,	1/7 to 1/11	...
g ,, ,, rolled bars and rods	,,	2/2 to 2/6	...
g ,, ,, rolled strip & sheet	,,	2/3 to 2/9	...
d Silicium Bronze Wire	per lb.	1/11½	...
r Steel, Magnet, in bars	,,	1/8	...
g Tin, Block (English)	per ton	£484	£38 to £39 dec.
n ,, Wire, Nos. 1 to 16	per lb.	5/3	...
White Anti-friction Metals	per ton	£90 to £145	...

Quotations supplied by—

a G. Boor & Co.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormston & Sons.
r W. F. Dennis & Co.

Electric Furnaces. — Mr. C. H. Booth describes in *Canadian Machinery* a new type of cylindrical rotating arc furnace of moderate size for dealing with brass and other non-ferrous metals, for which the advantages are claimed of even distribution of heat with consequent long furnace life and low loss of zinc by vaporisation. The furnace, which is made in sizes from 200 to 3,000 lb. capacity, consists of a lined cylindrical body with horizontal axis resting on rollers driven through gearing by an electric motor. The two electrodes project through water-cooled apertures in the end plates and the single-phase supply is taken to them by contact rings on the rotating body. Hand regulation is used in the smaller sizes, but the largest furnaces are fitted with automatic gear. The lining is cleverly contrived with as few joints as possible, and can be renewed without much difficulty. The charging door at the end of the furnace is hinged like the breech-block of a gun and swings back with the electrode in its centre and all the electrode gear. Before pouring, the furnace is stopped with the tap hole at the top, when it is opened by picking out the sand plug with a pointed tool, and the furnace is slowly rotated until the metal begins to pour. The movement can be controlled to a nicety due to the electrical drive. Thirty to forty minutes are required to melt a charge, and with a small furnace the energy consumption is about 300 kw.-hours per ton. From 600 to 1,000 heats are believed to be obtainable without relining, and the electrode consumption in a 250-lb. furnace, fairly constantly employed, averages 31 lb. per ton.

A novel device described in the *Iron Age* is a tilting mechanism for removing a furnace roof when charging. The furnace, as constructed by the Industrial Electric Co., Chicago, is mounted upon rocker-arms, and the roof is suspended from a frame which is tilted by a rack and pinion. All electrical connections are under the platform of the furnace. The motors for controlling the electrodes are mounted on the back of the roof frame. When the roof is tilted back the most bulky scrap can be dropped directly into the furnace as cold stock, pre-heated scrap, or melted metal. The furnaces are built in 2, 4, and 7-ton capacities, and are arranged for two or three-phase current.—*Technical Review.*

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PERMANENT MAGNETS IN THEORY AND PRACTICE.

By S. EVERSHED, M.I.E.E.

[*Résumé of paper read before the* INSTITUTION OF ELECTRICAL ENGINEERS.]

REFERRING to the difficulty of compressing the paper, which represented the work of 20 years, into the time available, the author made no attempt to read it, but delivered an exceedingly interesting lecture on its contents, of which the following is an outline :—

Ampère suggested that the magnetism of a permanent magnet was due to electric currents flowing in molecular circuits; this hypothesis was now accepted, and Ewing's theory of the interactions between neighbouring magnetic molecules with its aid fully explained the phenomena of the cyclic curve of magnetisation. The electron theory showed how the Ampère elements were constituted, consisting of a system of electrons moving with very high velocity in orbits round a nucleus; the existence of the molecular currents would be assumed, but for simplicity the molecule with its system of electronic currents would be represented by an imaginary circuit or "current ring," carrying a permanent and constant current, and behaving magnetically like the actual molecule. It was assumed that the rings were immersed in the universal magnetic medium of space.

Magnetisation of iron was effected by turning the molecules so as to co-operate, by the application of an extraneous magnetic field, which applied an orienting torque to the current rings (it did not "magnetise" anything). On removing the applied field, the mass of current rings was left in a more or less oriented condition, defined by their orientation angle θ. The magnetised iron would now possess an inherent magnetomotive force F in the direction of the field, the oriented mass of rings creating induction in that direction.

Ohm's law held good in the magnetic as in the electric circuit. An electric current could be changed by changing the resistance in the circuit, or by making an addition to the electromotive force. In a short-circuited battery of electromotive force E and resistance R the current $I_1 = E/R$—here called the "self-absorbed" condition. If now an external inert resistance r were added to the circuit (an "extended" circuit), the current would be decreased, requiring less E.M.F. to maintain it in the original resistance R, and setting free a surplus motive force which, when equilibrium was restored, would just suffice to maintain the diminished current in the external resistance r, so that $I_2 = E/(R + r)$, or if $V = I_2 r$, $E = I_2 R + V$. Or the current may be equally diminished by inserting an opposing E.M.F. e in the circuit, when $I_2 = (E - e)/R$ or $E = I_2 R + e$. It would be seen that $V = e$, or the opposing motive force applied to the self-absorbed circuit to produce the same change must be numerically equal to the surplus motive force set free in the extended circuit, but of opposite sign.

The statement was equally true for complete magnetic circuits, whether containing iron or not, because in the magnetic medium there was strict proportionality between motive force and flux. On the hypothesis of molecular currents and one universal magnetic medium, the word "permeability" ceased to have any meaning. The author showed that, as in the case of the electric circuits, so in a magnetic circuit the flux could be diminished either by extending the circuit, or by applying an extraneous motive force in the negative direction without altering the circuit. In the former case (extended circuit) he obtained the numerical relation $F = \beta + \phi$ where F = inherent magnetomotive force per cm., β = the magnetic induction, and ϕ = the surplus magnetomotive force not required to maintain the flux in the magnetised body itself. In the latter case (self-absorbed circuit) he obtained $F = B + H$, where H was the extraneously applied motive force, and B was the resultant flux density, due to the combined action of F and H per cm. If H were chosen so that $B = \beta$, and F the same in both cases, it followed that $\phi = H$; for equal change in the magnetic flux, the positive surplus motive force per cm. of steel in the extended circuit was numerically equal to the negative extraneous motive force per cm. of steel applied to the self-absorbed circuit.

After showing, on the basis of known and assumed electronic data, that the electron theory would fully account for the magnetomotive force inherent in iron (which was equivalent to a magnetising force of 17,000 ampere-turns per cm), the author proceeded to discuss the design and predetermination of permanent magnets. The function of these, he said, was to maintain magnetic energy in some particular space such as an air-gap. The primitive equations were, for terminal flux, $B = \beta A$, and for terminal potential difference $V = \phi L$. The magnetic energy was BV. To predetermine the characteristics of a magnet it was first necessary to determine the B H curve of demagnetisation of the steel. A typical curve for tungsten magnet steel was shown (fig. 1) in which B = flux density, and H the extraneously applied motive force per cm., to which ϕ, the surplus motive force, was numerically equal. Neglecting leakage, and denoting the length and sectional area of the core by L and A respectively, the relations between the factors of energy B and V and the dimensions of the magnet were $B = \beta A$ and $V = \phi L$. Any flux density β might be chosen, and by making $A = B/\beta$, the core would deliver the desired terminal flux; and if the corresponding value of ϕ were taken, by making $L = V/\phi$, the required terminal potential difference would be provided. But if economy of steel or of space were aimed at, such haphazard design would not serve. The energy requirement must be taken into account. The energy equation was obtained by multiplying the two primitive equations together, $BV = \beta\phi LA$, where BV was the amount of energy maintained in external space by a volume of steel LA in which the flux density had the value β. The product $\beta\phi$ was the available or useful energy per cubic cm. of magnetised steel. The volume of steel = $BV/\beta\phi$ so that to use the least volume of steel, $\beta\phi$ must be a maximum. Its value might be plotted against flux density, as shown on fig. 1, on the right, and the maximum value was then seen at a glance, giving at once the "economic density." The economic dimensions of the magnet core could then be determined by inserting the values of β and ϕ in the primitive equations.

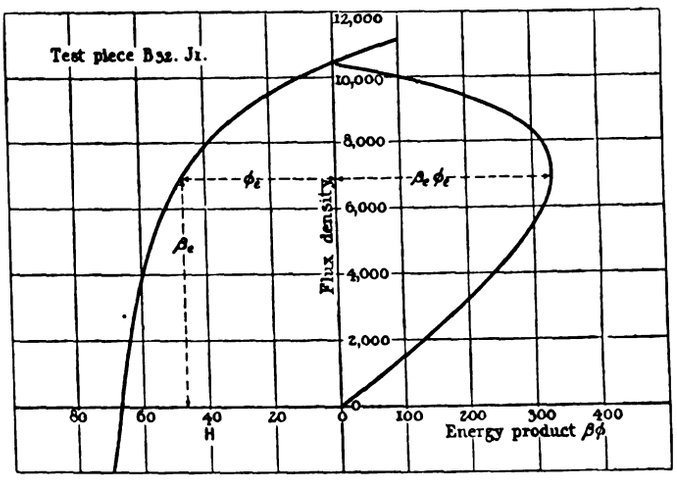

FIG. 1.—Typical demagnetisation curve for magnet steel, showing the derived curve of the energy product $\beta\phi$. N.B.—Numbers on the energy scale when multiplied by $1000/8\pi$ give the energy in ergs.

The author then dealt with the question of leakage, and showed how the formulæ could be applied to the design of economic magnets and the predetermination of their performance, giving examples which showed that a very high degree of accuracy was attainable. In the course of a summary of the paper he said :—

Throughout the paper the underlying purpose has been to gain a clearer view of fundamental matters and to build up a theory of the permanent magnet consistent with present-day knowledge, and readily applicable to the practical problems of design and predetermination.

The gathering together of molecules of equal magnetic moment into concentrated groups need not be regarded as the sole possible mode of departure from uniformity which will endow the mass with the necessary power to form local bonds of mutual induction. Any kind of molecular *variformity* which, in effect, brought about an unequal distribution of the molecular magnetomotive forces, would give rise to a similar state of things. And in view of the increased ability to maintain itself in a partially-oriented state, which iron exhibits when carbon and other non-magnetic substances have been introduced, it seems by no means unlikely that the necessary departure from uniformity may consist in the congregation, in one mass of equally-spaced molecules possessing unequal magnetic moments; some stronger, some weaker, than the average. As a limiting case, we may imagine the presence of non-magnetic molecules distributed throughout a mass of magnetic molecules. Such an arrangement would provide magnetically vacant spaces for the propagation of local fields of mutual induction, in much the same way as the concentrated groups which we have taken as a simple example of variformity.

As a corollary to Ewing's theory, the hypothesis of molecular variformity appears to be necessary to account for the facts of permanent magnetism.

DISCUSSION IN LONDON.

Mr. H. B. ATKINSON opened the discussion, and described the excellent paper as the result of 25 years' work on the part of the author. It would rank as a classic with those papers presented by Hopkinson and Kapp in 1886; it was a monumental work. The paper contained the first clear statement on the subject that had been put before the electrical world. The author's method of predetermination for the purpose of the design of magnets was one that could be used by engineers. The trouble to-day, he thought, was that engineers were not thinking sufficiently in terms of electrons, of electron currents. With regard to the author's statement that the "energy of an electric current being kinetic, any two or more current rings will tend to turn on their pivotal axes in directions which will increase their joint energy" he thought that only held if the energy was maintained constant by external means. Again, the statement that the "enegry of the mass will be increased if any two or more rings turn

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round until they possess a magnetic axis in common" was erroneous; on the contrary, the energy would diminish, in his opinion, 50 per cent. Those statements of the author referred to what would happen only if the currents in the coils were maintained constant by an external battery and not under other conditions. With regard to the predetermination of a ring magnet by step-by-step integration, the author in this way obtained a number of corresponding values of width of air gap and terminal flux, but the late Dr. S. P. Thompson had shown experimentally that no change in flux whatever accompanied variation of the air gap. These matters were referred to in the tenth Kelvin lecture delivered by the speaker last year. However, the speaker thought that the author's reasoning was correct, and would help greatly to clear up many doubtful points. Both the author's and his own theories, he felt, were correct mathematically, but some change in the interior mechanism of the author's was necessary so that it would conform with experimental facts.

Dr. G. Kapp complimented the author on the extremely able manner in which he had prepared his paper. Their object, he thought, should be to strive to help the steel maker; to tell him how to vary the constituents or the treatment of his materials so that he could produce the desired material. In the early days wrought iron was specified for dynamo magnets, but to-day he thought that Sheffield could say that it had produced cast steel which would give equal, if not better, results than iron. He thought it very desirable to formulate a theory that was capable of being put into everyday phraseology, so that they could give the steel-maker the information he required. Further information about the iron-cobalt-carbon-chromium steel mentioned in the paper would be very welcome.

Major K. Edgcumbe thought they were indebted to the author for giving them a classic paper which contained much information of which they had long been in need. They would now be able to deal with iron magnets as easily as they could with coils, but his opinion was that the predetermination of the qualities of a magnet and its design should be kept separate. The author's apparent object of obtaining the maximum possible energy from a minimum volume of steel was good, but was he sure that that method would give the desired permanency? There were two forms of permanency; first, for magnets used in such devices as magnetos, &c.; and secondly, for instrument magnets. The former magnets had to withstand a good deal of vibration, &c., and it was not of much consequence if their total flux decreased slightly, but with the latter type of magnet it was a serious matter if the flux varied by more than 1 per cent. With regard to symbols, some of those used in the paper did not meet with the speaker's approval. Some of them were in exact opposition to those selected by the International Electrotechnical Commission after a great deal of labour, and it was to be regretted that the author had struck out on his own instead of falling into line and adopting the standardised symbols.

Prof. E. W. Marchant said that the paper very clearly explained the position of the subject under discussion. It gave promise of much improvement in magnetic materials. The fact that the atomic weights of all strongly magnetic materials were very nearly the same was of much interest. Some substances, such as maganese and silicon, had the power of destroying magnetism, but could not produce it themselves. The atomic weights of non-magnetic substances differed appreciably from those of magnetic materials, and it would be of much interest to know whether any relationship existed between them. The paper raised hopes of obtaining the required steels by means of heat treatment, or by altering the molecular structure, the tribal arrangement as the author termed it, of the material. The author had shown them how to look at the subject from a new point of view which would be of extreme value.

Mr. H. M. Dowsett, whose remarks were illustrated by lantern slides, said that the very determined effort the author had made to build up a consistent theory of magnetism proceeding step by step from the inter-atomic electron ring to the commercial permanent magnet, would be welcomed by everyone who desired to see physics and engineering practice brought into one consistent scheme of evolutionary development. The weak link in the chain was the character of the inter-atomic electron current, which depended on the structure they postulated for the atom. In order to endow the atom with magnetism it was necessary to assume that the electrons were rotating rings, and were themselves magnetic. Some years ago he attempted to construct an atomic model which would satisfy the requirements of the physicist and of the chemist, and yet would be subject to the gravitational and electrodynamical laws. The principal obstacle in the way was the physicists' assumption, as the result of many experiments, that the total number of electrons in the atom could not very much exceed the number representing its relative atomic weight in the periodic series of the elements, and that the positive charge whose constitution and place in the atomic structure they knew nothing about, must, therefore, be credited with practically the whole mass of the atom. If the whole mass of the atom could be said to be due to the united masses of the electrons—as was at first assumed by J. J. Thomson—and the positive charge and the balance of the electrons above the atomic number could be so arranged in the atom as to be practically insensitive to most means of experimental research, that difficulty would be removed. Proceeding on these lines, the speaker said he had devised a model, which he illustrated by lantern slides, which was able to act electrically, chemically, and radioactively in a manner which could satisfactorily explain experimental results. His present object was to show that it was possible to devise a simple type of atom which conformed to the laws of electrodynamics, and also afforded a reasonable basis for a complete theory of magnetism which would start with the constitutional movement of the electrons in the atom.

Mr. A. P. Young, in congratulating the author on his work, said that they had imagined that they had discovered something new when during the past five years they began to plot betaphi curves in order to judge the quality of magnet steels, and to apply the product curve to the design of a permanent magnet. The author, however, told them that he had first used the method 18 years ago, which showed how far behind they had been. It was curious that although an alloy of three parts iron to one part nickel produced a non-magnetic metal, when heated to a temperature of 1,000 deg. and cooled in air the substance immediately became magnetic. He had recently heard that an American claim was that the permanent flux was improved by magnetising the material at a temperature of 200 deg. below zero. Another interesting metal was the cobalt steel mentioned by the author. The paper would cause them to think about the why and wherefore of such effects as he had mentioned; they had been given a lead, and good results would follow. In the future they needed to think more in terms of the atom when seeking solutions to their difficulties.

Dr. E. H. Rayner said that the paper raised again the question, what was the basis of the characteristic of ferro-magnetism? The modern conception of the atom was a planetary system of electrons, each possessing a charge of negative electricity, gyrating round a central positive system. The number, and perhaps arrangement, of electrons was directly associated with the atomic weight; and, therefore, with the characteristics of the atom, and gave each element its particular properties. In the general case such a system, if the electronic orbits of a single atom were arranged indefinitely in space, would exhibit no magnetic polarity. In order to exhibit polarity there must be more or less concentration of the motion of the electrons into one direction such as existed in the solar system, all circulating roughly in one plane, or at least on the surfaces of something like cylinders. An atom, or system of atoms, which possessed a polarisation of such a type, would in general have its external field largely neutralised by neighbouring ones, as they would tend to line up so as to produce a closed field. In order to exhibit polarity in the mass, it would appear necessary that, under the influence of an external field, for instance, the motion of the individual electrons in large numbers of atoms must be induced to rotate about axes more or less parallel. It was possible that in many atoms there was some particular constraint, associated with the distribution of electronic motion, which prevented the action of an external field producing this orderliness of motion necessary for the production of general magnetic polarisation. Such bodies would be non-magnetic. This would also be the case if, in spite of orderliness being part of the nature of the electronic motion in the atom, the constraint were due to the arrangement of the molecular or larger aggregation. There remained the crux of the problem, if such ideas corresponded to anything approaching the structure of the atom, how to explain why iron was almost unique in its properties. The electronic theory differentiated atoms of the various elements largely by the number of electrons in the atom. If they had a system of N^3 electrons, or electronic systems, it was possible to arrange such a number of electrons in very simple symmetrical systems, which might be illustrated by the corners of a cube which had 2^3 corners, or by the sides of an octahedron which had 2^3 sides. A similar symmetry was obtainable if they had $m \times 2^3$ systems. The atomic weight of iron was about 5 6, or 7×2^3, and it might be that this chance possibility of a peculiar symmetry endowed the atom and its agglomerates with the properties of ferro-magnetic bodies. There was also a peculiar symmetry associated with the number 7. For instance, a regular hexagon was formed by one central point and six surrounding it at equal distances from the centre and from each other. Such a system might be regarded as composed of six equilateral triangles, and such a figure in one plane could only be formed by a 7-point type of symmetry. The other elements which exhibited magnetic properties, and which, alone, or associated with certain other elements, as in the case of manganese in the Heusler alloys, were all very close to 56 in atomic weight as Prof. Marchant had stated. The four, manganese, iron, nickel, and cobalt lay between 55 and 59, while there was a relatively large jump to chronium 52 below, and to copper 63 above, both of which were non-magnetic. If they assumed that electronic number distribution determined atomic properties, including magnetism, then it would appear that atomic weight, which was associated with electronic number, must govern such things as magnetic properties, and magnetic properties must be the result of something dependent upon number and probably upon a peculiar symmetry associated with number.

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Colonel R. E. B. CROMPTON, C.B., welcomed the paper as an epoch-making one, and said it reminded him of the old days. The discussion would not end that night; the paper would continue to be discussed by electrical engineers the world over for some considerable time to come. It had given him keen delight to send copies of the paper across the water to Dr. Steinmetz and others, to show them that they were still capable of doing things in this country. He, however, wished the author had adopted a different course with regard to the symbols he had used. There was no reason why he should have selected a new set when there already existed an international set.

Mr. S. EVERSHED, in his reply, said it was impossible to reply to the discussion in the time at his disposal, and he, therefore, reserved his full reply for publication in the Institution *Journal*. He would feel that his work had not been in vain if the paper, as Mr. Young had said, would start other men thinking, and lead to something being done. It was not permissible to discuss the Kelvin lectures, and they had, therefore, not had the opportunity of pointing out the fallacy in Mr. Atkinson's argument. With his theory it was difficult to see how there would be any magnetism at all, and there would certainly be no permanent magnetism whatever. The speaker felt that there must have been something wrong with Dr. S. P. Thompson's experiment mentioned by Mr. Atkinson. The flux variations were so small that unless the experiment were made with extraordinary accuracy they were liable to escape notice. Finally, the author defended the use of his own set of symbols in preference to the international ones selected by the International Electrotechnical Commission.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Trading Restrictions.

Referring to a letter headed as above and signed "Interested," which appeared in your issue of the 30th ult., I have pleasure in sending herewith replies to the writer's questions:—

1. Can any contractor stock, advertise, or sell lamps which are not controlled by his Association? (Viz., E.L.M.A.)

Yes, excepting as provided for in answer to the second question.

2. Can any graded retailer stock, advertise, or sell metal filament lamps of any other than Association makes?

A graded retailer agrees not to advertise, stock, or solicit orders for lamps of non-Association make in return for special discounts over and above trade terms, but may sell such lamps on demand.

The writer quotes the following clause from a retailer's agreement:—

"We agree not to advertise, stock, or solicit orders for metal-filament lamps of any type or group of other than Association makes (as set out in previous page)."

This clause means exactly what it says. A graded retailer may supply non-Association lamps in fulfilment of an order received by him, but in consideration of special terms agrees not to push the sale of other than Association lamps. If a contractor wishes to reserve the right to advertise, stock, or solicit orders for non-Association lamps then he can do this and still buy Association lamps at ordinary trade terms.

J. E. Edgecombe,
Director,
Electric Lamp Manufacturers' Association of Great Britain, Ltd.

London, E.C.
May 11th, 1920.

City of York Advertisements.

With reference to the York advertisement and the comments in your issue of May 7th, I am glad to see that someone has raised the question of salaries of staff engineers, and I am quite in agreement with your correspondents. As they state, present salaries are a poor return for time and money spent in technical training.

The manual workers are in a much better relative position, because years ago they realised the value of co-operation. Individual effort, however praiseworthy, is not much use. The Electrical Power Engineers' Association has for the past two years done its best to improve the status of staff engineers, and has at last secured consideration of our claims.

Should this letter come to the notice of staff engineers who are not members, I would ask them seriously to consider whether they wish to go on taking benefits for which they have not worked, and towards the attainment of which they have not contributed? Association means strength. Remember the bundle of sticks.

Join the Association now. Work for it. Don't be content until every available man in your station is a member.

Sic Itur.

Emergency Braking.

A short while ago, there appeared in your "Correspondence" columns a series of letters dealing with the emergency braking of an electric street car.

If the mechanical and magnetic brakes had failed, and by some means such as a section breaker opening or the trolley leaving the wire, and thereby cutting the line current off, it was necessary to stop the car, one would proceed by opening the main switch, placing the reversing lever of the controller in the reverse position, and feeding up to the first parallel notch. This method will, without a doubt, stop the car, assuming that both motors are working.

But supposing that previously there had been a defective motor, and that it had been "cut-out" in the controller, then the braking effect would be nil. For it will be seen that when both motors are in operation they are acting as generators, and as such they are revolving in opposite directions, and they will, through the medium of a controller, tend to pull each other up, thus giving a powerful electric braking effect. But when there is only one motor working, and the other is electrically cut out, there will be no effect. I have tested this method on a car equipped with Westinghouse type T.I.C. controllers and Westinghouse type 323 motors.

It would be exceedingly interesting if someone could suggest a method of stopping a car assuming the above conditions.

C. E. Slack.

Chesterfield.
May 13th, 1920.

Battery Symbols.

Surely "Eau Delun" (ELECTRICAL REVIEW, May 14th), on second thoughts, will realise that his reference to "the negative (zinc) as the element having no standing" casts an undeserved slur on an *element* which not only is *positive*, but is, in truth, the fuel, and to a certain extent the veritable source of the cell's energy, in generating which, it (the zinc) is gradually consumed.

The very same energy which, in circuit tracing, is referred to as leaving the battery at the *carbon* or *copper* or *positive pole*, is due to the self-sacrifice of the *zinc*.

Outside the cell, the *carbon* or *positive pole* gets all the credit for the *zinc* or *negative pole's* hard work. However, for simplicity in circuit tracing, it is advisable that this somewhat paradoxical convention be adhered to.

This reminds me of a tragic episode long ago in the late seventies, before inspiriting *theory* had—in certain quarters—been to any great extent called in to vitalise stolid *practice*.

What in these days would be described as a frantic S.O.S. once reached me from a distant official. He had been ordered by H.Q. to make some tests with a fair number of Leclanché cells sent out for the purpose—a class of battery he had never before seen, his previous experience having been confined to Minottos—a kind of Sawdust Daniell, a cell of the "constant" type.

In those days, when Minottos were set up, it was customary to use water with which to soak the sawdust; the necessary sulphate of zinc in solution being subsequently obtained by the simple process of short-circuiting the battery on itself for something like 24 hours.

Our friend having set up the Leclanché's, had straightway short-circuited them, and, 24 hours later, was mystified and aghast to find that the zincs had melted into airy nothingness. They had vanished.

E. R. B.

The Policy of the E.P.E.A.

May we be allowed the hospitality of your columns to refer to the published statement of policy during contemporary industrial disputes issued by this Association in February, 1919.

The National Executive Council of the Electrical Power Engineers' Association in December last unanimously agreed to rescind this policy because of its incompatibility with the other functions of the E.P.E.A. as a protective organisation.

Considerable misunderstanding is arising on account of the prevailing impression that this policy is still being adhered to by the Association, and in order to remove the misapprehension, we take this opportunity of notifying its rescission.

W. Arthur Jones,
General Secretary,
Electrical Power Engineers' Association.

London, W.C.
May 18th, 1920.

[The statement of policy was published in our issue of February 28th, 1919, p. 231.—EDS. ELEC. REV.]

Electricity on the Farm.—A Spalding farmer, Mr. F. W. Farrow, has had plans of cottages for his workpeople approved by the Ministry of Health, and 40 cottages are to be built forthwith on bungalow lines. According to the daily Press, telephones are to be installed in each house, which are also to be electrically equipped throughout.

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A VISIT TO LOUGHBOROUGH TECHNICAL COLLEGE AND THE BRUSH WORKS.

THE members of the South Midland Centre of the Institution of Electrical Engineers were very fortunate in their choice of a day for their visit to the Technical College and the Brush Electrical Engineering Co.'s works at Loughborough last week. About ninety availed themselves of the opportunity, and the bulk of these came by motor omnibus from Birmingham, a four hours' journey. The main party arrived at the college shortly after 11 a.m., and the tour of inspection commenced at about 11.30. Small detachments of about eight visitors were put under the guidance of various members of the staff, who, with the greatest courtesy, replied to the various questions fired at them practically continuously. The first section of the college which came under notice was the cabinet-making department. Here, in what was originally a chapel, some beautiful work was being turned out by a number of ex-service men, who showed by actual results that at least one educational scheme was of great practical value. In one bay of this building one caught sight of a splendidly-finished bookcase, and a great variety of other furniture stamped with the hall-mark of good material and workmanship—dressing-tables, wardrobes, and bedsteads—also called forth admiration from the visitors.

Leaving the building, the party had to traverse a street or two to reach the next department. (Owing to the central position of the institute extensions cannot be made to the main building, and in consequence several other buildings within a short distance of the body of the college have been taken over.) This was the first of the machine shops, and the main item of interest was the gear shaping and cutting work being done there. The smithy was next visited, and a demonstration given on a pneumatic hammer in the centre of the shop. The three forges were hard at work, and the shop, although small, had a remarkably efficient appearance. Upon entering the heavy lathe shop the most noticeable features were a large variable-speed lathe, and another upon which hand-wheels were being turned up. The visitors were shown some good examples of elliptical collars and eccentrics in steel and brass made upon the latter machine. The next room to be seen was the automatic grinding and polishing department, where eight or nine machines were running. In the next shop, where screws were being manufactured, the party inspected some highly finished machine vices of very sound and accurate construction, and the guide stated that a large contract for these vices was being executed for Messrs. Alfred Herbert, Ltd. Every screw turned out is thoroughly tried on a special testing device, indicating by means of a pointer on a dial any inaccuracy in the thread. Welding by the electric arc, and also by oxy-acetylene apparatus was being carried out in the welding shop. The electrode in use was a silica-asbestos covered soft iron wire with a fine thread of aluminium incorporated. In the heat-engine testing shop the party were shown a six-cylinder optical indicator in course of construction, with which indicator diagrams will be taken simultaneously from six cylinders by means of a tube and diaphragm arrangement oscillating a small mirror which projects a beam upon a photographic plate. A demonstration of the principles involved was made upon a single-cylinder J.A.P. motor. A Daimler and an 80-H.P. Le Rhone aero engine were started up for the visitors' benefit, which left them rather deafened. Resistance and gas furnaces were then inspected, and the party next entered the X-rays room, where photographs of inspected work were exhibited. One or two sound-looking joints were shown to the party, and when the rays were applied the way in which the joints had been patched up was very forcibly brought out. Some very beautiful and costly photomicrographic apparatus was seen in the next department, and in the same room samples of iron were being subjected to heating and cooling tests by means of a small resistance furnace, a thermo-couple, and a temperature indicating mirror scale. As the allotted time had then reached its conclusion the party was forced to terminate the inspection, and passing through a nicely appointed students' reading-room, arrived at the dining hall at 1.30 p.m., where luncheon was efficiently served by the kitchen staff.

Dr. GARRARD, on behalf of the members of the South Midland Centre, rendered thanks to the Principal for his hospitality and for the opportunity given to members of seeing such a splendidly equipped institute, remarking that it was not his first visit to the college.

Mr. ROGER T. SMITH (President I.E.E.), in seconding Dr. Garrard's vote of thanks, said that he would extend it by offering the appreciation of not only the South Midland Centre but of the whole Institution.

Responding to the vote, Mr. H. SCHOFIELD, M.B.E., explained that the enterprise was started with a great deal of misgiving as to its success, but he was glad to say that it had more than justified its existence. The college, he said, was based on an American idea of bringing education and experience into closer contact, and followed the lines of similar institutions at Worcester (Massachusetts) and Cincinnati. The greatest proof of its practical value was afforded by the fact that engineers, men who knew the kind of training required, were sending their sons and other relatives to Loughborough. The usual complete course was for five years, but a shorter course of three years, had also been arranged. The college had been organised on a commercial basis, and all products were sold at prevailing market prices, and contracts had been entered into with several firms for the supply of the articles manufactured.

Mr. W. A. BROCKINGTON, education officer of the Leicestershire County Council, endorsed the Principal's remarks, and said that the County Council educational authorities looked with great pride upon their "child." It then being nearly 2.30, the party had to leave rather hurriedly in order to commence the second part of its visit punctually.

Upon arriving at the Brush works the party was met by members of the company's staff, and was again split up into detachments, and the inspection commenced right away, it being explained that there was a great deal to see in a very short space of time. The works cover a large area, and consequently the inspection had to be carried out at a fairly quick pace, which at times made one wish that it had been possible to allot a greater time to the visit. The first shop entered was the winding department, where was seen the construction of many sizes and types of stators and rotors in various stages of progress. Some of the most interesting features presented to the party in this department were coils, &c., of the largest Ljungstrom turbine-driven generator constructed by the company up to the present time. This is being built to the order of the Midland Electric Corporation, Ltd., and is to have a capacity of 8,000 K.V.A. at 7,500 volts (.6 power factor). It is of the two-phase type, designed to run at a speed of 3,000 R.P.M. Here was also seen a single-phase alternator from the works of the Uxbridge & District Electric Supply Co., which was being rewound for three-phase. The power used in the works is supplied by the municipal authorities of Loughborough, whose supply is 220 volts, three-wire D.C., and so it is necessary to employ a number of machines to convert the supply to meet the needs of the Brush Co. for testing purposes, &c. In the winding shop the party was shown a motor-generator set which is used to test and dry out the coils of every machine before leaving the works. Each phase is tested separately before the machine is assembled. The rotor coils shown to the party consisted of alternate windings of bare copper and copper strip insulated with mica, and impregnated "Empire" cloth. The coils of the stator are made up and completely insulated before being placed in position, and they are wound so as to give the smallest possible potential difference between any pair of conductors. The visitors upon leaving the winding department were taken to a machine shop where the smaller parts of the Ljungstrom turbine were in process of manufacture. Here there were a number of vertical lathes, which were stated to be some of the best in the country. One of the products of this department is the gland fitted to the turbine shaft to prevent the escape of steam. This consists of concentric rings, in which the vents are so small as to permit the escape of only a negligible amount. In the turbine shop, which was next visited, the party was shown the manufacture and assembly of the blades. Lengths of channel-shaped steel strip are passed over drums and ground to a very thin size before being cut into suitable lengths. The rings into which the blades are fitted are mounted on an automatic punching machine, which prepares them for the reception of the blades. The latter are then fitted by hand through a soft metal strip, and are thus supported while being placed in position in the outer rings. When the top cover is fixed, these soft metal supports are sheared out. The cover plates when fitted are cut out in the centre, and are then used for the smaller stages of the turbine—this effects a great economy in metal. A seventeen-stage turbine was on view in this shop, the inner stages of which were arranged axially, and the final stage, catching the exhaust steam, was radial. The heavy machine shop came next on the route, and here the visitors saw the rotors, which are solid forgings, being turned up and slotted ready for the windings. The turbine casings are also machined in this department, and one of the time-saving devices shown to the party was a Lancashire Dynamo Co.'s "quick return" planing machine. The casting being operated upon required three small cuts at distances of from two to three feet. Travelling slowly over the surface of the cut the bed was released at a high speed, falling to low speed again at the next cut. When the third cut had been made the bed reversed and quickly returned to its starting point. The testing department, at one end of the shop, where the machines are mounted on a platform above a standard condenser, has a capacity for the rial of two 1,500-KW. sets, and arrangements are being made for the accommodation of the larger sizes. At this end of the shop were the turbines of a twin-screw vessel undergoing final adjustment. The tramway-car and omnibus department was then visited, and the advancing stages of construction were explained. One outstanding feature of the work inspected was the great amount of bent wood in use which was turned out in splendid condition. In one part of this shop the vehicles were being wired in an early stage of construction which, although a great advantage in many respects, gave an impression of inaccessibility in the case of the development of a fault.

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Among the many vehicles undergoing finishing touches were cars for Birmingham and other Midland towns. There were also two or three of the latest type of L.G.O.C. 'bus with wide bodies and side rails in lieu of straps. The last department to be visited was the transformer shop, where various points of interest were noted. The largest transformer in hand was a 6,250-K.V.A., 3-phase type. The highest voltage transformer previously made by the Brush Co. had a pressure of 75,000 volts, but one at present under construction will be capable of dealing with 150,000 volts. The largest contracts for transformers in hand for use with rotary converters are 32,000 K.V.A. in 38 units, for the B.T.H. Co., and 21,259 K.V.A. in 24 units, for the G.E. Co. An order for 48 standard transformers, with a total capacity of 24,000 K.V.A., is being executed for the Yorkshire E.P. Co. In addition to winding, testing, &c., the company also makes the cases for its transformers, two old-type "guillotines" being used for corrugating the sheet iron which is built up and welded at the joints by oxy-acetylene apparatus.

Upon the conclusion of the tour of inspection, the visitors sat down to a "high tea," provided by the management, and votes of thanks were accorded to the Brush Co. for a very enjoyable and instructive afternoon. The party left the works for Birmingham at about 6 o'clock.

THE INSTITUTION OF ELECTRICAL ENGINEERS.

Annual Report.

The annual report of the Council of the Institution for the year 1919-20 shows that the membership at April 1st, 1920, amounted to 8,017, a net increase of 994 on last year's figure; it consisted of nine Hon. Members, 1,587 Members, 4,172 Associate Members, 620 Graduates, 1,152 Students, and 447 Associates. One hon. member, Prof. Hendrik Antoon Lorentz, of Leyden University, Holland, was elected during the year.

The military honours and distinctions arising out of the war that have been awarded to members during the year numbered 171.

The death of 55 members during the year is to be deplored, of whom nine laid down their lives on naval or military service. A service in memory of the members of the engineering profession who gave their lives in the war was held at Westminster Abbey on June 18th, 1918. The number of dependents of fallen members whose circumstances would warrant assistance from the War Memorial Fund is negligible, with the result that a larger proportion of the amount subscribed will be available for a suitable memorial in the Institution building. The book of biographies and portraits of members who gave their lives in the war is in active preparation.

Owing to the limited number of vacancies reported, the Electrical Appointments Board has decided that, for the present, members who have served in H.M. Forces shall continue to receive primary consideration.

On December 31st, 1919, the capital account of the Benevolent Fund of the Institution stood at £5,709, and the accumulated income at £1,750. The donations and subscriptions to the fund in 1919 amounted to £537. In the course of the year 24 grants were made, amounting to £291.

On behalf of the Institution the Council has accepted a benefaction from a donor who desires to remain anonymous during his lifetime; it consists of the transfer to trustees for the Institution, as a thank-offering to God for mercies vouchsafed to the donor during the war, of a sum of £2,000 5 per cent. War Loan stock on the following terms: The interest on the stock to be applied in such a way as the Council in its uncontrolled discretion may think fit (*a*) in the first place, to assist the education of one, or more, of those of our countrymen, not being a conscript, who has served overseas during the great war, and who is anxious to enter the profession of electrical engineering, and (*b*) in the second place, and subject thereto, to promote general electrical research.

The Council has rescinded the suspension of the associate membership examination rules, and in future, unless otherwise exempt, candidates will be required to pass the examination. In the case of applicants who have attained the age of 35, the Council may in its discretion dispense with the examination and the thesis.

Arrangements are being made for a deputation of the Council to wait on H.M. Commissioner of Works to urge the necessity for early reinstatement in the Institution building. The return of the Institution to its own premises will compel special reconsideration of financial provision for the future, and some increase in the subscriptions may have to be proposed.

During the year 67 books and pamphlets were presented to the reference library by members and others. The lending library is available to those who wish to borrow books, and during the year 667 books were issued to 300 borrowers, the corresponding figures in the previous year being 497 and 205 respectively. The catalogue is under revision. A number of valuable acquisitions have been made to the museum during the year, notably from the laboratory of the late Sir William Crooks, O.M.

The ordinary meetings held in London have been well attended; 17 ordinary, 18 Council, and 121 committee meetings were held during the year. The papers read during the session numbered 32, and 17 lectures were delivered at territorial and sub-centres, besides which five papers not read at meetings were published in the Institution *Journal*.

During the session the president visited each of the territorial and sub-centres in Great Britain, and also the sub-centres at Liverpool and Sheffield. Sub-centres were formed at Aberdeen, Dundee, Liverpool, Preston, Loughborough, and Sheffield. The meetings held by territorial centres numbered 35, and those held by sub-centres 23.

The Wireless Section of the Institution was formed in the spring of 1918; it has held eight meetings, at which the average attendance was over 140. The Council has drawn up rules for conducting the business of the section, which come into operation at the beginning of next session.

The Informal Meetings Committee has reported satisfactorily; eight meetings were held at which the attendance ranged up to 80, and a successful smoking concert was held in March, 1919. The meetings are now held fortnightly.

Since the armistice the Students' Sections have shown considerably increased activity, and a new Students' Section has been formed in connection with the Liverpool Sub-centre. The total number of Students' meetings was 27, in addition to a number of visits to works.

The scholarships awarded by the Council included three David Hughes, three Salomons, and one Paul scholarships, all tenable for one year, the former being of the value of £50, and the latter of £25. This is the first occasion on which effect has been given to the Council's decision to extend the scope of the David Hughes and Salomons scholarships by opening them to students in the provinces.

A local centre of the Institution has been established for Argentina, with headquarters at Buenos Aires.

The National Electrical Proving House Committee's report has been considered by the Board of Trade, and in the summary of the Government's proposals published in August, 1919, the matter was referred to as follows: "It is proposed to set up at the Board of Trade a Department of Standards, (1) to promote and co-ordinate standardisation generally, and (2) to establish and administer such testing institutions as may be found necessary, and authorise and, so far as may be required, supervise the testing work carried out by technical institutions, trade organisations, or private concerns."

The efforts of the Institution Patents Committee to obtain certain improvements in the patent law were continued in association with other institutions in connection with the passing through Parliament of the new law (Patents and Designs Act, 1919), with the effect that certain modifications were made, but on the whole the result was disappointing.

During the session several deputations representative of electricity supply, and organised by the Institution, were received by the Controller of Coal Mines with regard to coal prices and supplies, and giving to the consumer the benefit of the rebate on coal used for domestic purposes. From the point of view of electricity supply stations the question of coal prices and supplies is still on a very unsatisfactory basis, and the Council is to make further representations to the Government departments interested.

The committee appointed to report on regulations for overhead power lines (excluding tramway working conductors) will shortly present its first report to the Council.

The Civil Engineers' Registration Bill, promoted by the Institution of Civil Engineers, received the attention of the Council and of a special committee during the period under review. It is not the intention of the Institution of Civil Engineers to proceed with the Bill in the present session of Parliament.

The heavy cost of publication has prevented the publication of valuable matters which would otherwise have appeared in the *Journal*. With the object of making the *Journal* of the greatest value to the members a Committee of the Council has under consideration the question of its future form, and whether with a view to economy it should be divided into sections of interest to various groups and circulated accordingly.

The Council has decided to undertake a complete revision of the wiring rules. The committee has been strengthened by an additional representative of the Electrical Contractors' Association and by a representative of the Association of Supervising Electricians.

The regulations for the electrical equipment of ships were published in September, 1919, and were favourably received.

Lloyd's Register of Shipping is to issue a new set of electrical regulations for work done under its survey, and has embodied in them the Institution's regulations. During the year one meeting was held of the Standing Sub-committee, when an important discussion took place on the status of sea-going electricians, with the result that the Council communicated the following resolution to the Board of Trade: "That in view of the growth in the use of electrical power on ships, it would be desirable that the Board of Trade should consider the advisability of holding examinations and granting certificates to duly qualified electricians on sea-going ships." The Council also expressed willingness to prepare an examination scheme, if required.

During the past year a large expansion has taken place in

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the work of the electrical section of the British Engineering Standards Association. Considerable progress has been made with many matters of great importance to the electrical industry. The closest posible co-operation with the Electrical Research Committee is assured, and some of the B.E.S.A. panels have taken steps in conjunction with that committee to inaugurate the necessary research work, particularly with practice of radiography.

The organisation of the Electrical Research Committee is now nearly complete. The researches already in hand have been brought into full activity, and a comprehensive programme for the future has been prepared. The researches initiated by the Institution are being continued under the control of the Committee, and arrangements are in hand for a rapid extension of programme.

The draft memorandum and articles of association of the proposed Society of Radiographers have been approved by the Board of Trade. The principal objects of the society are to ensure that only adequately trained radiographers are employed in electromedical work, and to promote the science and practice of radiography.

The Council was asked by the Ministry of Munitions in 1916 to nominate a representative of the Institution to serve upon the Nitrogen Products Committee. The Institution's representative was appointed chairman of the Power Sub-committee of the Nitrogen Products Committee, and a letter of appreciation has been received from the Ministry of Munitions acknowledging the services which the Institution rendered in this important work.

In response to a request from the Ministry of Transport, the Council has nominated members to represent the Institution on the advisory panels from which committees of the Ministry are selected.

The annual accounts show that there is a margin to the good on the revenue account for 1919 of £1,495, which amount compares with £1,270 in 1918, an increase of £224. The assets stand at £141,212, against liabilities of £43,222, leaving a surplus of £97,990, an improvement of £6,241 on last year's figures.

The annual report of the Committee of the London Students' Section states that the Council considered all Students' papers read in the years 1915-19 for the revival of the award of premiums, which was made at the end of last session as follows:—A premium of £10 to Mr. R. L. Smith-Rose, B.Sc., and premiums of £5 each to Messrs. A. G. Everett, R. T. Fleming, R. Gates, E. A. Guthrie and A. G. Ramsey. In future the Council has decided to award three premiums of the value of £15 each. In the present session these have been awarded to Messrs. C. E. Webb, B.Sc., E. T. Norris and J. Scott-Taggart, M.C. The British Electrical and Allied Manufacturers' Association has offered prizes of £10 each for papers by Students suitable for publication in the B.E.A.M.A. *Journal*.

NEW PATENTS APPLIED FOR, 1920.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by MESSRS. SEPTON-JONES, O'DELL AND STEPHENS, Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

12,156. "Electrolytic manufacture of metallic sulphides for use as vulcanising pigments." C. O. GRIFFITH. May 3rd.

12,169. "Electric machines for perforating designs in paper, leather, fabrics, &c." H. H. GILBERT and J. H. MORLEY. May 3rd.

12,181. "Means for operating diaphragm horns." J. ETCHELLS. May 3rd.

12,182. "Electric switches." J. ETCHELLS. May 3rd.

12,215. "Apparatus for self-regulation of dynamos running at varying speeds." A. H. BLEZARD. May 3rd.

12,222. "Spark plugs." J. IACONO and S. E. PAGE. May 3rd. (United States, November 27th, 1918.)

12,225. "Devices for controlling electric discharges through gases and vapours and methods of operating said devices." BRITISH THOMSON-HOUSTON Co. (General Electric Co.). May 3rd.

12,229. "Time-controlled circuit-controllers." G. L. HALL. May 3rd.

12,231. "Means for arranging electrodes in vacuum tubes." EDISON SWAN ELECTRIC Co. and J. SCOTT-TAGGART. May 3rd.

12,263. "Electrodes for electric batteries, &c." A. POUCHAIN. May 3rd.

12,264. "Negative electrode for electric accumulators." A. POUCHAIN. May 3rd.

12,273. "Fittings or sockets for electrical conduits." J. JAGGER. May 4th.

12,275. "Electric light fittings." W. S. T. HARDS. May 4th.

12,279. "Electric lanterns." EFANDEM Co. and A. H. WILLIAMS. May 4th.

12,285. "Indicator for electric bells." C. LOVERSHOOK. May 4th.

12,291. "Telephone systems." AUTOMATIC TELEPHONE MANUFACTURING Co. (Automatic Electric Co.). May 4th.

12,305. "Magneto motor." D. SUCHOSLAWER. May 4th.

12,307. "Arrangement for production of sustained electrical vibrations for wireless telephony and telegraphy, &c." SOC. INDEPENDANTE DE TELEGRAPHIE SANS FIL. May 4th. (France, November 5th, 1919.)

12,312. "Telephone systems." WESTERN ELECTRIC Co. May 4th. (United States, May 5th, 1919.)

12,332. "Electric switches, &c." H. E. DONNITHORNE. May 4th.

12,334. "Air-cooled electric motors." M. J. PELTZ, M. STAMM and H. TUCKER. May 4th.

12,338. "Remote-control circuit-breakers, &c." J. HALL. May 4th.

12,342. "High-voltage distributors for electrical ignition apparatus." AKT. GES. BROWN, BOVERI ET CIE. May 4th. (Switzerland, May 14th, 1919.)

12,343. "Arrangement of distributor brush-holders in magneto-ignition apparatus for internal-combustion engines." SCINTILLA. May 4th. (Switzerland, May 15th, 1919.)

12,345. "Thermostatic apparatus." W. MOON and J. KIELL (executors of C. E. Hearson). May 4th.

12,352. "Devices for cooling electric machines." P. EHRMANN. May 4th. (France, April 4th, 1919.)

12,372. "Electric crucible ovens." C. SONCINI. May 4th. (Italy, April 25th, 1919.)

12,375. "Starting devices for internal-combustion engines." R. BOSCH AKT. GES. May 4th. (Germany, February 13th, 1915.)

12,389. "Electric cooking apparatus." S. PERCIVAL (De Mattetis Broiler System Co.). May 4th.

12,402. "Electric operated hammers." S. W. M. KOLLOCK. May 4th.

12,407. "High-speed telegraphy." J. SWINBURNE. May 5th.

12,435. "Vacuum-cleaner electric cord take-up." B. J. TAMARIN. May 5th.

12,439. "Electrically-driven winches." W. H. SCOTT. May 5th.

12,456. "Electro-chemical de-rusting and cleaning process." EMESCO, LTD. May 5th.

12,475. "Reversing of alternating-current shunt motors." SIEMENS-SCHUCKERTWERKE. May 5th. (Germany, April 8th, 1914.)

12,476. "Methods of transmitting wireless messages." SIEMENS & HALSKE AKT. GES. May 5th. (Germany, April 24th, 1918.)

12,480. "Electric vehicles." R. SLABY. May 5th.

12,481. "Electric furnaces." BRITISH THOMSON-HOUSTON Co. and G. J. RALPH. May 5th.

12,482. "Slow-motion devices for electric rheostats and controllers." BRITISH THOMSON-HOUSTON Co. and J. SUGDEN. May 5th.

12,488. "Directing electric waves in wireless telegraphy, &c." F. J. B. CATHCART. May 5th.

12,506. "Telephone exchange systems." WESTERN ELECTRIC Co. May 5th. (United States, August 17th, 1916.)

12,515. "Starting device for internal-combustion engines." R. BOSCH AKT. GES. May 5th. (Germany, July 14th, 1915.)

12,522/3. "Electrical contact-makers for steering-wheels of motor-vehicles." J. L. SCOTT. May 5th.

12,525. "Telephones." T. M. INMAN and THE RELAY AUTOMATIC TELEPHONE Co. May 5th.

12,529. "Electric tail lamps for motor cars, &c." E. JONES. May 6th.

12,533. "Electric switches." E. CUNNINGHAM. May 6th.

12,541. "Protective apparatus for alternating-current systems." C. C. GARRARD, A. E. MCCOLL and A. H. RAILING. May 6th.

12,567. "Electrodes for secondary or storage batteries." J. M. ALLEN. May 6th.

12,584. "Means for insulating circuits and for supply of electricity to circuits." A. R. ANGUS. May 6th.

12,586. "Method of fixing electrodes to insulators of sparking plugs." W. R. MARSHALL. May 6th.

12,592. "Electric tumbler switches." W. MANCHESTER and M. J. RAILING. May 6th.

12,593. "Recording mechanism for electrical sign telegraphs." H. K. HARRIS. May 6th.

12,599. "Method of driving electric centrifugal machines having mechanical unloaders." W. HUNT (S. S. Hepworth & Co. and E. M. Mackintosh). May 6th.

12,616. "Manufacture of electric wires and cables." H. DEBAUCE. May 6th. (France, December 23rd, 1919.)

12,656. "Electric tramway safety guard for trolley." J. & R. F. ELLIS. May 7th.

12,662. "Electro-deposition of iron alloys." S. O. COWPER-COLES. May 7th.

12,669. "Electrical fuses." F. WHIPP. May 7th.

12,670. "Electrical terminals." F. WHIPP. May 7th.

12,678. "Improving cutting qualities of razor blades, &c., by electricity." T. F. GAYNOR. May 7th.

12,682. "Means for amplifying sounds of receivers of telephonic, &c., instruments." F. H. GORDELIER. May 7th.

12,701. "Process of manufacture of perborates by electrolysis." H. G. C. FAIRWEATHER (Fredriksstad Elektrokemiske Aktieselskabet). May 7th.

12,712. "Means for advancing and retarding spark in internal-combustion engines." C. A. VANDERVELL & Co. and W. G. WARD. May 7th.

12,716. "X-ray plates." A. L. LANDAU and L. A. LEVY. May 7th.

12,717. "Systems of electric ship propulsion." BRITISH THOMSON-HOUSTON Co. (General Electric Co.). May 7th.

12,718. "Electric heating devices." BRITISH THOMSON-HOUSTON Co. (General Electric Co.). May 7th.

12,720. "Means for drying ink and discharging electricity in printing." W. H. CHAPMAN. May 7th.

12,754. "Means for transmitting electric current to electrically-driven motor vehicles." C. G. L. JUDGE. May 7th.

12,775. "Electric gramophone." A., S. T., W., and W. J. KEAST. May 8th.

12,788. "Sparking plugs." H. B. RANSOM and F. J. S. THOMSON. May 8th.

12,798. "Portable electric lamps." J. H. BERRY and D. W. JOHN. May 8th.

12,808. "High-frequency signalling systems." BRITISH THOMSON-HOUSTON Co. (General Electric Co.). May 8th.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1916.

15,468. WIRELESS TELEPHONE SYSTEMS. British Thomson-Houston Co. (General Electric Co.). October 30th, 1916. (141,386.)

1917.

6,932. ELECTRIC MOTOR CONTROL SYSTEMS. British Thomson-Houston Co. (General Electric Co.). May 15th, 1917. (141,387.)

1918.

20,557. RAILWAY SIGNALLING SYSTEMS. McKenzie, Holland & Westinghouse Power Signal Co. and T. J. Hornblower. December 10th, 1918. (141,402.)

20,757. ELECTRICAL FIRING OF EXPLOSIVE MINES. J. L. V. da Cruz. December 17th, 1918. (141,404.)

1919.

396. MINERS' SAFETY LAMPS. G. & J. Oldham. January 6th, 1919. (141,409.)

1,115. SPARKING PLUGS FOR INTERNAL-COMBUSTION ENGINES. V. Joly. January 5th, 1919. (141,435.)

6,760. ELECTRIC TRANSFORMERS. H. S. Binns and Ferranti, Ltd. March 18th, 1919. (141,480.)

7,102. ARC LAMPS. S. E. Crick. March 21st, 1919. (141,483.)

13,290. SPARKING PLUG. W. U. R. Goreham. May 27th, 1919. (141,539.)

14,409. MIXED MANUAL AND MACHINE-SWITCHING TELEPHONE EXCHANGE SYSTEMS, AND THE DESIGNATION OF SUBSCRIBERS LINES THEREIN. Western Electric Co. and G. Deakin. June 6th, 1919. (141,550.)

15,335. MEANS FOR MOUNTING ELECTRODES EMPLOYED IN THE PREVENTION OF CORROSION IN STEAM BOILERS, CONDENSERS, AND THE LIKE. A. S. Gush. June 18th, 1919. (141,559.)

17,216. ELECTRICAL FIRE-ALARM SYSTEMS. E. C. R. Marks (Spardon Electrical Products Co.). July 9th, 1919. (141,577.)

18,027. APPARATUS FOR CONVERTING DIRECT ELECTRIC CURRENT INTO HIGH-FREQUENCY ALTERNATING CURRENT. A. W. Dale. July 18th, 1919. (141,584.)

18,522. WIRELESS DIRECTION-FINDING APPARATUS. C. K. Chandler. July 25th, 1919. (141,587.)

19,377. ELECTRIC SWITCHES. E. M. Hewlett. October 31st, 1918. (134,519.)

23,345. SENDING-KEYS FOR ELECTRIC TELEGRAPHS. H. Roberts and F. J. Matson. February 19th, 1919. (Divided application on 139,859.) (141,604.)

29,140. MOULDS FOR THE MANUFACTURE OF GLASS-INSULATED SPARKING PLUGS FOR INTERNAL-COMBUSTION ENGINES. C. R. Gerbaud. November 22nd, 1919. (141,637.)

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THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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FOREIGN CAPITAL IN GERMANY.

As it is asserted to be difficult to raise fresh capital in Germany, the Germans seem to be inclined to welcome the investment of foreign capital in their industrial undertakings, provided that their national character is maintained and adequate safeguards are adopted to ensure the continuance of a majority of the votes in Teutonic hands—as, for instance, by endowing specified blocks of shares with manifold voting powers or the creation of preference shares for this purpose. In the case of the impending issue of shares by the A.E.G., of Berlin, the amount of 25,000,000 marks has been taken over by an American group at a price which would probably not exceed 1,500,000 marks in normal times, and further transactions are said to be in prospect. At the recent extraordinary general meeting of the A.E.G., the names of the American purchasers were not mentioned, but an American copper and banking group (Guggenheim-Kuhn-Loeb group) are stated to be the buyers. In this connection a French contemporary, apparently anxious to ascertain whether the General Electric Co. of the United States was a party to the operation, has received a cable from New York in the negative. Naturally, in view of recent international developments in the electrical industry, the French were highly desirous of being satisfied on this point, the denial in question having been given, it is said, by the General Electric Co. itself.

Herr Karl F. von Siemens, addressing the shareholders at the recent meeting of the Siemens & Halske Co., when it was decided to increase the share capital from 63 to 126 millions of marks and to confer 30-fold voting rights on the 9,500 shares held by the Siemens family, is reported to have stated that it was necessary to interest foreign capitalists in German industry, and the electrical industry, in particular, had still many duties to perform in connection with the scarcity of coal. It was, however, only possible to prevent foreign control by means of preference shares having a dominating voting power. Coming to consider the question of current business, the chairman remarked that definite predictions could not be made; prices and wages changed day by day; at the moment new wages demands had been put forward which exceeded by far those made previously. But an assured peace was desirable, as the exchange was more favourable to the Germans, and would probably steadily improve to the point of intersection of the internal and external purchasing power of their money if they correctly took cognisance of the present period and supported the improving movement by increased production, that is, by higher efficiency. As a consequence, everything should be avoided which would further depreciate the internal purchasing power of money. When they had reached the point of intersection, difficulties in exports would take place, and already the inland prices of electrical engineering products exceeded the world's market prices. The speaker blamed the rise in the prices of iron and steel as being the principal cause which had led to this effect. The requirements for electrical manufactures throughout the world would continue for a long time forward, but the demand had fallen off owing to the high prices resulting from reduced production in general.

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Imperial Telegraphs.

So much has already been said in the columns of the public Press, including our own, and so many resolutions have been passed by representative trade and commercial bodies the world over on the subject of providing an up-to-date and efficient Imperial Telegraphic system, that it may seem almost unnecessary to revert to the subject at this date. The policy of our Government in the past has been to appoint Imperial Departmental Committees and Sub-Committees to make a study of the existing conditions and recommendations for their betterment. Their reports are shelved and possibly forgotten as each new Government Chief is promoted to another field of activities, and it is left to men who have the interests of the Empire at heart, the Press and others, to keep interest in the subject alive, and to remind their successors in office of the nation's desires.

For the maintenance of an Empire like ours, it will be agreed that two things are necessary and of paramount importance, viz. :—Steamship and telegraphic facilities. Without these the guarding of our enormous interests and the proper expansion of the productive capacity of our world-wide colonial possessions is rendered practically impossible. The lack of these facilities makes trade and other relations between the Mother Country and her children most difficult, and profitable transactions are diverted to foreign countries and make our peoples across the seas to a large extent economically dependent on them. For strategic reasons alone the call for world-wide and all-red Imperial communications is so strong and well known that the necessity for emphasising their urgency should not exist, but so many important problems have to be faced by our legislators at the present time that the policy of making the Empire telegraphically self-contained may be permitted to remain in abeyance, and for this reason we again call attention to it. The need for prompt action is imperative in view of our late experiences, and for the purpose of maintaining the Imperial spirit which so largely assisted us to victory.

At one time the controlling centre of telegraphs was undoubtedly London, but changes occurred as other countries adopted a national policy, and laid their own cables and erected their own high-power wireless stations, freeing themselves to that extent from dependence on British-owned lines, and steps in that direction are still being taken. It is, therefore, essential that no weakening of our existing network or failure to strengthen and expand it be permitted. Nor should the control of our lines be permitted to pass into foreign hands. Unfortunately, British Atlantic and West Indian cable companies have been allowed to pass under the ownership and management of American companies, and while the United States is a friendly nation, yet with the expansion of her diplomatic and trade interests, political complications may very well arise whereby such ownership may injuriously affect our interests. The lessons of the Spanish-American War, when the telegraphic correspondence of all British West Indian Islands, except Jamaica, was censored and delayed by the American authorities, who controlled the Key West cable route, should not be forgotten. All German cables were cut on the declaration of the European war, and had it not been for her high-power wireless stations, Germany would have been completely isolated. The United States has established a large number of these stations, and is rapidly building more, and eventually communication by wireless will be available to all European countries, South America, &c. Other countries are also going ahead in this direction. High-power wireless stations are as essential to a country as ships and aeroplanes, and our legislators should lose no time in supplying the necessities of our Empire in the way of cables and wireless stations. It will not need much investigation or study to decide what shall be done, but we hold the opinion very firmly that much has been left undone in the past, and that leeway has to be made up, and that rapidly.

The Beama Dinner.

THE leading feature of the proceedings at the dinner of the B.E.A.M.A., last week, was the optimism of Sir John Snell, who made on that occasion, we believe, his first public speech since his appointment as Chief Commissioner. As a result of—or, as a later speaker implied, in spite of—the attentions of no fewer than seven Departmental Committees since 1916, Sir John said, the Electricity Supply Act had been passed—"the great charter of electricity"—and the electrical industries were on the brink of an era of unimagined prosperity. We earnestly hope that his view is correct; every indication certainly points in that direction, and, as has happened before, whether other industries thrive or languish, the electrical industry is inherently certain to develop. The Utopia is placed by Sir John at five to ten years hence; in the meantime, the Commissioners are struggling with the accumulated arrears of five years, and appeal for the patience and forbearance of the industry. We are sure that they have the sincere sympathy of all electrical men, and will do their utmost to get the machine into full operation. Apart from the routine duties of various other departments and bodies which have fallen upon their shoulders, we venture to urge them to settle the broad principles as quickly as possible; in particular, we would again draw their attention to the case of the small isolated stations, and the urgent need for these "to know where they stand," so that they can at once get on with the extensions that are urgently called for. The revision of the various codes of regulations is also a matter of most pressing importance, particularly in respect of the prehistoric and obsolete regulations for overhead mains, on which a committee has been sitting for some 18 months, so that the ground must have been pretty well covered by now. Sharing out the country into districts is a matter of less urgency than the settlement of these questions, and if completely satisfactory solutions to them cannot be given at the moment, let us have the best approximation to them that can be given *now*.

The Station Men.

AT the dinner above-mentioned, Mr. James Swinburne, who, unfortunately, is too seldom seen and heard at electrical gatherings nowadays, pleaded the cause of the salaried men with an earnestness and sympathy which commanded attention. In view of the commotion set up recently by an advertisement in our pages, which placed a technical officer on a pecuniary par with a fitter, and Mr. Swinburne's remarks, the arrival of a batch of papers from the Electrical Power Engineers' Association this week, embodying particulars regarding the National Joint Board which is dealing with the case of the station men, and the schedules of wages agreed upon, is very timely. The Board will play the part of a Whitley Council for the station technical and clerical staffs, which are otherwise unprovided for in this respect, having been omitted from that scheme by an extraordinary oversight. As we pointed out recently, it is incumbent upon all electricity supply authorities to accept the decisions of the National and District Joint Boards under this scheme; they cannot expect their staffs to do so if they themselves do not. Whilst writing, we have received particulars of a dispute between Wimbledon Corporation and the National Joint Board, in which the Corporation turned down the recommendation of its own Electricity Committee that an award by the Board of an increase of salary of £30 per annum, from January 1st, 1920, should be adopted.

As we have already pointed out, the workers are not going to play at "heads I win, tails you lose," to please the employers. Loyal compliance with the decisions of the Joint Boards is essential to industrial harmony. The electrical staff of the Corporation threaten to cease work on Monday next: the Executive Council of the E.P.E.A. will support them, unless the decision of the Corporation is reversed, and who will blame them? Certainly we shall not. We hope, however, that wiser councils will prevail, and that peaceful methods will be found to settle the dispute, in which the Corporation of Wimbledon is in an utterly untenable position.

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A STUDY IN LOAD FACTORS.

Based on an Experiment carried out by the Glasgow Corporation.

By COUNCILLOR DENNY, Member of Glasgow Town Council.

In August-September, 1918, Glasgow Corporation Electricity Department fitted up two tenement dwelling-houses with electrical apparatus for all domestic purposes. Ammeters were put in circuit in each case for record-keeping purposes. The rate of charge was on the basis of 4½d. per B.O.T. unit for 70 units, and ¾d. per unit for all further units consumed. In the one case the consumption for a year amounted to 10,052 units, and the amount of the electricity bill for the year was £32. In the second case, the consumption for the same period was 10,981 units, and the bill £35.

In the two houses in question no coal or gas was used for any purpose during the period of the experiment. It is estimated that had coal and gas been used for the purposes covered by the electrical energy consumed, the cost would have been £16. The houses in question comprised two rooms, kitchen and bathroom in each case. In one house the equipment consisted of :—One 3-kw. oven with hot-plate on top; one 2-pint kettle; one 1-kw. immersion heater; one smoothing iron, 2-ampere; two 3-kw. radiators; one 1-kw. radiator; one 1·5-kw. Belling fire. In the other house the apparatus consisted of :—Cooker; two hot-plates; one oven with top grill; one 2-pint kettle; three radiators; one smoothing iron.

Having established the fact by experiment that the use of electricity is entirely practicable for all domestic purposes, and knowing that electricity so used has many advantages from the point of view of health and convenience, it is obviously a matter of urgent public concern to devise ways and means whereby electricity can be made available for all domestic purposes.

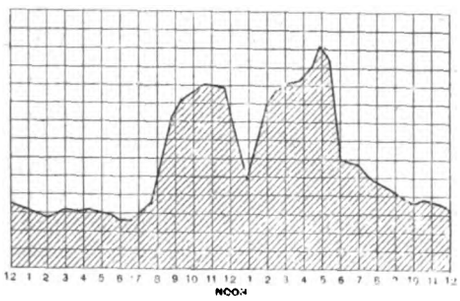

Fig. 1.

The first consideration is cost. The difference between gas and coal and electricity must be substantially reduced. There are various suggestions forthcoming as to how this may be managed. In the first place, electricity supply concerns, whether municipally or company owned, need to be brought to see the possibilities of the domestic load in the improvement of load factor. We hope to show that it will pay the electrical undertakings to take a liberal view of the domestic consumer, and to cater for him in such a way as to lead him to use electricity for all purposes in the home.

Electricity supply from the load factor point of view may be said to have had three phases. At first it was thought that electricity would always be mainly used for lighting, and all the early legislation relative to electricity supply referred to lighting. The early Acts were all Electric Lighting Acts. At that time the lighting load represented the major portion of the total output, and the power load was a matter of minor concern. The development of the electric motor has changed all this, and electricity supply is now in the second phase. The power load is at present the dominating factor in electricity supply, and lighting is comparatively negligible. But a third phase is now appearing: the domestic load is gradually being recognised as a serious competitor to the power load, and it has attractions to the supply undertaking which even the power load does not possess. The great advance in the manufacture of domestic appliances during the last few years has turned the scale in favour of the domestic load being better distributed and bigger than the power load. The experiment recently carried out by the electricity department of the Glasgow Corporation, already mentioned, has given conclusive confirmation of this important fact. In one house, the load extended over the full 24 hours, while in the other it extended over 15 hours of the 24, whereas the power load normally is confined to 10 hours per day. It does not seem to be clearly understood that the domestic load has greater possibilities than the power load. Glasgow, for example, it is estimated, has in the aggregate a power load equivalent to 1,000,000 h.p.; and allowing for what is known as the diversity factor, the electricity department of the Corporation could supply that load with 400,000 kw. of generating plant. On the other hand, after making allowances, there are 228,000 occupied houses in Glasgow. Taking these at 3¼ kw. per house, we should require 721,000 kw. of generating plant to meet their demand. Further, the output for power purposes, basing the estimate on 55½ hours' use of the maximum demand per week, would be 1,150 million units per annum, whereas the output for domestic supply, based on the above-mentioned experiments, would be 2,683 million units. Thus the securing of the domestic load on the mains is at least of equal importance, as a commercial consideration, to that of the power load, so far as the public supply of energy is concerned. If one extends the point of view from the cash nexus and the profit and loss account of electricity supply, to the question of public health, the whole problem takes on a fresh complexion, and arguments in favour of encouraging the use of electricity in the home are overwhelming. The advocacy of the importance of the domestic load in this connection is not to be construed as an attempt to minimise, or to throw cold water on, the power load. The industrial importance of an ample, cheap, and reliable supply of electrical energy is of the first national consequence. The present article is rather intended to show that the encouragement of the domestic load along with the development of the power load will beneficially affect both, and will tend to cheapen electrical energy to the whole body of consumers.

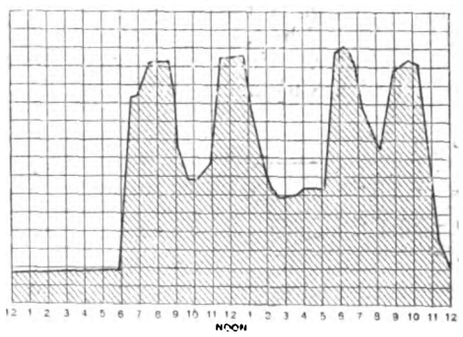

Fig. 2.

The curve on fig. 1 shows an average week-day load on the Glasgow mains, and gives a load factor of 40 per cent. for the 24 hours. For the whole year the load factor was 27 per cent. The output was 170 million units and the maximum demand 70,000 kw., approximately one-sixth of the demand to be expected from the total power load of the city.

Fig. 2 has been made by adding together the load curves of the two experimental houses and multiplying the addition by 8,000. The result is a maximum demand of 75,000 kw. and an annual output of 185 million units, the actual consumption being 169 millions. It will be seen, by reference to fig. 3, that the domestic load of 16,000 houses—about one-twelfth of the number in the city—

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would more than double the present output, with an addition of only 57 per cent. in plant capacity.

Fig. 3 is a combination of figs. 1 and 2. It shows an annual load factor of 55 per cent. as compared with the present load factor of 27 per cent., or 63 per cent. as compared with 40 per cent. week day load factor referred to in fig. 1.

Fig. 4 shows the domestic curve multiplied by two, and superimposed on fig. 1, by means of which we obtain a curve

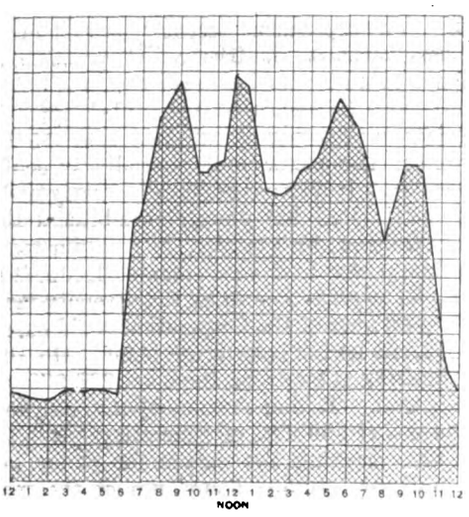

Fig. 3.

showing one-sixth of the possible obtainable load for power and domestic supplies. It will thus be observed that the main load runs up to 120,000 kw., and extends over 18 hours out of the 24, while the peaks average 1¾ hours' duration and, multiplied by 4, give a total of 7 hours' use of the peak load per day. The comparative figures for the existing main load are 9½ hours out of the 24, or just

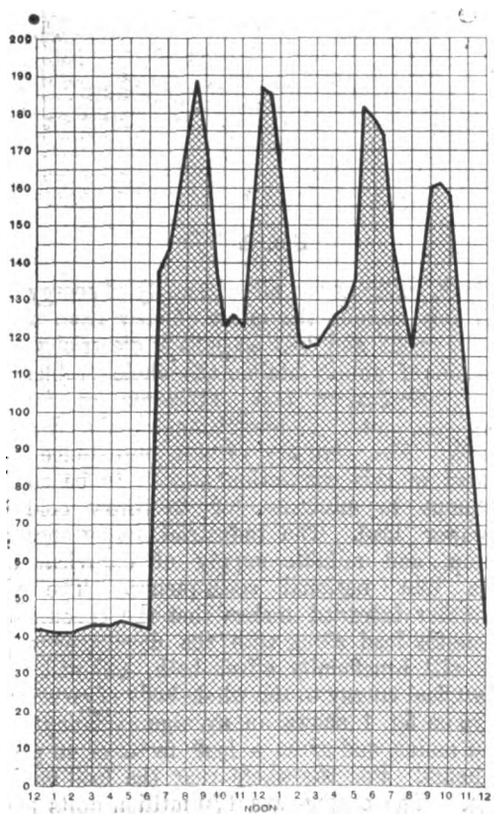

Fig. 4.

2½ hours more than the new peak load, while the extent of the peak at present has an average of one hour's duration as against the new figure of seven mentioned above.

When it is considered that no allowance has been made for tramways, electrochemical processes, for the electrification of general vehicular traffic, &c., it will be seen that the load could be made nearly uniform throughout the entire day, and thus reduce the standing charges to nil. Moreover, the economy in coal consumption through larger plant units, together with reduced capital and labour charges, will further contribute to the possibility of reducing the price of electrical energy to all classes of consumers. The foregoing figures are also based on coal remaining at its present high price. Although the Glasgow experiments show annual bills of £32 and £35 per house, by the simple development of the industry on economic lines, it is not too much to expect that we should, at least, obtain electrical energy for domestic purposes at ½d., instead of ¾d., which would mean that the annual bill for electrical energy for all purposes in a working-class home would be £22 to £25, as against £16 for coal and gas.

The question, therefore, is: Are the people prepared to purchase immunity from the dirt, dust, domestic drudgery, and atmospheric pollution, consequent upon the use of coal and gas, at the small extra cost of, say, 2s. 6d. per week for electricity? The present writer ventures to think that with the foregoing facts before them, the people of this country will unhesitatingly cast their vote in favour of the universal adoption of electricity for all purposes.

Meanwhile, the nation ought to be prepared to take the opportunity of the large housing schemes at present under consideration to revolutionise currently accepted ideas with regard to lighting, heating, and cooking installations in domestic premises. In a word, the ideal in housing ought to be the chimneyless house which would solve along economic and sound commercial lines the whole problem of atmospheric pollution.

SWITCHBOARD EXTENSION.

By F. A. P.

In the early days of electrical plant, the switchboard was merely a board upon which were mounted various instruments and switches symmetrically arranged, the back being usually a maze of loose wiring, making extension difficult. In the course of time, it was divided up into separate panels, and each machine, &c., had all its gear mounted on one panel, so that extra panels

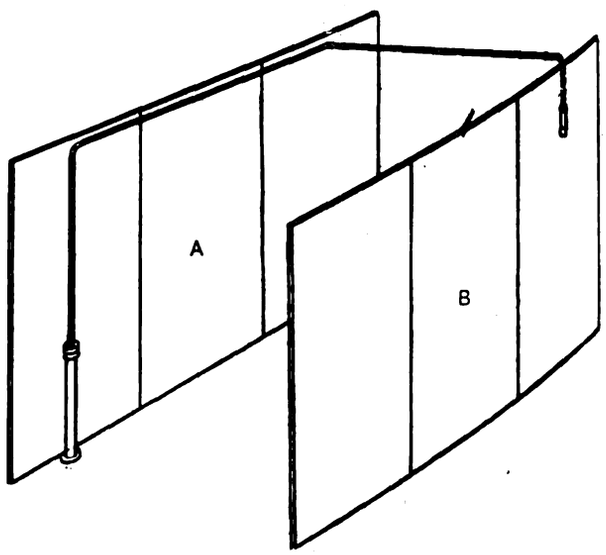

Fig. 1.

could be more conveniently added. Other arrangements more suitable for rough usage, now in vogue, consist of armoured units which can be placed side by side to form a complete switchboard.

Now these later arrangements are a great improvement on the earlier boards, but the writer has yet to see a really flexible arrangement carried out in practice. The average board has panels crowded on the back with apparatus and cables, and with busbars crossing horizontally, making it practically impossible to extend, and

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at the same time keep to the orderly arrangement of panels originally installed. When an alteration or extension is required the board as a whole is unnecessarily complicated, say, by adding generator panels at the end of the existing board beyond the feeder panels, or *vice-versa*.

Now, if all machines, feeders, &c., had their cables run to the nearest point on the wall behind the switchboard, or preferably on a separate frame mounted just clear of the wall, and were then cross-connected to their

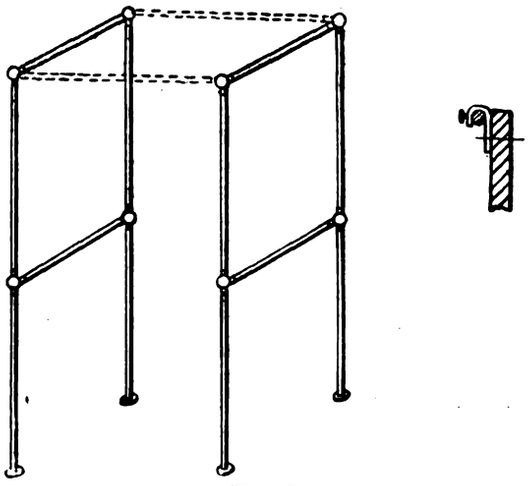

Fig. 2.

particular control panel, a far more flexible arrangement would be obtained. The wall or back frame would be the permanent board, but the front frame would carry panels which could be rearranged.

Referring to fig. 1, A is the back frame where all feeder or machine cables terminate, B is the switchboard proper which can be added to or any section moved if the cross connecting cables are lengthened or shortened to suit. If these consisted of standard lengths and sections of copper rod with clamping connectors, this could easily be done.

On the type of board suggested busbars would not cross the panels, but would have a panel to themselves, and need be only of sufficient length to take all the required connections. This need not necessarily entail extra expense in copper if the connecting cables take the shortest possible route.

Another point is that the switchboard cannot usually be safely worked on when alive, chiefly owing to overcrowding. But it should be possible to do so, in order to avoid shutting down for this purpose, and the avoidance of crossing busbars would distinctly assist in this direction, combined with the use of box spanners well taped or insulated. These can be purchased very cheaply nowadays.

The writer suggests that all boards should be made as simple at the back as on the front, and that rheostats, &c., should not be mounted directly on the back unless one can easily get at the cable lugs. Where they are difficult of access a separate slate terminal block might very well be used.

Frames should be of a uniform size, say, 7 ft. 6 in. by 2 ft. 6 in., if the size of the largest apparatus will allow, and should have adjustable horizontal members. One wonders why the American system of tubular frames is not more often adopted, being simple to build up, extend, or dismantle.

Some lengths of piping and a stock of fittings take up little space, and would be much appreciated by the engineer called upon to put up a temporary board for testing or other purpose, or a back and front frame might be made up, and kept in stock, ready to be joined up by two or more pieces of piping to make a box frame which would stand anywhere. Apparatus or slates could be hung on the tubing by simple hooks or clamps for temporary use, as in fig. 2. This frame would be used up in the main switchboard when it was required to extend it.

When we really do get our cheap electricity, extensions and alterations will be of more importance than they are, perhaps, at the present time, but the time will come, and users of power will be well advised to keep in mind this possibility when installing plant, and put in switchboards capable of some such flexibility as outlined above.

HEAT TRANSMISSION AND BOILER EFFICIENCY.

By EDWARD INGHAM, A.M.I.Mech.E.

Although the question of heat transmission through metal plates is one of great importance to all engineers, and particularly to designers of steam boilers, economisers, and feed water heaters, &c., very few subjects are so imperfectly understood. It is perhaps no exaggeration to say that comparatively few engineers are acquainted with the laws of heat transmission, and in the light of the numerous experiments and researches which have been made during recent years, this is a matter of surprise. A thorough knowledge of the subject is absolutely essential if improvement in existing designs of steam boilers and similar vessels is to be effected.

In the early days of steam boilers, it was commonly believed that the efficiency of the heat transmission through a metal plate depended almost entirely on the nature of the metal, and on the thickness of the plates. Hence it was thought that, since copper was a better conductor of heat than steel, this metal, although inferior in tensile strength, was a more suitable material for the construction of a boiler. As time went on, and more experience of the working of steam boilers had been obtained, it was found that soot and dirt, scale and grease, offered a far greater resistance to the passage of heat from the furnace gases to the water in the boiler than did the plates themselves.

The prevailing idea at the present time appears to be that the principal factor in preventing the free flow of heat from the hot gases to the water is scale, and figures are frequently given to show how seriously the efficiency of the boiler falls off if scale be allowed to accumulate on the plates. Thus, it is stated by one authority that the percentage loss of fuel due to layers of scale 1/64 in., 1/16 in., $\frac{1}{8}$ in., and $\frac{1}{4}$ in. thick are respectively 2 per cent., 9 per cent., 18 per cent., and 38 per cent. Too much reliance should not be placed on such figures, since so much depends upon the particular nature of the scale. They will, however, serve to show that scale is an important factor in reducing the efficiency of a boiler. In the same way, soot, being a very bad conductor of heat, has also a serious effect. The importance, therefore, of maintaining the plates clean on both the water side and the fire side cannot be too strongly urged.

Supposing, however, the plates to be perfectly clean, the amount of heat which is actually transmitted through them under working conditions is surprisingly small. For example, the amount of heat which may be transmitted through 1 sq. ft. of clean plate per hour is given by the formula:—

$$q = \frac{k\,(t_2 - t_1)}{T},$$

where q = the quantity of heat transmitted in British thermal units per hour.

t_2 = the temperature of the hot side of the plate.

t_1 = the temperature of the cooler side.

T = the thickness of the plate in inches.

k = a constant, which for mild steel is 450.

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If we apply this formula to the furnace plates of, say, a Lancashire boiler, where the temperature of the hot gases is 1,400 deg. F., and the temperature of the water 350, we find that the heat transmitted per sq. ft. per hour through, say, ½-in. plates, should be:—

$$q = \frac{450\ (1{,}400 - 350)}{\frac{1}{2}} = 945{,}000 \text{ B.TH.U.}$$

Now in actual practice, the amount of heat actually transmitted will be only about 5,000 British thermal units per sq. ft. of heating surface per hour. It will be seen, then, that the heat actually transmitted through a boiler plate is only a very small fraction of the heat which would be transmitted through a clean plate of the same material and thickness, with the same temperature range. Evidently, in the case of a boiler, there must be present on the plates certain agents which are seriously impeding the free flow of heat from the hot gases to the water. It would appear that these agents comprise a stationary film of gas on the fire side, and a similar film of water on the water side.

The experiments already referred to have served to show that if these stationary films, particularly the gas film, be removed, the heat transmission is enormously increased, and such removal may be effected by compelling the gases to move over the plates at high velocity. The generally accepted opinion amongst engineers has hitherto been that if a maximum of heat is to be extracted from the furnace gases, the latter shall not be allowed to move too rapidly over the plates, and hence

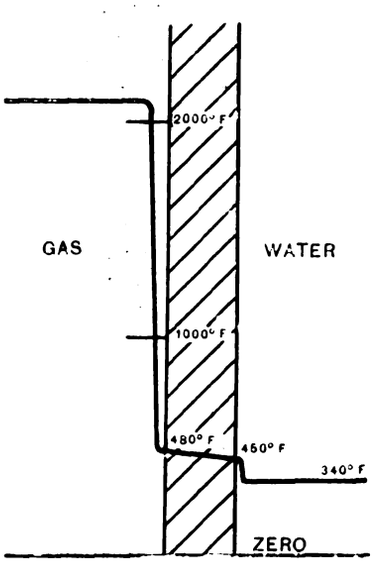

Fig. 1.

designers have been inclined to arrange that the gases shall remain in contact with the hot surfaces long enough for them to give up as much as possible of their heat to the water. For example, it is sometimes argued that the brick-work flues of Lancashire boilers should be made of large sectional area in order that the speed of flow of the gases will be slow. There can, however, be no longer any question that if a high rate of heat transmission is to be obtained, the gases must flow rapidly over the hot plates.

More than forty years ago, Prof. Osborne Reynolds showed that the rate of heat transmission increases as the speed of flow of the gases increases, and a year or two later, some experiments made in France proved that by closing up one-half of the tubes in a locomotive boiler, the heat transmission was again increased.

The late Prof. Nicolson, of Manchester, after carrying out exhaustive experiments, concluded that the rate of heat transmission depended principally upon the product of the speed and the density of the gases, but that the average value of the gas and metal wall temperatures, the nature of the metal surface in contact with the gas, and the hydraulic mean depth of the tubes through which the gases passed, were also factors which influenced the rate of heat transmission. As the result of his experiments, he designed a boiler of a modified Cornish form, in which the gases were forced through the tubes at high velocity by means of a powerful fan. The boiler was, in fact, a forced draught steam plant, where the draught was an unusually high one. The rate of evaporation in this boiler was extremely high, higher, in fact, than had previously been obtained in any other boiler, but the efficiency was seriously reduced because a large amount of steam was consumed in driving the fan.

From what has been said, it will be evident that the problem to be solved by boiler designers who desire to obtain a high efficiency is that of procuring a high speed of gas flow with the expenditure of only a small amount of power for whatever device is employed for forcing the gases over the heating surfaces.

Many years ago, Prof. Perry, in his well-known book on the "Steam Engine," stated that "the surfaces of the metal wall must be scrubbed, the one with hot gases and the other with circulating water," and further, "the best boiler will be one in which a flame or a hot gas tube surrounds or is surrounded by a water tube, the gas and water flowing fast in opposite directions."

It will be seen that there is much scope for research and experiment on the part of boiler designers.

It may be mentioned that the principle of high speed flow has been employed to great advantage in the design of certain feed water heaters. A well-known firm of engineers, who specialise on such apparatus, have designed what they term a "high velocity heater," the result of experiments in which water was passed over the steam heated surfaces at a considerable velocity. It was found that the quantity of heat transmitted was very much greater when the flow was rapid than when sluggish. It is claimed for this high velocity heater that the feed water may be heated some 20 deg. F. higher than is possible with heaters of the ordinary type.

Those who wish for further information on this important question of heat transmission will find the subject fully treated in a paper by Prof. Nicolson, entitled "Boiler Economics and the Use of High Gas Speeds," published in the *Transactions* of the Institution of Engineers and Shipbuilders in Scotland, 1911. Although we are unable to discuss this paper here in detail, we have thought it advisable to reproduce a diagram (see fig. 1), which Prof. Nicolson has given to show the enormous effect of a stationary film of gas on a boiler plate in impeding the passage of heat from the furnace gases to the water in the boiler. It will be noted that the original temperature of the gases is taken to be a little over 2,000 deg. F., but the temperature at the point of entering the plate has fallen to 480 deg., and at the other side of the plate, to 450 deg. A further drop then occurs, due to the presence of scale, the final temperature of the water being 340 deg. F., which corresponds to a steam pressure of approximately 100 lb. per sq. in. gauge. According to Prof. Dalby, the fall in temperature due to the resistance of the gas film, is about 97 per cent.; that due to resistance of the plate, 1 per cent.; and the fall due to the resistance of the water film, 2 per cent. Evidently, so far as heat transmission is concerned, the resistance offered by the boiler plates is so slight that it is of practically no importance.

Another Oil-Electric Yacht.—The Westinghouse Electric and Manufacturing Co. has been awarded the contract for supplying the electrical propulsion equipment for the yacht *Guinivere*, which is being built by George Lawley & Son Corp., Neponset, Mass., for a member of the New York Yacht Club. The *Guinivere* is to be a three-masted schooner, with oil-electric auxiliary power, and will be 195 ft. overall, 150 ft. water-line, and 32½ in. beam. Her draught is 15 ft., and her displacement 642 tons. Her power plant is to consist of two six-cylinder, 350-H.P. Winton-Diesel oil engines of 225 R.P.M., each of which is directly connected to a 225-KW., 125-volt, D.C. generator. Each engine drives also, through a chain, a 15-KW. exciter, which supplies the field current for its generator and the propeller motor, and, in addition, power for other purposes. The propeller is connected through a clutch to a 550-H.P., 250-volt motor of 220 R.P.M. Normally, the two generators connected in series will supply current to the propeller motor, but the control is so arranged that either can be used alone to operate the propeller at reduced speeds or in case of emergency.—*Electrical News*, Canada.

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NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

A Liquid Motor Starter.

Among the more recent developments of the General Electric Co., Ltd., 67, Queen Victoria Street, E.C. 4, is the liquid starter shown in fig. 1. This consists of a sheet steel tank, three earthenware chambers, top and bottom electrodes, operating gear, and accessories. The earthenware chambers, in which the electrolyte is placed, are enclosed in the tank, thus preventing leakage should the earthenware be cracked. The cast-iron electrodes fitted to the lower ends of the chambers are connected through porcelain insulators to the cables from the rotor terminals. The insulating bushes on the lower side of the bottom contacts are protected by a shield against any leakage which might cause short circuits. The electrodes are supported on mild steel

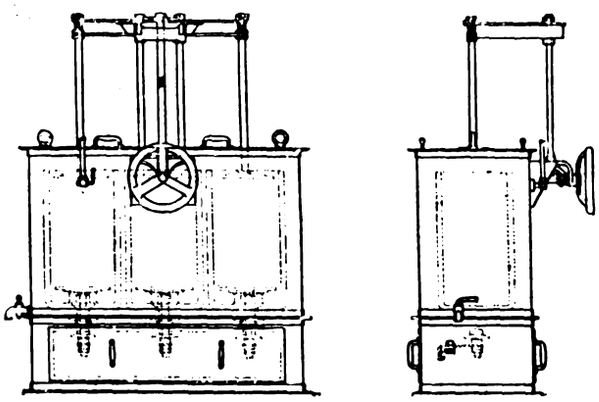

Fig. 1.—G.E.C. Liquid Starter.

rods, and connected together at the top with laminated copper strips. These dipping contacts make an efficient contact with the bottom electrode, and there is no residual resistance. To obviate flashing the starter is so designed that the electrodes are always immersed. The operating mechanism is provided with springs which are compressed as the handwheel is screwed down. At its lowest position the handwheel comes against a stop which prevents overwinding and ensures that neither the pots nor insulating bushes are overstrained. It is claimed for this starter that it is capable of starting a motor against twice full-load torque in 1½ minutes three times every half-hour.

A Watertight Tumbler Switch.

The Delta Electrical Co., of Temple Courts, Temple Row, Birmingham, has recently placed on the market a 5-amp. tumbler switch which possesses the following features: It is operated by an external dolly, as shown in fig. 2, and it is

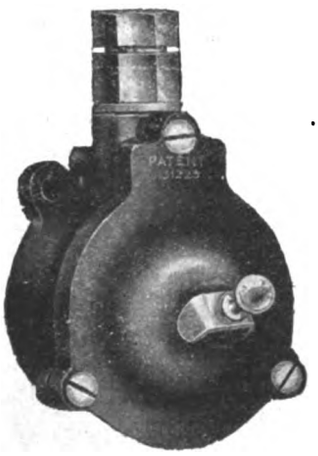

Fig. 2.—Watertight Tumbler Switch.

wired without the removal of the interior. All external metal parts are in electrical continuity, so that it is impossible to sustain a shock when the switch box is earthed. It is rendered watertight by a packing washer between the lid and box. This washer is made of specially treated asbestos, and is claimed to be acid, steam, and moisture proof.

Baking Carbon Electrodes for Electric Furnaces.

La Technique Moderne states that French patent No. 488,778/1918 has been granted to Det Norske Aktieselskab for Elektrokemisk Industri Norsk Industri-Hypotekbank in respect of improvements designed to overcome the low initial conductivity which prevents the baking, by electricity, of mixtures of carbonaceous matter and binders forming electrodes for electrolysis or electric furnaces. The difficulty is that the initial conductivity of the formed electrode is so low that it is only possible to send through it a current of about 1 amp., whereas some hundreds or even thousands of amperes would be required to bake the material. The invention provides for the mixture of coke, graphite, tar, and pitch being formed in a mould round one or more iron or other metal rods extending the length of the mould. The current used for baking passes at first through the metal bars and gradually extends to the whole of the electrode as the conductivity of the latter improves. The specification states that 20 electrodes in series may be connected to the secondary of a variable voltage, 220 amp., 110 volt transformer. Commencing at 800 amps., the current is increased to 2,500 or 3,000 amps. during the final stages of baking. The baking occupies 25 to 35 hours, and the electrodes are allowed to cool in the furnace for 36 hours. The size of electrode is not stated.

Electrodes of this type for lofty metallurgical furnaces may be baked *in situ* if arrangements be made for continuous mixing and baking. Waste heat from the furnace then contributes to the baking. Fresh sections of electrode are

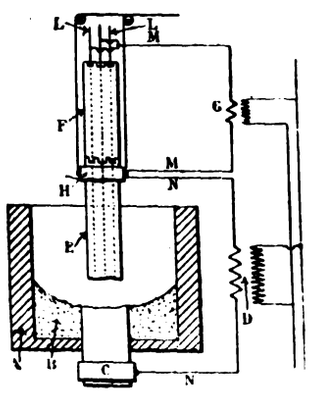

Fig. 3.—Arrangement for Baking Carbon Electrodes.

moulded and baked to keep pace with the consumption in the furnace. By employing the arrangement shown diagrammatically in fig. 3 the current required for baking and the cross section of the metallic reinforcement in the electrode may be reduced to a minimum. The furnace A, charge B, lower electrode C, and main transformer D are arranged as usual. The equipment for continuous moulding of the upper electrode is omitted for simplicity. The lower part of E is baked completely, and carries 18,000 amperes. The upper portion F is newly moulded, and is heated by 2,000 amps. derived from the auxiliary transformer G. The reinforcing bars L, and the connections M have only to carry 2,000 amps.

Templet for Cutting Commutator Mica Segments.

Commutator micas are usually cut by first laying one of the segments on a sheet of mica and marking out the desired form, after which the segment is cut out with a pair of shears. This method, even at the very best, does not produce segments that are of uniform shape. If a rigid construction of the commutator is to be obtained, not only must

Fig. 4.—Templet for Mica Segments.

the insulating segments be of the proper thickness, but the V's in them must be uniform in shape and size, as also the part of the segment on the inside of the commutator.

To obtain uniformity a templet, similar to that shown in the figure, may be used as a guide in cutting the segments. It is made of a piece of 1/16 in. iron bent in the shape

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indicated. After this has been done the two sides of the templet are gripped in a vice and the V's cut the exact shape of those in the commutator for which the insulator is being cut. A notch is cut at A to indicate the maximum width of the mica, and another at B to give the minimum width. The mica is cut to the approximate width of the segments, and then the templet is filled tight with these strips. While being held in a vice, the insulating segments are cut to the required shape with a hacksaw. A notch is cut in the mica at A and B to give the maximum and minimum width, so that after the segments are removed from the templet the excess material can be cut off with a pair of shears. The outside dimensions of the segments need only be approximate, since the excess material can be removed when the commutator is turned down.—*Power.*

THE COMMERCIAL APPLICATION OF ELECTRICAL OSMOSIS.

IN a paper bearing the above title, read before the ROYAL SOCIETY OF ARTS on May 19th, Messrs. J. S. Highfield, M.Inst.C.E., M.I.E.E., W. R. Ormandy, D.Sc., and D. Worthall-Laurie, F.I.C., put forward the results of practical work in this direction. The first part of the paper dealt with the definition of terms and the history of the study of matter in a colloidal state. After a brief general survey of the subject the paper was devoted to the application of the principles involved to the purification or practically the reconstruction of clay. The late Count Schwerin demonstrated that the addition of small quantities of an alkali to a suspension of clay in water resulted in the particles becoming highly mobile, and in the impurities such as pyrites, mica, &c., falling to the bottom of the vessel. The addition of an acid caused coagulation of the particles. Mr. Highfield proved to the audience by experiment that this was so. It was found that bodies in suspension in an electrolytic solution which tended to move to the cathode required an acid electrolyte to bring about the necessary dispersion or peptisation, whereas bodies with a tendency toward the anode required a solution of an alkaline character. By means of a simple device, a copper anode in an alkaline solution in which clay was suspended, the principle was demonstrated, and the audience was shown how in a remarkably short space of time the anode became covered with a thick layer of purified clay. Photomicrographs taken by means of polarised light showing the osmosed material and the deposits of felspar, quartz, mica, &c., were exhibited.

The commercial development of the principle of osmosis was described. The machine used consists of a tank, containing in its lower part two paddles which keep the suspension in continual movement, and drive it in a steady stream between the cathode and anode. The latter is a metal cylinder revolving at a speed of about one revolution in three minutes. The cathode surrounds the lower half of this cylinder, and there is a space of three-quarters of an inch between the two. A scraper is fixed against the direction of rotation of the anode and takes off the deposit to a chute over which the clay moves in a continuous "blanket." Fresh clay suspension is introduced into the lower part of the trough in a continuous stream, and the effluent water is returned to be mixed with more clay. The action of the machine is as follows: The clay in suspension, passing through the perforated cathode, becomes negatively charged, and immediately moves to the anode, while the water is attracted to the cathode forming a watery zone. Fresh clay entering the machine passes through this zone, and all the impurities are washed away with the effluent from the machine. As the effluent invariably contains some clay in addition it is taken to a settling tank, where the mica and other impurities settle out, and the rest of the effluent is then put into a mixing machine from which the osmosis machine is fed. The clay leaves the machine in the form of a sheet varying from one-quarter to one-half of an inch in thickness containing a little water which, owing to the loose form of the material, is easily expelled. By means of such a machine with a cylinder five feet long and two feet in diameter a total of 1,000 tons of purified clay may be produced per annum. The working cost varies widely with the class of clay treated, the amount of energy required ranging from 20 to 70 B.O.T. units per ton of material produced. A small-scale working model was put into motion, and operated very effectively. Another application of electro-osmosis was then described. This is a filter press which has been developed for the de-watering and purifying of many substances in a finely divided state. In its simplest form the press consists of a series of chambers into which the suspension is fed at a sufficient head to ensure a rapid filling. The chambers are closed in on both sides by filter cloths, but the latter are held in position by grooved or perforated metal or carbon plates, one forming an anode and one a cathode. An electrical pressure of from 20 to 100 volts, depending on the substance being operated upon, is established between the plates, and the water is forced towards the cathode. Materials fine enough to choke the ordinary filter press can by this means be de-watered, and the press can, therefore, be used for filtering clays and other colloidal materials which the ordinary press cannot deal with.

In the discussion which ensued upon the conclusion of the reading of the paper, Sir HERBERT JACKSON paid a glowing tribute to the results obtained by electro-osmosis in the production of purified clay. Owing to the high temperatures to which vessels made of this clay could be subjected, combined with a low sintering temperature, the manufacture of high-grade optical glass had been facilitated to a great extent.

Mr. WALTER HANCOCK also spoke of the great advantages to be obtained from clay produced by this process in the production of optical glass, and said that after using the "ore" for so many centuries they had at last got down to the "metal."

Mr. MURRAY MORRISON predicted a large field of application of electro-osmosis in the near future.

Mr. PATCHELL referred to the fact that prior to 1910 the process was in use in Germany, but had been "turned down" by this country chiefly on the part of Cornish manufacturers, whose methods were hard to change, especially as sales were already abreast of supplies.

Mr. GOODWIN asked if the principles could not be applied to peat production and the decomposition of sewage.

Dr. ORMANDY, in his reply, said that crucibles made of clay produced by electro-osmosis had been found to withstand a temperature of 1,500 deg. C. for fifteen journeys, whereas the ordinary crucibles, besides introducing iron and other colouring matter, would not withstand three charges. Peat could easily be dealt with by the process, but the treatment of sewage was a much more difficult and complicated matter. There were at present several works in Austria producing clay in very large quantities by electro-osmosis, and even Spain had become alive to its possibilities.

THE SYNTHETIC MANUFACTURE OF NITRATES.*

IN the fixation of atmospheric nitrogen by the electric arc, the reaction depends mainly upon contact of the air with the arc, and the best device is clearly that which brings most air under the action of the arc. In single-phase furnaces a considerable percentage of air escapes this action; thus in the Birkeland-Eyde furnace, the arc alternately fills the higher and lower halves, but never both simultaneously. Then as the air penetrates into the chamber of reaction through all the orifices it results that only half this air is on the side where the arc has been emitted at the same instant, whence there is a loss of air, especially for the orifices near the circumference. Analogous inconveniences have occurred with the Schönherr and Pauling furnaces.

In three-phase furnaces the three electrodes, separated by refractory bricks, are placed so as to entirely surround a pyramidal space with six sides, which air, entering at the base, gradually fills before passing out through the single opening at the top. The three-phase currents which feed the electrodes produce an arc rotating with the frequency of the source, viz., at the rate of 50 revolutions per second, and as the air requires more than 1/50 second to pass through the reaction chamber, each particle is brought into contact with the flame.

For good working of the furnaces it is essential to blow the arc. This can be done either with a permanent magnetic field (Birkeland-Eyde) or a variable magnetic field (Moscicki), or by the aid of the air passing through the furnace (Schönherr, Pauling, Kilburn-Scott). The inconvenience of magnetic blowing is that it necessitates direct current to feed the electromagnets. The substance of the electrodes exerts considerable influence on the production. The Birkeland-Eyde electrodes, for example, are copper alloy, which experience has demonstrated to be very advantageous. In some Pauling furnaces, at Legnano, Dr. Rossi utilises electrodes made of an aluminium alloy, which, it appears, exerts a catalytic action favourable to the reaction. Single-phase furnaces are set working by bringing the electrodes together until the voltage applied is sufficient to produce the arc. With the high voltages usually employed, there is danger of intense rushes of current and excessive voltage. In three-phase furnaces there is no regulation, the arcs are excited with auxiliary sparks; this enables the electrodes to be kept at the optimum distance.

In all electric furnaces it is of very great importance to make working continuous, because extinguishing and igniting the arcs may cause excessive voltages and other harmful phenomena. The three-phase furnace has a marked advantage in this respect, because the phases are always traversed by currents, and the arcs are mutually maintained. The power is always practically at a maximum, whereas in a single-phase furnace it passes from zero to the maximum value, twice per period.

Preliminary heating of the air gives economy in heat, raises the temperature of the furnace, and also dries the air. This, according to Prof. Guye, gives a slight increase in production. It facilitates ionisation also, and consequently the working of the arc. A temperature of 250 deg. C. gives good results. It

* From *L'Engrais*, January 9th, 1920.

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is profitable to obtain this heating with gas from the reaction chambers.

A high-efficiency heater can feed several furnaces.

The chemical reaction being reversible, it is important to cool the nitric oxide produced rapidly. In single-phase furnaces this cooling is obtained with excess of air blown into the reaction chamber.

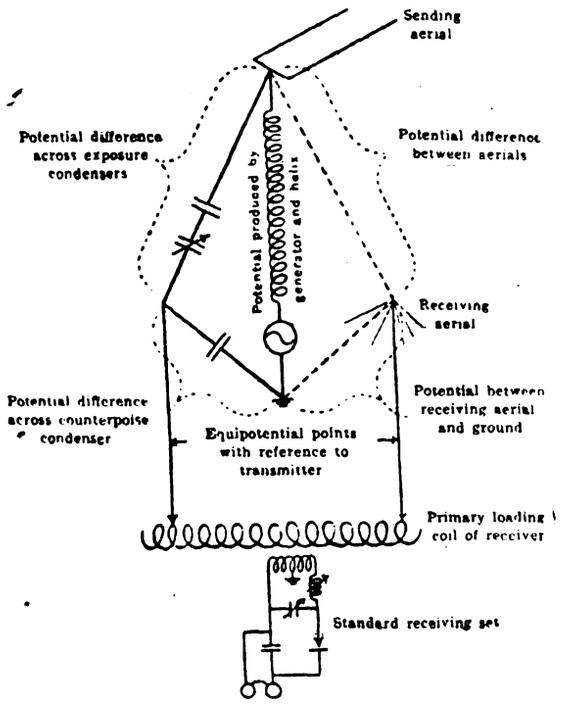
Mr. Kilburn-Scott prefers to make the upper part of the furnace in the form of a boiler upon which the blown electric arc acts much the same as an ordinary flame. The centre of the flame is the neutral point, and the boiler being earthed there is no disturbance in the electric connections. The metal of the boiler is not attacked by nitric oxide (NO). It might be so by nitrogen peroxide (No_2) at a tmeperature below 600 deg. C. The attack, however, is slow, and necessitates the presence of humidity.

The generally accepted production for single-phase furnaces is 50 to 60 grammes of nitric acid, pure, per kilowatt-hour, corresponding to one metric ton of acid per kilowatt-year. With three-phase furnaces, Kilburn-Scott obtained a 50 per cent. greater efficiency. By placing a boiler above the furnace the same author states that about 10 per cent. of the total energy can be recovered.

The voltage is about 1,500 volts. With properly working furnaces one can obtain a power factor of 0.5. The most commonly utilised system of absorption is constituted by a series of high towers, built of bricks, acid proof, and filled with quartz pebbles or other materials which resist acids. The first condition to obtain good absorption is a very slow circulation of the gases. The surface of contact must also be as great as possible. Moscicki runs the liquid down, intermittently, so that the substances in contact will be alternately wet and dry. This, it appears, greatly improves absorption (97 per cent.), and gives nitric acid with a concentration of 40 to 50 per cent.

DUPLEX WIRELESS TELEPHONY AND SELECTIVE RECEPTION.

The first part of a paper which was read by Mr. E. F. W. Alexanderson before the Institute of Radio Engineers, N.Y., deals with duplex wireless telephony, and the second part with a highly selective "barrage" receiver. In the duplex method described, the speaker can hear the called party without manipulating a switch to transfer from sending to receiving. For this to be possible it is necessary to neutralise the intensity of the transmitted signal, and the first method that yielded


Sending aerial
Potential difference across exposure condensers
Potential difference between aerials
Potential produced by generator and coils
Receiving aerial
Potential difference across counterpoise condenser
Equipotential points with reference to transmitter
Potential between receiving aerial and ground
Primary loading coil of receiver
Standard receiving set

DUPLEX WIRELESS TELEPHONY WITH CAPACITATIVE NEUTRALISATION.

practical results was the use of separate sending and receiving antennæ, located sufficiently far apart that the selectivity of ordinary receiving instruments could differentiate between the wave lengths of the receiving and sending stations. The subscriber and sending stations are connected like two ordinary subscribers on a central exchange, with the only difference that a transformer with its primary winding connected across the line from the receiving station is, by its secondary, permanently introduced in series with the line to the sending station. A telephone current originating in the receiving station is thus transformed into a current flowing in the closed circuit between the subscriber's instrument and the instrument in the sending station. A telephone current originating in the subscriber's instrument will follow exactly the same path. Both these currents will, therefore, be transmitted by the sending station, and both sides of the conversation may, in fact, be heard by a third party tuning his apparatus to the two wave lengths. This system is suitable for inter-connection with wire telephone exchanges.

The most practical method consists in mounting the sending and receiving antennæ on the same masts, and preventing mutual interference between them by inductive or capacitative neutralisation. In the former method, an inductive coupling is provided between the two aerials by a transformer connected in such a manner that it creates in the receiving antenna a potential opposite in phase to the potential directly induced by the sending antenna. The second (capacitative neutralisation) method is explained by the figure.

The bridge receiving set connections are analogous to a Wheatstone bridge. By adjusting the condensers in the bridge arms extremely perfect neutralisation is possible of the effect of one antenna on the other. Local strays may be effectively neutralised by intercepting them on a wire loop in the neighbourhood of the receiving set and impressing the potential so generated on a little coil mounted with an adjustable coupling close to the secondary loading coil of the receiving set.

The "barrage receiver" is a highly directional combination of aperiodic antennæ with unilateral directional characteristics. When two antennæ are used, the phase difference of the received currents depends on the direction of the incoming signals. By phase-shifting devices and differential coupling to a common receiver the signals from any given direction can be balanced out. Each antenna is connected to earth through an intensity coupler, the secondary of which is connected to the primary of a phase adjuster, built in the form of an induction regulator. The primary current is connected in split phase so as to produce a rotating field that cuts the secondary windings. The neutralisation of the signals from any particular direction is effected by adjustment of the intensity couplers and phase adjusters.

An experimental set was erected three miles from the New Brunswick station, the wave length of which is 13,600 metres. Nevertheless, signals from Carnarvon, Wales, with 14,200 metres wave length, were received, the signals from the New Brunswick station being entirely eliminated, notwithstanding their intensity and small difference in wave length. By using a double set of phase adjusters, signals from two stations in different directions may be neutralised simultaneously.—*Technical Review.*

SOME DEFECTS IN ELECTRODEPOSITED IRON.

BY W. E. HUGHES, B.A.

(*Abstract of paper read before the* IRON AND STEEL INSTITUTE.)

THE electrodeposition of iron has lately been employed to a considerable extent for the purpose of "building up" worn and under-gauge parts—both of aeroplanes and guns. This work has not been done under proper scientific control; and the observations made during this research show that results obtained in the workshop, though apparently satisfactory, are very far from being so in fact.

Microscopic and macroscopic examination shows that electrodeposited iron is subject to the following defects:—

1. Pin-holes.
2. Lumps (or roughness).
3. Inclusions (of foreign matter).
4. Cracks and quasi-cracks.
5. Differences of structure—at different parts of the same specimen.

Pin-holes (or "pits") are due to gas which is liberated by the current during electrolysis, and which adheres in the form of bubbles to the articles on which the deposit is being formed. The gas bubble acts as a screen or insulator. The deposit grows up round it, and thus a hole of circular cross-section is formed in the deposited iron. The bubbles are usually said to consist of hydrogen, and probably in the majority of cases that is so. It is necessary so to choose the conditions of deposition that hydrogen evolution is reduced to a minimum, and then to direct one's efforts to removing by mechanical means (agitation of the solution or movement of the articles being deposited upon) the gas formed and adhering to the work.

Lumps very often are caused by the plating solution containing tiny particles in suspension. Sometimes the lumps are rounded and smooth. This result is due to suspended particles having been initially present, and, after settling, having left the solution clear. A lumpy deposit of this kind will often be formed after a plating bath has been for some reason stirred up (*e.g.*, when new salts have been added), and sufficient time has not been allowed in which the sediment, that is always present at the bottom of plating baths, could settle down.

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At other times a deposit will be *rough* to the touch. In this case, though the first settled particles have become covered, other layers are being continually formed. This kind of thing will result from the use of anodes that do not wear well, or, in the case of iron, from using anodes containing a high percentage of carbon. The effect on the structure is that it is of a more or less porous type, instead of being compact and dense.

Of the substances occurring as inclusions in electrolytic iron, the following are probably most often recurrent:—

(*a*) Oxide or hydroxide of iron, produced by oxidation of the solution.

(*b*) Hydrogen, produced at the cathode by electrolysis; and

(*c*) Carbon or carbide, that comes from the anodes used, or is derived from a constituent of the electrolyte.

Oxidation takes place quickly and extensively, even when the solution contains acid. The resulting oxide (or hydroxide) becomes disseminated throughout the solution by reason of its disturbance in the practical operations, and is caught up by the deposit. This defect is diminished—(1) If the bath continually contains sufficient acid to prevent the formation of any large amount of oxide (or hydroxide); (2) if the solution be allowed to "settle out," and be then siphoned, at frequent intervals; (3) if care be taken to disturb the solution as little as possible during the operations of putting in and removing the articles to be deposited upon.

Many writers have made statements to the effect that electrodeposited iron owes its brittleness (when it is brittle) to the fact that hydrogen is in some way or other included in the deposit. Such statements are quite inaccurate.

It remains unproven that the cause of brittleness (where it occurs) in electrolytic iron *is* the presence, in some form or other, of included hydrogen.

Carbon is found in electrolytic iron, but there is nothing to show that it causes any structural effect.

Electrolytic iron is commonly thought to be very pure. It may be, and it may not. The impurities, other than hydrogen, probably come, for the most part, from the anodes used. All impurities must be considered as causing the iron to be defective, and, from this point of view, the deposits obtained from solutions containing organic substances must be looked upon with suspicion. Cracks frequently exist, and they form a very serious defect in electrolytic iron.

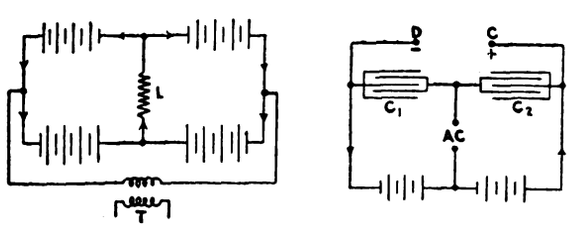
The manifold differences of crystalline structure that are to be found in electrodeposited iron must be accounted as a defect in it. Sometimes complete differences of structure will be found to occur in the same cross-section of one and the same sample.

These defects arise from causes which can be largely eliminated by efficient control and conduct of the deposition process.

It is believed that electrodeposited iron could be used with advantage to a much greater extent than it is at the present time, and that a great saving of material and expense would be effected by such extended employment of it. But the author is sure from long experience that if the electrodeposition process is to be used with success this will have to be done by methods and under workshop and other conditions that are much less lackadaisical and much more scientific than is at present the case.

METHODS OF REDUCING FLUCTUATION IN RECTIFIED CURRENTS.

Fig. 1 illustrates the circuit arrangements of the well-known Nodon system of aluminium rectifiers. Each cell consists of aluminium and lead or carbon plates immersed in a salt solution. T is the transformer through which the current is fed to the circuit, and L is the load. It is found that although this arrangement completely rectifies the current (at no time does it reach a zero value), the fluctuation is very large.



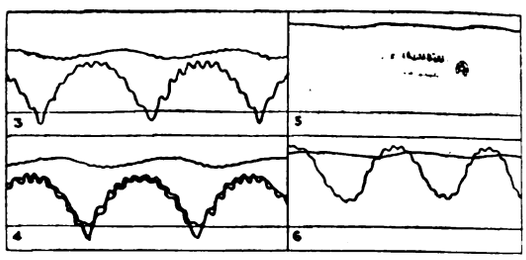
Figs. 1 and 2.—Circuit Arrangements for Aluminium Rectifier and Loads.

Two methods may be employed to "smooth out" the current: (*a*) the introduction of inductance in series with the load, and (*b*) the placing of a condenser in parallel with the load. The effect of the first method is shown in fig. 3, where the upper and lower curves represent the current and voltage respectively. In fig. 4 the curve which just touches the zero line represents the voltage when the load is a non-inductive resistance. The curve that falls slightly below the line represents the voltage with the same total resistance, and the addition of an inductance of 33 millihenries. The upper curve shows the current with the inductance in the circuit.

Fig. 5 is an oscillogram showing a current in the load of 2.5 amps. rectified with the four-cell combination shown in fig. 1. An inductance of 33 millihenries is placde in series with the load, and a 25 mf. condenser in parallel with it. The fluctuation has a maximum value of 1 per cent. of the mean current.

A high voltage can be obtained by employing the inductance without the condenser, but the current is small. This is illustrated in fig. 6. The curve showing the larger variations is the voltage without a condenser. The effect of connecting a condenser of 2.8 mf. capacity across the load is shown by the other curve.

The arrangement shown in fig. 2 makes it possible to obtain a direct E.M.F. more than twice as large as the effective value



Figs. 3, 4, 5, and 6.—Rectified Waves of Current and Voltage.

of alternating E.M.F. The condensers are of 2.8 mf. capacity. At the peak of one-half cycle one of the condensers is charged to the maximum voltage produced by the transformer; i.e., to 1.41 times the effective value of the voltage. The other condenser receives a similar charge at the peak of the next half-cycle. The two are in series, hence the p.d. between terminals D and C is $2\times1.41\times E$, where E is the effective value of the alternating E.M.F. This assumes the wave to be harmonic and leakage negligible.

We are indebted to the *Electrical World* for the foregoing details and accompanying diagrams.

LEGAL.

Bootle Corporation *v.* Bootle Cold Storage & Ice Co., Ltd.

In the Commercial Court of the King's Bench Division, before Mr. Justice Bailhache, on Thursday, May 20th, an application was heard in which the Mayor and Corporation of Bootle, Lancs., proceeded under the Courts (Emergency Powers) Acts, 1917-19, asking for the setting aside of a contract dated January 19th, 1912, for the supply of electricity for power to the Bootle Cold Storage & Ice Co., Ltd. The plaintiffs asked for the relief on the grounds that through the war and its attendant increases in the cost of coal, labour, &c., the whole basis upon which the contract had been entered into had been changed. Mr. A. T. Miller, K.C. and Mr. M. Bailey were for the applicants, and the defendants were represented by Mr. R. A. Wright, K.C., and Mr. W. Proctor.

Mr. Miller, K.C., in opening the case, said that there were sections under which the Courts Emergency Powers Act gave power to set aside contracts, the performance of which had become impossible or onerous through circumstances created by the war, and his submission would be that this was precisely the sort of case that the Act was intended to relieve, as through the war there had been an entire change in the trade conditions of the Corporation's electrical undertaking. The agreement with the defendant company was dated January, 1912, and it fixed the charge for power supply under two heads as follows: (1) To cover the capital and standing costs irrespective of the quantity used; this was based upon the plant capacity and was charged at £1 per kilowatt of demand per quarter. (2) To cover the running cost. This charge was made with respect to the electricity used as measured in Board of Trade units, and the rate was 0.375d. per unit. In the year 1917 the electricity works of the Corporation were declared a controlled establishment under the terms of the Munitions of War Act, 1915, and they had to be carried on under the Director of Electricity Supply. The consequence was that various new works and large extensions of works were constructed within the Corporation's area of supply at the instigation of departments of the Government, for the production of war material, and the Corporation had to furnish electricity for them, but the Corporation was unable to obtain any sanction to the extension of its area. In December, 1917, it was obliged to get a supply in bulk from the Liverpool Corporation at disadvantageous terms, and at a price that increased the cost beyond that which it would have been if the Corporation had been permitted to extend its works. From 11s. 3d. per ton in June, 1914, the price of coal had increased to 36s. per ton—an increase of 220 per cent— and

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wages had risen by some 130 per cent. Figures supplied by the borough electrical engineer, Mr. T. Dawson Clothier, showed that for the year ending March 31st, 1915, the costs with respect to: (1) Capital and standing costs per kilowatt of maximum demand for all consumers were £1 12s. per kilowatt per quarter; and (2) the average running cost per unit of electricity sold to all consumers was 0.435d. per unit. The charge then made to the defendants of £1 per KW. and 0.375d. per unit were fair and reasonable, and in the year in question the undertaking showed a surplus of £3,014 over expenses, but for the year ending March 31st, 1919, very different results appeared, for the figures were: (1) Capital and standing costs, &c., £2 14s. 3d. per kilowatt per quarter; (2) average running cost per unit 0.84d., and a deficit of £7,670 resulted, although the charges for electricity were increased to every other consumer. Since March 31st, 1919, costs had risen still further, and the figures were: (1) Capital and standing costs, &c., £2 19s. 6d. per kilowatt per quarter; (2) average running cost per unit 1.06d. In the case of other consumers the charge for energy had been increased by 3½d. per unit for lighting and from 0.85d. to 1.7d. per unit for power. Mr. Miller, K.C., submitted that this was just the type of case that the Act intended to relieve. He relied on the words in the clause to the effect "alteration of trade conditions occasioned by the war . . . which involved serious hardship in carrying out the contract."

Mr. Clothier gave evidence, and was cross-examined by Mr. Wright for the defendants. He said it was true that the defendants had a reduced charge because they took the supply at a time when there would not be a general demand. They had a summer day load and used it in daylight. The Corporation had another pre-war contract with Harland & Wolf. Later contracts had a coal clause and a percentage clause. There was another cold storage company called the Union Co. now taking supplies. The coal clause meant an increase of over 100 per cent. on the basis price per unit. The bulk of the increased cost was for coal. Witness said that the defendants did offer to pay three-quarters of the coal clause increase dating back to 1918, which would involve an extra payment of £1,200.

Mr. Wright: If your contract is annulled you would not get that retrospective relief, you would have to start from now and make a new contract?—I suppose so, and they would be treated as new consumers.

I understand that in your arrangement with the other company (the Union Cold Storage Co.) you eliminated coal altogether for the purposes of determining if there has been an increase of cost of production, and then you charge a percentage to be settled by arbitration.—Yes.

His Lordship: And the percentage in that way might turn out to be very small on the total price?—Yes, it might turn out to be nothing at all.

Mr. Justice Bailhache: This agreement with the defendants really has only two years to run.

Mr. Miller: Yes, and the parties have been at loggerheads since 1917.

His Lordship said it would appear that if the Corporation allowed the defendants to go on the terms of their offer of three-quarters of the coal clause increase they would be on slightly better terms than were the Union Cold Storage Co.

Mr. Wright: Yes, they would start with 0.3d. instead of 0.375d.

Mr. Clothier explained that there were several differences in the basis on which the Union Cold Storage and the defendants were supplied—which were favourable to the defendants as compared with the other firm.

At the close of the evidence Mr. R. A. Wright said there were two alternatives—one was agreement between the parties, and the other was whether the circumstances were such as would justify the Court in annulling the contract. Mr. Wright said the position of his clients was that they had got a contract—they had offered to have the agreement revised to the extent of three-quarters of the coal clause increase with retrospective effect. The defendants' offer was retrospective. He submitted that the position could not be dealt with as if there was no contract at all. The Court must consider the fact that the contract existed. The Corporation's offer was after June, 1918, the whole of the coal increase and up to then three-quarters of it.

Mr. Miller, K.C., said the Corporation made a fair offer in December, 1917, that had been modified since. The defendants had brought the Corporation to Court to have the matter discussed, and he submitted the plaintiffs should have the costs in any event. It was agreed that the case should be adjourned until the following day for the parties in the meantime to discuss the matter with a view to an agreement, and Mr. Justice Bailhache intimated that subject to Mr. Wright's argument he thought that failing an agreement the contract should be annulled.

When the case was further mentioned, Mr. R. A. Wright, K.C., for the defendant company, announced that his clients had agreed to accept the offer of the Corporation, so that the contract by consent would be amended, increasing the contract price by three-quarters of the coal clause charges as from January 1st, 1918, to June 30th, 1919, and as to the whole of the coal clause charges from July 1st, 1919, to the end of the contract. As this was an application by the plaintiffs for relief, he submitted there should not be any costs on either side.

Mr. Justice Bailhache: I do not agree. I think the defendants were unreasonable in the matter. They forced the plaintiffs to come here, and defendants must pay the costs.

The contract was accordingly amended on the terms indicated, and the plaintiffs were given the costs of the proceedings.

Improvements in Electrodes for Secondary Batteries.

In the King's Bench Division, on Wednesday, May 19th, Mr. Justice Greer had before him an action relating to the commercial exploitation of a patent covering improvements in electrodes for secondary batteries (No. 120,671 of 1914-1915). The plaintiff was Mr. Herman Edward Gluck, of Priory Road, West Hampstead, and the action was brought against Mr. S. Willner, of Turle Road, Tollington Park, and Mr. Alfred Connell, Philpot Lane, London, plaintiff claiming damages for alleged breach of contract.

Plaintiff's case was that in February, 1916, Willner requested him to assist defendants with the necessary finance for commercially exploiting the patent. It was alleged that Willner stated to plaintiff that he was the owner of the patent, that he had sold the German and American rights, that he wanted to exploit the English, Colonial, and other foreign rights, and that the patent was held in trust for him by Connell, to whom he would have to allow a small interest for services rendered. In May, 1916, it was verbally agreed that plaintiff should provide the necessary finance for commercially exploiting the patent, and should take offices and register or obtain control of a company with limited liability, and that in consideration plaintiff should have in addition to payment of the money advanced and expenses incurred by him under the agreement, one-third share of the English and Colonial rights or one-third of the profits to be made from the sale of the patent. It was further agreed that Willner should act as secretary of the proposed company. Certain personal loans were made by plaintiff to Willner, who undertook not to dispose of his rights in the patent unless with the plaintiff's consent. Plaintiff said he advanced money and incurred expenses, and took offices at Wormwood Street, E.C. In May, 1917, Connell assigned the letters patent to a gentleman, who afterwards assigned them to the Apex Electric Accumulator Syndicate, Ltd., and plaintiff said he was entitled to one-third of the profit made by defendants from the sale.

The defendant Willner denied that he was interested in the letters patent as owner or partner or joint owner with his co-defendant Connell, or that he ever acted or had any authority to act as principal or agent as alleged. It was alleged by the defence that in January, 1916, Willner introduced plaintiff to the defendant Connell as a person who was able and willing to provide the capital required for exploiting the letters patent commercially, but plaintiff failed to find the required capital, and in August, 1916, Willner informed him that Connell would dispose of the letters patent. The defendant Willner denied that the agreement alleged by plaintiff was ever made.

The defendant Connell also pleaded that there never was any agreement at all between him and the plaintiff. The letters patent were granted to him and were eventually assigned to the Apex Electric Accumulator Syndicate, Ltd.

After hearing the evidence and counsel's address, Mr. Justice Greer said Mr. Willner's own evidence satisfied him that he knew Mr. Gluck was undertaking liabilities and meeting expenses in consideration of a promise made to him. He could not find that Mr. Connell was liable. The breach of contract was due to what Mr. Willner did. He had decided to give Mr. Gluck against Mr. Willner £100 beyond the £94 which the plaintiff had expended, and to which he was entitled, and there would be judgment against the defendant Willner for £194, and judgment for the defendant Connell.

The Belgian Charleroi Works.—The report for 1919 of the directors of the Ateliers de Constructions Electriques de Charleroi states that the expectations entertained a year ago regarding the resumption of production had been realised. It was possible for the Marcinella works, from which but little machinery had been removed, to make a fresh start in February, and in August the construction of large motors and lifting appliances was resumed at the works of La Villette. The foundry and pattern shop, which had not suffered any damage, were able to work on a normal basis as early as January, but the cable factory had been stripped of all the plant, and was only able to turn out the first cables and insulated wires in September. The equipment of the cold rolling mill had been recovered, and its installation was practically completed, whilst it was hoped to start the new shops for tubes and insulating material in a short time. In addition, the construction of small motors in bulk had been begun at Ruysbroeck, where the signal department was to be transferred from La Villette. Although orders of any importance were not booked until the end of May, the value of the orders received in the whole of 1919 was 45,454,000 fr., and the present year promised to be still more favourable. The accounts for last year show profits of 2,546,000 fr., but after deducting the loss of 2,337,000 fr., incurred in the years 1915 to 1918, the sum of 209,000 fr. remains to be carried forward to 1920.

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CORRESPONDENCE.

Letters received by us after 5 P.M. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

The Policy of the E.P.E.A.

With reference to letters in your issue of May 21st, written by "Sic Itur" and Mr. Jones, Secretary E.P.E.A., I should like to ask them: (1) How many of their members receive the awards they claim for? (2) Have they cleared their minds as to whether they are what they claim to be, viz., genuine trade unionists? (3) If they have, why do they want confirmation at the hands of the T.C.P.C.?

And, further, all their claims are based on the basic rates obtained by the E.T.U., the members of which get what they are awarded. Mr. Jones in his letter does not state that he was absolutely forced to publish something of the sort by a trade union, as a result of two conferences with the E.T.U., at one of which I was present. And the defence they put up was pathetic. There is only one thing for the E.P.E.A. to face, and that is absorption by the E.T.U.

W. E. Weston,
No. 1 Station Engineers, E.T.U.

London, S.E., *May 20th*, 1920.

Electrical Japanning Ovens.

I was expecting to see some comment re the above, and the following will answer Mr. W. M. Mason's ten questions:—

No. 1.—Fittings in gas stove replaced with electric fittings.

No. 2.—See "Electric Japanning Ovens" (Electrical Review, April 23rd).

No. 3.—The same exhaust flue in use for electric stoves as for gas stoves.

No. 4.—Sufficient to complete the stoving of the work in the ovens.

No. 5.—Long enough to turn out a satisfactory job.

No. 6.—Yes.

No. 7.—To regulate gas-heated stoves requires more care than is required in switching off electric current.

No. 8.—Electric heaters.

No. 9.—Sufficient for the work in the ovens according to the temperature required.

No. 10.—See answer No. 2.

I am not certain what is implied by the term "nigger," but Mr. Mason can take it for granted that my electric stoves are not "white elephants."

Alfred Rider.

Hull.
May 18th, 1920.

BUSINESS NOTES.

Small Electric Lighting Sets for Cuba.—The D.O.T. has received a report from the Commercial Secretary to H.M. Legation at Havana (Mr. G. T. Milne, O.B.E.) stating that there is an opening for the sale of small electric lighting sets of British manufacture. Already some American manufacturers are in the Cuban market, which is not a very large one, but British manufacturers should be able to secure orders, provided they can supply a suitable type of lighting set. It is suggested that firms interested should forward catalogues, lists, &c., to the Commercial Secretary, British Legation, Havana, Cuba, indicating at the same time the present prices and conditions of delivery.

Illuminating Engineering Society. — The Council's report for the 1919-20 session was presented at the annual meeting of the Society, held on May 11th. The arrangement by which positions on the Council are held by the presidents of kindred societies has been extended to include the Illuminating Engineering Society of the U.S.A., the Institution of Electrical Engineers, the Institution of Gas Engineers, the Illuminating Engineering Society in Japan, the Council of British Ophthalmologists, the Ophthalmological Society, the Physiological Society, the Electrical Contractors' Association, and the Association of Railway Electrical and Telegraph Engineers. A list of the subjects dealt with at meetings of the Society includes "Colour-Matching by Natural and Artificial Light," by Mr. L. C. Martin; "Lighting Conditions in Mines, with Special Reference to the Eyesight of Miners," by Dr. T. Lister Llewellyn, as well as reports of Committees, &c. Among the questions investigated by Committees was "Eyestrain in Kinemas," an inquiry entered upon at the instance of the London County Council. Committees were also set up to report upon railway lighting, and progress in lamps and lighting appliances.

Dual Tickets.—The *Journal* of the National Association of Supervising Electricians for May gives correspondence between the Association and the E.T.U. in which the former asked whether the latter would countenance joint membership of more than one Trade Union. The E.T.U. replied that the Executive Council had definitely decided that no member of the E.T.U. could hold two Trade Union tickets.

Motor Fuels Committee.—The Imperial Motor Transport Council, of which Prince Arthur of Connaught is President, and the Hon. Sir Arthur Stanley chairman, has appointed an Empire Motor Fuels Committee under the chairmanship of Mr. E. S. Shrapnell-Smith. The terms of reference are the following:—

1. To take immediate steps to encourage and develop the production and utilisation of additional motor fuel supplies and of raw materials therefor in all parts of the Empire, and more particularly to ensure increasing shipments of motor fuels to Great Britain, and, so far as may be necessary, to the Empire Overseas.

2. To co-operate with any Government or incorporated or unincorporated body of persons in order to further the objects set forth in (1) hereof.

3. To offer for the purposes in view bonuses or other rewards and to incur such expenditure as may be desirable, all such expenditure being subject to the approval of the Council.

Captain F. G. Bristow, F.C.I.S., will give his services as secretary to the committee, and any communications are to be addressed to him at 50, Pall Mall, London, S.W. 1.—*The Times.*

Tests on High-Pressure Box Compound.—Very good results were recorded in a recent report by the National Physical Laboratory on "Berry's" high-tension box compound, supplied by the Premier Bitumen and Asphalte Co., Ltd., of Stratford Market, London, E. 15. We understand that a cube of the material to meet Admiralty requirements, placed in a metal box, was immersed in boiling water for 30 minutes, and fulfilled the requirements of the specification. The material was then subjected to a pressure of 2,000 volts between electrodes placed $\frac{1}{16}$ in. apart, for half-an-hour, without breakdown, and when tested again under a temperature of 100° C. for a period of half an hour, an alternating pressure of 2,000 volts was withstood. Two 2-in. cubes of the compound were immersed in distilled and sea-water for a week, and showed an increase in weight of '06 per cent. and '04 per cent. respectively; the specification stated that the weight of neither cube was to be increased by more than '5 per cent.

Three 8-Hour Shifts at Sheffield.—In response to an application by five societies representing the steam service men, the Sheffield and District Engineering Trades Employers' Association have decided to put into operation Award 84 on May 30th. This means that the three eight-hour shifts system will be worked by over 10,000 men, instead of two shifts per day. This arrangement is expected to increase employment and abolish overtime.—*Times.*

Dynamo Manufacturers' Amalgamation.—An amalgamation of interests has been arranged between the Lancashire Dynamo and Motor Co., Ltd., of Manchester, and the Crypto Electrical Co., Ltd., of Willesden. It is intended that all machines below about 10 H.P. shall be manufactured at the Willesden Works, and that machines above this size shall be manufactured at Manchester. Special arrangements have been made to meet the requirements of customers who require to duplicate existing machines of either make.

The Crypto Electrical Co.'s works at Willesden are being extended to double their present size. The extensions are practically complete, and a greatly increased output will be available within a short time. It is hoped that the extensions will ensure the production of approximately four times the existing output of motors from about ¼ B.H.P. up to 10 B.H.P.

The selling organisations of the two companies have been combined throughout the British Isles. The associated firms have branch offices in London, Glasgow, Newcastle, Birmingham, Dublin, Cardiff, and Bristol, and full information regarding the products of both works can be obtained from any of these offices, or from the head offices and works of either firm.

The directors are confident that the increased efficiency obtained by limiting the range of manufacture of each works will greatly increase the combined output, with corresponding benefits in regard to price and delivery.

Canadian Exhibition.—Sir George Perley, K.C.M.G., High Commissioner for Canada, will open the Exhibition of Canadian Products at the Royal Agricultural Hall, Islington, on Thursday, June 3rd, at 12 o'clock. The Exhibition will be open from 11 a.m. to 9 p.m., and will close on June 17th. Up to 2 p.m. each day the Exhibition will be open to traders only. After that hour the general public will be admitted.

The exhibits include iron and steel products, minerals, chemicals, tools, sheet-metal goods, agricultural machinery, furniture, provisions, confectionery, footwear, musical instruments, building materials, &c.

Employment for Disabled Men.—In an endeavour to find work for the 630 disabled ex-Service men at present unemployed in Greater Manchester, local ex-Service Associations recently called a meeting, inviting the men and about 30 employers. This resulted in placing about 60 men in employment. Further steps are being taken, including the sending of a circular letter to all employers in the district. When this task is ended, efforts will be made to secure employment for the other unemployed ex-Service men—about 6,000 at present.

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National Joint Board of Employers and Members of Staff (Electricity Supply Industry).—We have received from the Secretary of the Electrical Power Engineers' Association a pamphlet containing an account of the constitution and functions of the National Joint Board, which was formed on December 12th, 1919. A list of members of the Board is given, Ald. W. Walker being the chairman, and Mr. J. H. Parker, vice-chairman; the secretary is Mr. A. C. Tappenden, 1 and 2, Great Winchester Street, E.C. 2. In addition to Ald. Walker, the representatives of the I.M.E.A. are Ald. A. R. Jephcott, M.P., Ald. E. Vaughan, Bailie W. B. Smith, Mr. H. Faraday Proctor, and Ald. J. A. G. Beaumont; the Incorporated Association of Electrical Power Companies is represented by Messrs. R. P. Sloan, C.B.E., and W. B. Woodhouse; the Conference of the Chief Officials of the London Electric Supply Companies by Messrs. F. Bailey and F. J. Walker; and the Provincial Electric Supply Committee of the United Kingdom by Messrs. K. A. Scott-Moncrieff and J. C. Wigham. For the employés, the E.P.E.A. is represented by Messrs. J. H. Parker, W. J. Cooper, G. W. Essex, A. L. Lunn, W. A. Jones, and J. W. Thomas; and the Electricity Supply Commercial Association by Messrs. P. Burr, N. A. Chesterfield, W. Goodson, P. R. Jackson, G. R. Smith, and A. J. Squire. Meetings are held monthly. Areas for 13 District Joint Boards have been defined, covering Great Britain. The organisation is based upon that of the Whitley Councils, and the object is to secure the largest possible measure of joint action between employers and members of the staff for the safeguarding and development of the industry, and for the general improvement of conditions, with a view to promoting the best interests of all parties. The functions and procedure of the Board are fully set out in the pamphlet.

We have also received a pamphlet, dated May 12th, defining the "conditions of employment and schedule of salaries for technical engineers on the staffs of electricity supply undertakings." It is stated that the Board has been officially recognised by the Ministry of Labour as the competent authority to deal with all matters affecting salaries and conditions of employment, and that the Board has agreed to the conditions and schedule, which apply to all members of the technical staffs from "student engineer" up to and including the deputy chief official.

The conditions define the "week" as consisting of 48 hours, and cover the questions of temporarily increased responsibilities, sick leave, holidays, termination of employment, &c. The schedule is based upon plant capacity, which is closely defined; undertakings are graded in nine classes, from 1,000 to over 100,000 KW., and there are four basic grades:—(1) Deputy chief official; (3) power station superintendent; (3) mains superintendent; and (8) shift charge engineer. Intermediate grades are provided in the schedule. The total rate of salary and bonus, as at March 1st, 1920, is adopted as a basis of calculation. The salary of a shift charge engineer in the lowest size of station scheduled is to be £293 per annum, or more if he is already paid at a higher rate. The salaries are subject to re-adjustment in proportion to the official figures as to cost of living. The conditions and schedule come into operation as from May 21st, or June 1st, 1920. We print the schedule herewith. No doubt copies of these pamphlets will be in great demand from the secretary during the next week:—

SCHEDULE OF SALARIES.
PLANT CAPACITY IN KILOWATTS.

Grade.	Class A. 1,000—2,000	Class B. 2,001—4,000	Class C. 4,001—6,000	Class D 6,001—8,000	Class E. 8,001—10,000	Class F. 10,001—30,000	Class G. 30,001—50,000	Class H. 50,001—100,000	Class J. 100,001 and over.
	£	£	£	£	£	£	£	£	£
1	538	574	625	657	—	—	—	—	—
2	471	502	547	576	620	—	—	—	—
3	427	455	498	523	564	585	—	—	—
4	371	407	432	469	504	521	575	611	657
5	352	378	411	433	465	499	518	565	596
6	322	354	376	407	426	457	486	516	581
7	293	322	354	371	399	427	442	484	509
8	293	293	322	349	365	392	416	430	467
9	—	—	—	270	291	313	343	354	376
10	—	—	—	—	—	252	266	284	309

The Coal-Mining Industry.—In the May issue of the *Industrial League and Council Journal*, Mr. David Gilmour, O.B.E., general secretary of the National Democratic and Labour Party, who has seen upwards of 40 years' service in connection with the coal mining industry of Great Britain, shows how it is impossible for this industry to be developed to any appreciable extent while the seven-hour working day is in operation. He points out that in 1913 the output from British coalfields was 287 million tons, and had not the war supervened, it would to-day have been at least 300 million tons per annum. Under existing conditions it will work out at about 240 million tons, and the sad fact is, that if the field could only be brought up to 300 million tons the terrible tragedy of the gradual and persistent ever-increasing cost of living would be abated, if not eliminated altogether. Mr. Gilmour says: "My suggestion is, therefore, that it should be made worth the while of the miners to consider reverting to the eight-hours day for the period of one year on trial, and for the extra hour worked they might be paid a higher rate, as for overtime. Supposing the concession of £1 per week higher wage was granted for the extra time, this would absorb about £50,000,000 per annum of the extra £150,000,000 derived from 60 million tons additional exports, leaving a surplus of £100,000,000 yearly, which could be utilised to reduce the price of coal for industrial purposes, and bring down very considerably the charge for house coal. If this could be achieved, British trade would have such an era of prosperity as we have never previously enjoyed."

Training Ex-Service Men.—Sir Montague Barlow, Parliamentary Secretary to the Ministry of Labour, recently stated that the number of ex-Service men in training was 22,856, and the number waiting 24,880. The number already trained was 20,633, including 11,000 trained under the direction of the Ministry of Pensions.

Society for Electrical Development, U.S.A.—The above society has elected Mr. W. W. Freeman to the position of president, while the general manager, Mr. J. Wakeman, and the secretary-treasurer, Mr. James Smieton, jun., have been re-appointed.

Book Notices.—"Public Opinion in Preventive Medicine." Price 4d.; post free 5½d.—The Lady Priestley Memorial Lecture delivered by Sir George Newman, K.C.B. (Chief Medical Officer, Ministry of Health), before the National Health Society, on April 22nd, 1920, has been issued as an attractive little book of 30 pages. Everyone should read this illuminating little book, for the health and well-being of the community are of national importance. Teachers, in particular, can do much to impress upon their pupils the importance of the observance of simple and elementary precautions to avoid disease, of proper food, fresh air, and exercise. Copies of the booklet are obtainable from all booksellers and from H.M. Stationery Office.

"Controllers for Electric Motors." By H. D. James. Pp. xiv + 354; figs. 259. London: Crosby Lockwood & Son. Price 21s. net.

"The Real Wealth of Nations, or a New Civilisation and its Economic Foundations." By J. S. Hecht. Pp. viii + 350. London: G. G. Harrap & Co. Price 15s. net.

"Armature Winding." By C. Sylvester. Pp. xii + 171; figs. 129. London: S. Rentell & Co., Ltd. Price 7s. 6d. net.

"Vickers News." Vol. II, No. 16. Pp. 20.—The present number of this interesting journal includes further articles on the Cairo to the Cape and the trans-Atlantic flights, as well as a description of submarine construction at Barrow.

MESSRS. W. & G. FOYLE, LTD., 121-125, Charing Cross Road, W.C. 2, have sent us a catalogue of new and second-hand technical books (39 pp.). Divided into subject-divisions, the volumes are classified under authors' names, and the published and present prices are given in each case. The subjects range from "Aeronautics" to "Brewing," and the "Electricity" division contains nearly 200 works; dates of publication, however, are omitted.

"Problems in Physical Chemistry." By E. B. R. Prideaux. Pp. xii + 294. London: Constable & Co., Ltd. Price 18s. net.

"Cheap Steam." Vol. IV, No. 3. Pp. 16. London: Ed. Bennis and Co., Ltd.—The May issue of this journal contains several articles of interest, including notes on boilers at iron and steel works, and a description of plant at the works of Messrs. W. & R. K. Lee, Ltd., Sowerby Bridge.

"The *Bulletin* of the Hydro-Electric Power Commission of Ontario." Vol. VII, No. 4. April, 1920. Pp. 32.—This issue is well illustrated, and contains a long article upon the Lincoln demand meter, and a description of the Nipigon power development.

Factory and Plant for Sale.—By direction of the Disposals Board Ministry of Munitions, the Controller of Land and Factories is offering for sale by private treaty H.M. factory and power house at Langwith, Derbyshire, the ground area of buildings cover about 145,000 ft., the power installation consisting of producer gas engines and generators, capable of developing 11,000 H.P. or 7,400 KW. Peterborough Corporation Electricity Department invites offers for one 240 cell, complete with boxes, trays and insulators. Full particulars are given in our advertisement pages to-day.

Catalogues and Lists.—MESSRS. SIEMENS BROS. & CO., LTD., of Palace Place Mansions, Kensington Court, W. 8, are distributing a new coloured showcard of their "Stannos" system of wiring, illustrating the inconspicuous nature of the work in the mansion, and drawing attention to the inexpensivness of the system in the cottage, and to its other advantages. The simplicity of the new way as compared with the old is shown. Merchants, contractors, and traders can have copies of the showcard on application.

BRITISH BRASS FITTINGS, LTD. (Proprietors of Sperryn & Co., Chas. Joyner & Co., Ingram & Kemp, and Player & Mitchell), Moorsom Street Works, Birmingham.—Catalogue Edition B E1. (157 pp.). Beautifully produced on art paper, and profusely illustrated. Dealing chiefly with electroliers and other electric lighting fittings. Fully priced.

MESSRS. ALFRED HERBERT, LTD., Coventry.—Section E 6, a 16-page illustrated, priced and dimensioned list of turret-lathe tools and accessories of all descriptions.

MESSRS. GALLOWAYS, LTD., Knott Mill Iron Works, Manchester.—Two well-produced and illustrated catalogues. "Large Gas Engines" (39 pp.), and "Uniflow Steam Engines" (17 pp.), giving detailed descriptions and specifications.

MESSRS. DONOVAN & CO., 47, Cornwall Street, Birmingham.—An illustrated and priced sheet of electrical accessories, including tumbler switches, cut-outs, bells, accumulators, insulators, jointing materials, &c.

MESSRS. W. CANNING & CO., 133-137, Great Hampton Street, Birmingham.—A booklet entitled "Linking the Past with To-day, 1785-1920." (32 pp.).—This gives a brief history of the firm, and is copiously illustrated by photographs of persons and premises.

Mr. D. C. BATE, 16, John Dalton Street, Manchester.—A four-page list setting forth the advantages of the "Bipol" accumulator, giving prices and details of working costs compared with dry batteries.

MESSRS. DRAKE & GORHAM WHOLESALE, LTD., 67, Long Acre, W.C. 2.—Pamphlet No. 288 describing and illustrating the "Silent Alamo" 1-KW. house lighting plant.

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Liquidations and Dissolutions.—SIGNAL ELECTRIC CO., LTD.—Winding up voluntarily. Liquidator, Mr. G. L. Winn, c/o Bristowe & Co., Ltd., 11, Tothill Street, S.W. A meeting of creditors was held at Cannon Street Hotel on May 26th.

The following is a list of the principal creditors :—

Fisher & Ludlow, Ltd.	£603	H. K. Brownrigg, secretary (salary)	£46
W. & J. Dangerfield (judgment, including costs)	896	D. Gilson & Co.	39
Abbey Industries, Ltd. (contract amount)	218	W. E. Baker	94
Jas. Cartland & Sons, Ltd. ..	169	Leopold Norman (commission)	22
Ephraim Phillips	169	H. Drewitt, a director (expenses, &c.)	21
Drycells, Ltd. (judgment including costs)	114	S. A. Bailey, solicitor (costs, approx.)	20
R. E. H. Lovelace (including salary)	113	C. D. Flint..	18
Walthamstow Urban District Council (rates)	99	Lea Bridge Gas Co. (deposit, £5, held)..	14
Concordia Electric Wire Co. (judgment, including costs)..	82	C. St. John, a director (balance of account)	13
John Matthey & Co., Ltd. (contract amount)	80		£2,380
British Insulated and Helsby Cables, Ltd.	68	CONTINGENT LIABILITIES.	
		Pref. share interest, approx. ..	134
		Directors' fees, approx. ..	637
			£3,151

The loss for the period from May 31st, 1919, to May 5th, 1920, was £4,375.

GLOBE ELECTRIC CO., LTD.—In this liquidation Mr. W. Osborne is acting as liquidator in place of the late Mr. G. E. Corfield. We understand that a small dividend is available.

THACKER BELL & Co.—Particulars of claims must be sent by June 30th to Messrs. Woodcock, Rylands & Parker, 15, Bloomsbury Square, W.C., solicitors to the liquidators.

THE BRITISH ELECTRICAL ACCESSORIES, LTD., Fawcett Row, Bradford.—In pursuance of Sec. 188 of the Companies (Consolidation) Act, a meeting of the creditors of the above was held on May 21st, at the offices of Mr. F. W. Rhodes, solicitor, Cheapside, Bradford. A statement of affairs was presented by Mr. W. A. Judge, I.A., the liquidator of the company, which showed liabilities of £9,122. The assets were estimated to realise £2,281, from which had to be deducted £192 for preferential claims, leaving net assets of £2,089, or a deficiency as regarded the unsecured creditors of £7,034. The issued share capital of the company was £965, and as regarded the contributories there was a deficiency of £7,999. The liquidator stated that the company went into voluntary liquidation on May 5th of the present year, as it was unable to meet its liabilities. The following day the Sheriff attempted to enter into possession, but the liquidator's title held good, and the Sheriff retired. With regard to the unsecured liabilities, it appeared that about £4,000 was in respect of moneys advanced. During the year to April 30th, 1918, the trading resulted in a profit of rather more than £1,300, and at that date the assets were valued at £7,400. During the following 12 months there was a loss on the trading of between £400 and £500. Further accounts had been prepared covering a period of 23 months to March 31st, 1920. It was estimated that the stock at the commencement of the period was £3,981, while at the close it amounted to £1,330. The trading appeared to have resulted in the 23 months in a net loss of rather more than £5,600, while in the period the purchases aggregated £16,615, against sales of £17,425. The company was formed in May, 1914, with a nominal capital of £1,000 in £1 shares, but in view of last year the capital was increased to £15,000. The position disclosed was discussed at some length by the creditors, and eventually it was resolved to confirm the voluntary liquidation of the company, with Mr. Judge as liquidator, and a Committee of Inspection was appointed, consisting of the representatives of Messrs. Driver, Drennan & Cooper, Ltd., W. Sanders & Co., W. D. Wilson, J. H. Rushworth, and Parkin S. Booth.

COALITE, LTD., and BRITISH COALITE CO., LTD.—Meetings are called for June 30th, at 62, London Wall, E.C., to hear an account of the winding-up by the liquidators, Messrs. H. Bacon and J. H. Macaulay.

ENDALL & SOTHERAN, electrical, mechanical, and automobile engineers, Canal Motor Works, Canal Bridge, Church Street, St. Helens.—Mr. G. W. Endall and Mr. A. W. Sotheran have dissolved partnership. Debts will be attended to by Mr. G. W. Endall, who will continue the business at the same address, under the style of Endall & Co.

A Glasgow Exhibition.—We have received an advance prospectus of the Shipbuilding, Engineering, and Electrical Exhibition which is to be held in the Kelvin Hall, Glasgow, from November 8th to December 4th, 1920. The Exhibition is being promoted by the Corporation of Glasgow with Mr. J. M. Freer, as general manager, and applications for space are now being received. The Engineering Section will include prime movers, traction, mechanical devices, and models. The Electrical Section will cover instruments, magnetos, dynamos, and wireless apparatus. Other sections will be :—Shipbuilding, motor boats, motor cycles, and miscellaneous (including all articles applying to the foregoing trades). The prospectus contains rules and regulations, particulars of space, charges, specimens of stands, and information relating to the Kelvin Hall.

A South African Steel Corporation.—It is announced that the South African Iron and Steel Corporation, Ltd., has been registered at Cape Town, with a capital of £1,500,000.—*Times.*

Bankruptcy Proceedings.—F. MITCHELL (F. Mitchell and Co.), electrical engineer, Manchester.—Discharge suspended for two years until April 27th, 1922.

E. CLONEY, tramways divisional traffic superintendent, 5, Albans Road, N.W. 5.—Second dividend of 5s. in the £, payable at Carey Street, W.C.

Auction Sale.—MESSRS. P. HUDDLESTON & Co. will sell by auction, on June 7th, at Dalling Road, Hammersmith, a quantity of electrical apparatus, including dynamos, motors, generators, &c. For full particulars, see our advertisement pages to-day.

Catalogues Wanted.—MR. E. AMES, consulting electrical engineer, 12, Whitehall Crescent, Dundee, having closed his office at the beginning of 1915 to join the B.E.F., has re-opened to continue his practice. He will be glad to receive catalogues, price lists, and any particulars from electrical manufacturers, gas and steam engineering firms.

Trade Announcements.—MR. F. LAW, electrical engineer, contractor and automobile electrician, of Grove Gardens, Headingley, Leeds, has opened premises at Tower Buildings, Ilkley, and invites manufacturers to send catalogues, lists, &c.

BUCK & HICKMAN, LTD., announce that their Birmingham warehouse and offices have been removed from 55, Station Street, to 23, Newton Street, Corporation Street, Birmingham.

THE JACKSON ELECTRIC STOVE CO., LTD., have removed their showroom and offices from Blandford Street to 143, Sloane Street, London, S.W., and all communications should be sent there.

As from May 31st the telephone number of the West End depôt (Arthur Street, New Oxford Street, W.C. 2) of POPE'S ELECTRIC LAMP CO., LTD., is changed from "Gerrard 3000" to "Gerrard 6074" (two lines). Larger stocks will be held there.

Gas Regulation Bill.—The text of the Bill recently introduced into Parliament by the President of the Board of Trade has now been published. This Bill seeks to fix the quality and price of gas, to institute penalties for deficient values, and to set up the means of making periodical tests. One of the alterations suggested in the present practice of gas undertakings is a system of charging according to the heat value of the gas supplied.

Plant for Sale.—City of Gloucester Electricity Department has for disposal one 150-KW. Belliss-Silvertown generating set, two Blake-Knowles and one Summers 10,000 lb. Scott steam-driven jet condensers. See our advertisement pages to-day.

Liverpool Corporation Electricity Supply Department has for disposal two 2,000-KW. Westinghouse-Parsons turbo-alternators with condensers, air and circulating pumps, &c. See our advertisement pages to-day.

Fire.—Early on Whit Monday morning fire broke out in the power house of Messrs. Brown's engineering works in Chapman Street, Byker, Newcastle-on-Tyne, and considerable damage was done to the installation.

Trade Openings in Italy.—The British Chamber of Commerce for Italy (Inc.), whose headquarters are at Genoa, have issued a lengthy list of openings for British firms to do business with Italian purchasers and agents.

Strike at Liverpool.—Cable jointers employed by the Liverpool Corporation are on strike for the same conditions as obtain in the building section of their Union. About 100 men are affected.

Dispute in Wimbledon Electricity Department.—According to statements issued by the E.P.E.A., a recommendation that the award of the National Joint Board for the Electricity Supply Industry of an increase of salary to station engineers of £30 per annum from January 1st, 1920, was submitted by the Electric Lighting Committee to the Wimbledon Town Council ; the matter was referred to the Staffing Committee, and on the advice of the latter, the Council rejected the recommendation. The technical staff members have, therefore, given notice that they will cease work on Monday, May 31st, unless the Corporation adopts the recommendation of the Electric Lighting Committee, and the executive council of the E.P.E.A. is prepared to support the local members.

Copper and Lead Prices.—Messrs. F. Smith & Co. report May 25th :—Electrolytic copper bars, £109, £5 decrease ; electrolytic wire rods, £124, £5 decrease ; electrolytic H.C. wire, 1s. 4d., ¼d. decrease ; silicium bronze wire, 1s. 11¾d., ¼d. increase.

Messrs. James & Shakespeare report May 26th :—Copper bars (best selected) sheets and rods, no change. English pig-lead £41 10s., an increase of from 10s. to 30s. on the week.

Juvenile Employment.—The fourteenth annual report of the Skilled Employment and Apprenticeship Association has recently been published. Fifteen Committees were affiliated during the period covered by the report, but seven of these have announced their inability to carry on owing principally to the lack of funds and voluntary workers. The Association has been approached with a view to its taking over the management of the East London Apprenticing Fund, established some years ago by the late Lord Swaythling to provide loans for non-Jewish boys residing in the Tower Hamlets entering trades. The Association has expressed its willingness to take over this fund. The office of hon. treasurer has been taken over by Mr. Alfred P. Griffiths. The expenditure for the year exceeded the income by £65, but an appeal for funds is being made, and it is hoped to secure a number of regular subscribers. The Association was successful in finding places for 40 per cent. of the boys who applied and 47 per cent. of the girls, the same proportion as in 1918.

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Turkey.—The report of the Société des Tramways et Electricité de Constantinople for the year ending June 30th, 1919, which has only just been issued, states that the year 1918 proved an exceedingly difficult one for the company owing to the scarcity of coal, and the need for tramway material, the service having for these reasons to be suspended for a certain period of time. Thanks to the influence of the Allied missions the tram fares have been greatly increased, which has considerably improved the running conditions. The demand for current is steadily increasing, but the company is not yet in a position to satisfy all the demands owing to it not being possible to promptly secure the necessary material.

New French Company.—La Société des Electrodes de la Seine is the name of a new company which has lately been formed at Paris (2 Rue Blanche), with a capital of 2,000,000 fr., to manufacture electrodes of all kinds.

Italian Company Note.—The shares in the Società Bolognese di Elettricita, of Bologna, which have hitherto been mainly held in Belgium, have been acquired by an Italian syndicate, so that the concern shall become a purely Italian undertaking.

LIGHTING AND POWER NOTES.

Birmingham.—Proposed Extensions.—The Electricity Supply Committee recommends the City Council to approve of the extension of the Nechells station at an estimated cost of £1,757,700. In 1918 authority was given for the erection of the first portion of the station and works at an estimated cost of £1,626,140. The capacity of this new plant is 30,000 KW. It was anticipated that the new station would be in commission for the winter 1920-21, and the principal contracts were placed early last year; but owing to labour disputes which prevented deliveries of material, the station will not be ready for duty before the winter of 1921-22, except possibly to a partial extent. There is at present no reserve plant. The simultaneous maximum daily load on the works during the past winter was about 63,250 KW. In the opinion of the engineer, there should be in reserve not less than 12,000 KW. to allow for normal overhaul of machinery and breakdown of plant. There are at present applications aggregating 27,000 KW., awaiting acceptance, which total would have been bigger had the department been able to deal with new business. The Committee has been advised that the Nechells station should be increased in capacity from the 30,000 KW. now in hand, to 90,000 KW. by the addition of two 15,000-KW. sets. Provisional estimates have been prepared, as follows:—Station buildings, £269,200; engine house equipment, £380,000; boiler house, £603,500; cooling towers, £81,600; switchgear, station transformers and cables, £166,900; sub-station building and equipment, £74,100; 30,000-volt trunk mains, £36,000; and 5,000-volt and low-tension mains, £146,400.

Price Increase.—Owing to the advance in the price of coal, the Electric Supply Committee has revised its rates. Making due allowance for increased output, it finds it necessary to increase the price of low-tension supplies by approximately ½d. to ¼d. per unit, according to the class of supply.

Blackpool.—Year's Working.—During the year ended March 31st last, the Corporation electricity undertaking had a total income of £80,259. Working expenses, £54,913, and £20,077 for the interest and sinking fund, left a profit of £5,269, compared with a deficit last year of £2,727. The capital outlay on the undertaking stands at £273,057, loans and sinking fund, £46,045, loans redeemed, £128,595, net indebtedness, £98,417, reserve fund nil, working balance, £2,835.

Burnley.—Prospective Price Increase.—Owing to the increase in the price of coal, it is anticipated that the cost of electricity for lighting will be ½d. per unit more after the June reading of the meters. The charges for supplies for power and tramway purposes will also be increased.

Castleblaney (Co. Monaghan).—Public Lighting.—The Urban Council has granted permission to the local electric lighting company to erect poles, wires, &c., for the electric lighting of the town.

Clones.—Public Lighting.—The Electric Light Co. has written to the Urban Council denying statements alleging wastage of electricity in public lighting, stating that the lighting was carried out in accordance with the Council's instructions. The opinion was expressed that economy was needed.

Corby.—Public Lighting Scheme.—Subject to the observance of certain conditions, the Northants County Council has decided to offer no objection to a scheme for public lighting by electricity.

Dalkeith.—Unsatisfactory Plant.—A Committee of the Town Council has inspected the power station, and is of the opinion that the plant is in an unsatisfactory condition and requires immediate attention. Several breakdowns have occurred recently, causing a great deal of inconvenience.

Darlington.—Extensions.—Extensions to the electricity undertaking, involving an expenditure of £100,000, have been approved by the Electricity Committee, to meet next winter's prospective demands, and the Finance Committee has been asked to apply for sanction to borrow this sum. The scheme provides for four additional boilers and two 5,000-KW. sets; with one set boilers to be ordered immediately.

Dublin.—Dock Troubles.—Consequent upon the refusal of dockers to handle military stores, the electric cranes and the Port Board's power station were taken over by Royal Engineers. The dock electricians threatened to call out the Corporation electricians, as a protest against the action taken by the military authorities.

East Grinstead.—Power Station Building.—The Urban District Council has decided to purchase premises with a view to adapting them for the proposed electric light works.

Gillingham.—Wages.—Threatened with a strike, the Council has agreed to increase the wages of electrical operatives.

Hamilton.—Electricity Supply.—Subject to a satisfactory report from the consulting engineers, the Town Council has approved of an application by Edmundsons, Ltd., to expand £5,250 on the installation of a 500-KW. rotary converter, &c., and £400 for the laying of a new feeder to Clydesdale Street.

Hatfield.—Mains Extensions Approved.—The Commissioners have informed the District Council that they have informally approved the proposal of the North Metropolitan Electric Power Distribution Co. to lay mains between St. Albans and Hatfield.

Kingstown (Co. Dublin).—Electricity Supply.—The Urban Council has received a letter from the Law Agent stating that an electricity supply might be obtained from the Dublin Corporation or the Dublin United (Electric) Tramways Co. without the erection of a special power station.

Kingston-on-Thames.—Loans.—The Town Council has applied for loans of £6,000 for two new chain-grate stokers, superheaters, and a steel stack with induced-draught plant; and £9,200 for H.T. and L.T. mains and the cost of converting consumers' plant for a three-phase supply.

Lanark.—Electric Light Scheme.—The Town Council has decided that an expert shall be consulted respecting the suggested electric lighting scheme for the town.

Liverpool.—Special Rates.—The Corporation has approved an agreement for the supply of electrical energy for trade purposes to be charged at power rates.

Navan.—Electric Light Scheme.—Mr. L. J. Lawless, consulting electrical engineer, reporting to the Council on a scheme for electric lighting of the town, estimates the cost at £10,750, plus £1,713 working expenses, and revenue at £2,350. The charge to private consumers to be 1s. per unit. The Council has resolved to ask another expert to furnish a separate report.

Perth.—Extensions.—The Town Council is communicating with the Electricity Commissioners with regard to an extension of plant at the power station and the construction of a railway siding.

Price and Supply of Electricity.—In the House of Commons, Mr. W. H. Sugden asked the Minister of Transport if he would say when he hoped to have a definite economical price fixed and increased electrical power at the disposal of industrial undertakings, bearing in mind the fact that the first portion of the cycle of trade activity had now been entered upon, and could assurances be given that some definite portion of the scheme would be operative before the trade activity passed. Mr. Neal (Parliamentary Secretary to the Ministry of Transport) said there would be a fixed economical price, which would be of general application. The fixing of the price or prices would depend on the operations of the new authorities to be set up under the Electricity (Supply) Act of last session. The Electricity Commissioners were engaged on work preliminary to the determination of the new districts, in accordance with the provisions of the Act. It would then be for existing electrical undertakings, local authorities, and others in each district to formulate schemes for submission to the Commissioners embodying improvements in the supply of electricity in such districts. The Commissioners were fully aware of thelimportance of expediting the work of reorganisation under the Act, and had already made substantial progress.—*Manchester Guardian.*

South Shields.—Training Electricians.—A scheme formulated by the Electricity Committee to train boys in the municipal station as electricians was adopted by the Town Council. Trainees will receive no payment for the first six months, but after that time a scale rising from 10s. to £2 per week will be put into force. A proposal for training ex-officers in this work was referred back to the Committee for further report.

Warrington.—Extensions.—Official sanction has been received to the expenditure of £183,000 on extensions to the electricity works.

Wrexham.—Extensions.—Application has been made by the Town Council for sanction to borrow £17.000 for the extension of the electricity undertaking. It is intended to provide a new boiler, complete with stoker, coal bunkers, foundations, pumps, &c., at a cost of £11,350; economisers, flues, &c., £2,230; buildings, £2,000; and water-softener, £1,260.

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Wigton.—Electricity Supply.—The Urban District Council has asked the Carlisle Town Council the price at which electricity can be supplied to the district.

York.—Time Extension.—The Minister of Transport has extended the time of the York Electric Lighting (Extension) Order, 1914, until April 30th, 1921, for the extension of mains, &c.

TRAMWAY AND RAILWAY NOTES.

Australia.—Wage Demand.—Railway and tramway men in Victoria and New South Wales are demanding double wages during the visit of the Prince of Wales.—*The Times.*

Blackpool.—Year's Working.—The Corporation tramways made a profit during the financialyear ended March 31st last, of £15,583, compared with £30,052 the preceding year. The receipts were £186,475, as against £140,929, but the working expenses totalled £147,770, compared with £90,033 for the previous period.

Bradford.—Proposed Fare Increase.—At a special meeting of the Tramways Committee last week, Mr. R. H. Wilkinson, the manager of the department, presented a report concerning the proposal to increase the fares. Additional information is, however, required as to whether a scheme of short stages for a penny and at the same time increasing the 1½d. fare to 2d. is not practicable, and the question is to be further discussed.

Brazil.—Railway Electrification.—The contract for the electrification of the Paulista Railway Co.'s line between Jundiaby and Campinas, has been secured by the International General Electric Co. The total cost is estimated at $2,000,000, the line being 28 miles in length, double track. The rolling stock is to consist of 12 geared type 3,000-volt D.C. locomotives, four passenger and eight freight engines. The power will be supplied by the Sao Paulo Light and Power Co. at 88,000 volts, 60 cycles. Extension of electrification as far as San Carlos is contemplated, which will make a total length of 128 miles.

Continental.—Italy.—It has been decided to extend the electrification of certain lines in the north-west, especially in Liguria, Piedmont, and Lombardy. The three-phase system is used on the lines already electrified in this region. The following are the sections which the Railway Administration has been authorised to electrify:—Turin-Alexandria-Rouco, 137 km.; Voghera-Novi, 35 km.; Alexandria-Tortona, 22 km.; Asti-Ovada-Sampierdurena, 101 km.; Trofarello-Fossano-Mondovi-Ceva, 80 km.; Bussoleno-Turin, 45 km.; total, 420 km. A sum of 280 million lire has been earmarked for the work, which will be crrried out by the State Railway Department. A further 209 km., comprising Turin-Milan and Milan-Voghera will be electrified. This part of the work is being put to tender by private industry. The cost will be some 60 million lire.—*L'Industria.*

Doncaster.—Inadequate Service.—Some very caustic comments were made at the last meeting of the Bentley District Council anent the dilatory manner in which the village was being served with tramways. The track is partly up, owing to repairs, and only one car has been running for the past three weeks. The Council decided to lodge a complaint with the Ministry of Transport.

Liverpool Electric Signalling.—On the Mersey Electric Railway it is intended to introduce new automatic signalling, so as to concentrate a larger volume of traffic in the busy hours of the day. The system will be similar to that in use on the underground railways in London. The contract for the work has been placed, and it is expected that the new installation, which will be of the most modern type, will be completed by October next in time for the heavy winter traffic, which usually commences about that time. The power for operating the apparatus will be supplied by special sets installed at the power stations, and will be independent of the main supply for operating the trains.

Huddersfield.—Coal Haulage.—It was reported at a recent Council meeting that £1,687 had been received for the haulage of coal along the tramlines to mills at Lindley and Outlane. The loss of revenue in consequence of the recent strike of tramway employés was £7,536.

India.—Tramway Reconstruction.—The Bombay Electric Supply and Tramways Co. has approved a scheme for the reconstruction of the company, and it has been resolved to raise the capital from £1,430,000 to £1,680,000.—*Engineer.*

Johannesburg.—Overhanging Trees.—Unusual circumstances attended the payment by Johannesburg Town Council of £2,000 to a man who lost the sight of an eye owing to an accident while a passenger on a tramway car. The mishap was due to a tree brushing against the top deck and striking him as he sat in his seat. The Tramways Committee reported that it had been advised that the other eye was affected, and on an examination being made, its medical officer reported that the sight of the other eye was limited to five-ninths of the normal. The claim originally was for £4,500, but the passenger's solicitor offered to settle, without prejudice, for the sum already mentioned. That amount was voted "in full and final settlement of the claim." The case is not without interest for other tramway and also omnibus undertakings. It is the duty of owners of trees to keep them from becoming a danger to traffic. In case of neglect the local authority can demand a removal of the obstruction, and, if necessary, carry out the operation. Such action has been taken in the metropolitan district and elsewhere at the request of the London General Omnibus Co. There have been occasions when in cases of delay the company's employés have been seen undertaking the task, the men working from the top of an omnibus. In the case of lamp-posts situated too near the edge of the kerb, disputes have arisen between a local authority and the company. While the former has attributed collisions to the overhanging of the top deck, the company has complained that the road has too pronounced a camber. This is a matter that ought to come under the cognisance of the Minister of Transport, at least on main thoroughfares.—*Tramway and Railway World.*

Leeds.—Reserve Fund.—The Tramways Committee recommends that in future any surplus receipts from that department shall be paid into the tramway reserve fund, authorised by the Act of 1905, and that the fund shall accumulate till £100,000 is reached. Previously the reserve fund was fixed at £25,000. In 1919 the department relieved the rates to the extent of £90,000. Last year's working showed a net surplus of £83,757.

Proposed Fare Increase.—The proposal to increase the tramway fares to 1d. a mile is to be again brought before the full Council for discussion, despite the fact that a similar proposal was negatived by the Council about six weeks ago. It is stated on the authority of the chairman of the Tramways Committee (Alderman R. A. Smithson) that the department is losing £300 a day on the present fares.

Llanelly.—Strike Ended.—The tramway workers have resumed work, after being on strike for three weeks.

London.—Higher Fares.—At a recent meeting of the L.C.C., the chairman of the Highways Committee foreshadowed further increases in fares in the near future. A proposal to reserve cars for women only was not considered desirable.

Oxford.—Strike.—The employés of the Oxford Electric Tramway Co. (which runs an omnibus service in the neighbourhood) came out on strike for higher wages on May 19th, and no vehicles were running. The city is very full of visitors, and the stoppage caused great inconvenience.—*The Times.*

TELEGRAPH AND TELEPHONE NOTES.

Argentina.—New Wireless Stations.—According to the *Review of the River Plate*, the wireless stations are inadequate for a general public service as they are practically constantly occupied in the transmission of official dispatches. They are, therefore, to be augmented, and the wireless telegraph division and the Ministry of Marine has formulated a plan which has been approved by the Government, and a naval officer is to come to England to make the necessary acquisitions. The project comprises the erection of three stations at the Patagonian ports of Gayman, Rawson, and Puerto Gallegos, in addition to one at Buenos Aires. These stations will be capable of transmitting over a distance of 2,000 km. under all conditions. It is intended later to supplement them with four other stations of 800-km. capacity situated at Corrientes, Puerto Militar, Comodoro Rivadavia, and Ushuaia.

Cable Repairs.—The work of repairing the Stornoway, Castlebay, and Skye cables is being carried out quickly. The services of the Lochboisdale and Tobermory wireless stations are no longer necessary, and the repairs to the Stornoway and Poolewe cables would have been completed had the weather remained favourable.

Canada.—Telegraph Rates.—According to the *Times*, a ruling of the Railway Commission permits the increase of rates on telegrams in Eastern Canada by 32 per cent., and in Western Canada by 20 per cent. This ruling does not, however, apply to Press messages.

United States.—Wireless Telephony.—The *Telephone Engineer* announces that tests in the U.S.A. have proved that it is possible to communicate by wireless telephony over a distance of 1,500 miles, using a generator having a capacity of only ½ KW. The De Forest Radio Co., of New York, enlisted the aid of members of the American Radio Relay League in its experiments. Tests, which commenced in February last, were carried out nightly with many members of the League listening in, and Mr. R. F. Gowan, engineer to the De Forest Co., at the New York end, and Mr. R. H. G. Matthews, vice-president of the League, at the receiving station at Chicago. Eventually communication was established between the two cities, a distance of 750 miles, with the power mentioned above. Later, letters were received from observers at Topeka, Kas., 1,500 miles away; Valley City, N.D.; Battle Creek, Mich.; and Gaffney, S.C., announcing that they also had heard the conversation.

The U.S.A. Department of the Interior has equipped its rangers in the forests of the West with small wireless telephone sets having a small range to facilitate communication.

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CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the Electrical Review *in which the "Official Notice" appeared.)*

OPEN.

Australia.—Melbourne.—May 31st. Victorian Railways Department. Four 4,500-kw., 1,500-volt traction converter sets, and eight 1,000-kw., 1,500-volt ditto. (April 30th.)

Sydney.—August 4th. N.S.W. Government Railways and Tramways. Two 1,000-kw. sub-station units. Chief Electrical Engineer, 61, Hunter Street, Sydney.

August 3rd. Department of Public Works. Turbines and generators for the Barren Jack hydro-electric development scheme. Department of Public Works, Sydney.

July 18th. City Council. Maximum demand indicators. Electric Lighting Department, Town Hall, Sydney.

Perth.—July 14th. P.M.G.'s Department. Telegraph and telephone instruments (various parts). Schedule 674.

June 16th. P.M.G.'s Department. Telegraph and telephone instruments (various parts). Schedule 680. (May 14th.)

Adelaide.—June 23rd. P.M.G.'s Department. Telephone parts (schedule 541). (May 21st.)

Barnes.—June 7th. Urban District Council Electricity Department. Coal-handling plant and overhead steel or ferro-concrete bunkers. (May 14th.)

Belgium.—June 2nd. La Société Nationale de Chemins de Fer Vicinaux, 48, Rue Montoyer, Brussels. Installation of the overhead electric equipment of the Namur La Citadelle line and branches. Particulars from the department of the Services Electriques at the above address.

July 9th. Brussels Municipal Authorities. A turbo-alternator at the generating station on the Quai des Usines, Laeken. Specification 2 francs and drawings 1½ francs, from the Hotel de Ville, 15, Rue des Augustins, Brussels.

Carlisle.—June 25th. Electricity Department. One 3,000-kw. turbo-alternator and condensing plant. (See this issue.)

Dublin.—June 7th. Electricity Supply Committee. 12 months' supply of single-phase and three-phase meters.

June 1st. Electricity Supply Committee. 22 direct-current magazine flame arc lamps. (May 21st.)

June 10th. Electricity Supply Committee. Feed pump, tanks, pipework, &c., for Pigeon House generating station. (See this issue.)

Dundalk.—June 15th. Urban District Council. Electricity Department. 750 yd., L.T., 3-core, paper-insulated, lead-covered and armoured cable; disconnecting boxes (pavement type) and joint boxes. (See this issue.)

Edinburgh.—June 19th. Electricity Supply Department. E.H.T. and L.T. switchgear, &c., for Portobello station. (May 21st.)

Grimsby.—June 7th. Electricity Department. E.H.T. cables and pilot cables (specification No. 146). (See this issue.)

Ince-in-Makerfield.—June 15th. Urban District Council. Waterworks Department. Motor-driven pumping sets; cables; alterations to winding engine from steam to electric drive; switchgear. (See this issue.)

Leeds.—June 14th. Electricity Department. 12,000-kw. steam turbine, alternator and condensing plant. (May 14th.)

London.—Hackney.—June 9th. Electricity Department. Four water-tube boilers, each 33,000 lb. per hour capacity, with superheaters, mechanical stokers, &c.; four induced-draught plants; four fuel economisers; one 10,000-kw. turbo-alternator and exciter, with ventilating fan and air filter or cooler; one surface condensing plant; two circulating water motor-driven pumps; E.H.T. switchgear; two 20,000-kw. coupler panels; one 10,000-kw. generator panel; six 2,000-kw. and one 4,000-kw. feeder panels. (May 7th.)

Bethnal Green.—June 7th. Electricity Supply Department. Two 500-k.v.a. transformers; one E.H.T. and one L.T. panel; L.T. feeder cables; section pillars and road work. (May 21st.)

St. Pancras.—June 10th. Electricity Department. 45,000 tons steam coal for the Regent's Park and King's Road electricity stations. Electricity Department, 57, Pratt Street, Camden Town, N.W.

Wimbledon.—June 12th. Electric Lighting Committee. Two boilers, with mechanical stokers, induced-draught fan and motor, pipework, steel chimney, &c. (See this issue.)

Manchester.—June 7th. Electricity Department. Main and auxiliary switchgear; Section A, 33,000-volt and 6,000-volt main switchgear; Section B, pressure-testing switchgear; Section C, 420-volt A.C. auxiliary switchgear; Section D, 240-volt D.C. auxiliary switchgear. (April 30th.)

Auckland.—September 1st. Harbour Board. For the supply of electric capstans and spares. Messrs. W. & A. McArthur, Ltd. 18-19, Silk Street, Cripplegate, London, E.C. 2.

Salford.—June 5th. Electricity Department. 12 months' supply of D.C. and A.C. meters. (May 21st.)

Southampton.—June 14th. Electricity Department. E.H.T. and H.T. switchgear and D.C. control panel. (See this issue.)

Spain.—June 2nd. Gijon-Musel Harbour authorities. Three 3-ton electric cranes. Tenders to the Junta de Obras del Puerto de Gijon-Musel.

Warrington.—June 15th. Electricity and Tramways Committee. Motors and transformers. (See this issue.)

CLOSED.

Government Contracts.—The following Government contracts were placed during April, 1920:—

Admiralty (Contract and Purchase Department).

Conduit tubing and accessories.—Barton & Sons, Ltd.; Oriental Tube Co., Ltd.
Electrical plant.—British Thomson-Houston Co., Ltd.
Electric lighting.—Foote & Milne, Ltd.
Reconstruction of motor-generators, &c.—British Electric Plant Co., Ltd.
Turbo-generator armature.—Metropolitan-Vickers Electrical Co., Ltd.

Ministry of Munitions.

Armoured cable.—Siemens Bros. & Co., Ltd.

India Office: Stores Department.

Accumulator battery.—Chloride Electrical Storage Co., Ltd.
Cells.—Siemens Bros. & Co., Ltd.
Creed printers.—Creed & Co., Ltd.
Insulator cups.—Bullers, Ltd.
Generating sets.—Lancashire Dynamo & Motor Co.
Insulators.—Bullers, Ltd.
X-ray plates.—Kodak, Ltd.
Insulator stalks.—Bullers, Ltd.
Switchboard.—Bertram Thomas, Ltd.
Desk telephone sets.—Peel-Conner Telephone Works, Ltd.
Coolidge tubes.—British Thomson-Houston Co., Ltd.

Post Office.

Laying conduits.—London-York (Sections 1 and 2): W. Dobson; Nottingham-Derby (Sections 2 and 3): W. Dobson; Glasgow (South): A. Duncan; Newcastle-on-Tyne (Sections 1, 2, 4 and 6): W. Turner (Ardwick), Ltd.; Leeds-Harrogate, Leeds-York (Section 1): W. Ellis. London-Bristol-Newport (South Midland, Section 2): J. F. Hodge & Co.; Nottingham-Derby (Section 1): Kettle & Son; London-Southampton (Section 2): Hodge Bros. (Contractors), Ltd.; Lee (High Road): J. Mowlem & Co., Ltd.; Toll Exchange area: J. Mowlem & Co., Ltd.; Penge-Anerley: W. H. Wheeler & Co., Ltd.; Brompton Road, S.W.: O. C. Summers; Nottingham-Derby (Section 4): Chandler Bros.
Manufacture, supply, drawing-in and jointing cable.—London-Southampton (London-Guildford section): Callender's Cable & Construction Co., Ltd.
Repairing battery, East London Telephone Exchange: Hart Accumulator Co., Ltd.
Runaway, ash hoist, overhead travelling crane and geared trolley.—Mount Pleasant E.C. Boiler House and Sub-station: H. Morris, Ltd.
Telephone exchange equipment.—Port Talbot, New Cross, Bradford (central), Crosby, Trafford Park: Western Electric Co., Ltd.; Northwich: Automatic Telephone Manufacturing Co., Ltd.
Sub-contractors for batteries.—Chloride Electrical Storage Co., Ltd.
Starting switch and field rheostat.—Crompton & Co.
Switches, D.P., and measuring instruments.—Park Royal Engineering Co., Ltd.
Fuse switch.—Berry's Electric Co.
Charging rheostat.—Geipel & Co.
Circuit-breaker.—Whipp & Bourne.
Scarborough Telephone Exchange equipment.—Siemens Bros. & Co., Ltd.
Sub-contractors for accumulators.—Tudor Accumulator Co., Ltd.
Charging machine.—English Electric Co., Ltd.
Ringing machine.—Crompton & Co., Ltd.
Knife and meter switches, starting switches, field regulator (switchgear on power board).—English Electric Co., Ltd.
Indicating meters.—Everett, Edgcumbe & Co., Ltd.
Circuit-breaker for generator.—I.T.E. Electric Co.
Fuse switch (switchgear on power board).—Berry's Electric Co.
Protective apparatus.—Siemens Bros. & Co., Ltd.; International Electric Co., Ltd.
Telegraph apparatus.—W. Sanders & Co.
Telephone apparatus.—British L.M. Ericsson Manufacturing Co., Ltd.; International Electric Co., Ltd.; Peel-Conner Telephone Works, Ltd.; Phœnix Telephone and Electric Works, Ltd.; Siemens Bros. & Co., Ltd.
Terminal blocks.—Edison Swan Electric Co., Ltd.
Bolts for insulator spindles.—Horton & Son; Portland Bolt and Nut Co., Ltd.
Iron brackets.—D. Willetts, Ltd.
Telegraph and telephone cable.—British I. & H. Cables, Ltd.; Enfield Ediswan Cable Works, Ltd.; Fuller's United Electric Works, Ltd.; Hackbridge Cable Co., Ltd.; Henley's Telegraph Works Co., Ltd.; Johnson & Phillips, Ltd.; Union Cable Co., Ltd.
Artificial cables.—H. W. Sullivan.
Dry cells.—Siemens Bros. & Co., Ltd.
Leclanche cells.—Siemens Bros. & Co., Ltd.
Secondary cells.—Van Raden & Co., Ltd.
Joint box channels.—Bailey Pegg & Co., Ltd.; Falkirk Iron Co., Ltd.; McDowall, Steven & Co., Ltd.
Stoneware ducts.—Donington Sanitary Pipe and Firebrick Co., Ltd.; G. Jennings; Robinson & Dowler, Ltd.; Stanley Bros., Ltd.; J. H. Turner & Lesney, Ltd.
Stoneware Leclanche jars.—J. Bourne & Sons, Ltd.
Glow lamps.—British Thomson-Houston Co., Ltd.; Edison Swan Electric Co., Ltd.; General Electric Co., Ltd.; Siemens Bros. Dynamo Works, Ltd.
Earth plates.—Walls, Ltd.
Insulator spindles.—T. W. Leach, Ltd.; Bayliss, Jones & Bayliss, Ltd.
Swivel stays.—Bullers, Ltd.
Voltoids.—Brunner, Mond & Co., Ltd.
Bronze wire.—T. Bolton & Sons, Ltd.
Enamelled, &c., copper wire.—London Electric Wire Co. & Smiths, Ltd.
H.D. copper wire.—T. Bolton & Sons, Ltd.; British I. & H. Cables, Ltd.; Elliott's Metal Works, Ltd.; R. Johnson & Nephew, Ltd.; Shropshire Iron Co., Ltd.; F. Smith & Co. (incorporated in the London Electric Wire Co. & Smiths, Ltd.); J. Wilkes, Son & Mapplebeck, Ltd.
Tinned copper wire.—T. Bolton & Sons, Ltd.
Switchboard wire.—Macintosh Cable Co., Ltd.

H.M. Office of Works.

Engineering work, &c.—Birmingham Hostels electric storage battery: Premier Accumulator Co., Ltd.; Hampstead Research Institute switchboard: Drake & Gorham, Ltd.

Crown Agents for the Colonies.

Aerial cable.—Callender's Cable & Construction Co., Ltd.
Copper cable conductors.—Siemens Bros. & Co., Ltd.
Electrical fittings.—General Electric Co., Ltd.
Telegraph ironwork and line material.—Siemens Bros. & Co., Ltd.

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Shrewsbury.—
Two new economisers for the generating station, £1,155.—Messrs. Lowcock.

Southend-on-Sea.—Town Council :—
24 40-H.P. traction motors, £6,720; and 12 electric brakes and equipment, £1,800.—English Electric Co., Ltd.

FORTHCOMING EVENTS.

Junior Institution of Engineers.—Friday, May 28th. At 39, Victoria Street, S.W. At 7.30 p.m. Lecturette on "Two Years as an Engineer in the Grand Fleet," by Mr. A. Arnold.

(South-Western Local Section).—Friday, May 28th. At the Public Library, Plymouth. At 7.30 p.m. Inaugural meeting.

Royal Society of Arts.—Friday, May 28th. At John Street, Adelphi, W.C. At 4.30 p.m. Paper on "Lignite," by Prof. W. A. Bone, F.R.S.

Friday, June 4th. At John Street, Adelphi, W.C. At 4.30 p.m. Paper on "The Oil Resources of the British Empire," by Prof. Sir J. Cadman.

Electrical Power Engineers' Association (Southern Division, London Industrial Section).—Friday, May 28th. At Anderton's Hotel, Fleet Street. At 7.30 p.m. Open meeting.

Physical Society of London.—Friday, May 28th. At the Imperial College of Science, South Kensington. At 5 p.m. Discussion on "X-Ray Spectra," to be opened by the President, Sir W. H. Bragg, F.R.S.

Royal Institution of Great Britain.—Saturday, May 29th. At Albemarle Street, W. At 3 p.m. Tyndall lecture on "Recent Revolutions in Physical Science: (1) the Theory of Relativity," by Prof. J. H. Jeans, F.R.S.

North of England Institute of Mining and Mechanical Engineers.—Saturday, May 29th. At the Wood Memorial Hall, Newcastle-on-Tyne. At 2 p.m. General meeting.

Chief Technical Assistants' Association.—Thursday, June 3rd. At Anderton's Hotel, Fleet Street, E.C. At 7 p.m. Paper on "Maintenance of Tramway Equipment," by Messrs. Manley & Stanley.

NOTES.

Parliamentary.—On May 17th the Tramways (Temporary Increase of Charges) Bill was read a third time and was passed.

Electric Vehicle Charging Garages.—We are informed by the chairman and hon. secretary of the Electric Vehicle Committee, Mr. Frank Ayton, that the Electricity Commissioners are prepared to consider applications from local authorities, being authorised undertakers, for sanction to loans for the purpose of providing public electric vehicle-charging garages and the equipment thereof. Provisional sanction has already been given to the borrowing by the Ipswich Corporation of the sum of £4,000 for this purpose.

Brevities.—Work varies inversely as the square of the talk.

The torque of a rotor gets things done; the rot of some talkers doesn't.

If you want to lose your good name, have it stamped on your two-foot rule.

He that will not be ruled by the rudder will be wrecked by the rocks.

There are no half measures about automatic plants; they are either automatic or autoblazes.

Increase of resistance means decrease of current. Some fellows go through life as if this were the last word. What's the matter with increasing the pressure and getting a move on?—"BEOLA," in the *Journal*, N.A.S.E.

The Nobel Prizes.—The distribution of the 1918 and 1919 Nobel prizes will take place in Stockholm on June 1st. Among those who will be present are Prof. Sir W. H. Bragg and his son, Prof. W. J. Bragg, and Prof. Charles G. Barkla, of Edinburgh.

Inquiry.—Makers of the "Hough" watertight ship fitting are asked for.

The Electricity Supply Amending Bill.—According to *The Times* the Electrical and Allied Trades' Section of the London Chamber of Commerce has passed a resolution expressing alarm and regret at the introduction of the Bill for the purpose of reviving the "objectionable clauses" which were dropped from the Electricity (Supply) Act of 1919, largely at the instance of associations (including that chamber) representative of consumers and producers alike.

The Metric System in U.S.A.—In the May issue of the *Journal* of the American Society of Mechanical Engineers, a resolution of the Council is recorded, stating, in view of the publication of articles to the effect that the Society is opposed to the metric system, that the Society has not taken any stand either for or against the metric system. This declaration is important, seeing that the Society has repeatedly been represented as the leading opponent to the adoption of the metric system in the United States.

Oil-Electric Locomotives.—According to *The Times*, oil-electric locomotives have been tried on the French Nord Railway with great success, and it is now proposed to make a more general use of such engines owing to their practicability in case of strikes.

Educational.—Prince Arthur of Connaught has received two important donations to the University College Engineering Fund from America, namely, £500 from Mr. J. Pierpont Morgan, and £500 from Mr. E. R. Stettinius. Other donations received recently include Igranic Electric Co., Ltd, £50; and a promise of apparatus to the value of £50 from Messrs. Nalder Bros. & Thompson, Ltd. The total of the fund up to date amounts to £32,375.

At a recent conference of technical teachers, it was resolved to press for the formation of a Burnham Committee to deal with salaries of teachers in technical institutions. An immediate increase is being asked for, to bring salaries up to the level which would have been reached if the Civil Service bonuses had been awarded.

Legal.—CORK.—At the Fermoy (Co. Cork) Quarter Sessions on June 7th, the Recorder of Cork will have before him for hearing the claim of the Postmaster-General for £230 compensation for the cutting of many telegraph and telephone wires in several parts of East Cork on Saturday night, May 8th.

Judgment was given by Sheriff Substitute Macleod at the Sheriff Court, Edinburgh, in the case in which James Cameron, electrician, 37, Saughton Hall Drive, Edinburgh, was charged with having, between February 11th and 23rd last, resetted in his premises at Haymarket Terrace, three electric motor engines. Evidence had been heard last week. His Lordship, in finding the charge proved, said that accused had yielded to temptation under very special circumstances. It was thus an exceptional case, and therefore he dealt with it by imposing a fine instead of a term of imprisonment. But the fine must be a substantial one of £25.

Turbine Steam Consumption.—In discussing Mr. W. T. Lane's recent paper on "Fuel Economy in Power Production [or Utilisation of Waste Heat]" before the South Wales Institute of Engineers, Prof. F. Bacon said that the figures which the author gave of a turbine of 5,000 KW. capacity, with a guaranteed steam consumption of 10·2 lb. per KW.-hour, were very interesting, and persumably they were based on a turbine which was on order for the Powell Duffryn Co. This showed that South Wales was to possess about the most economical steam turbine yet produced. Particulars had been recently published of the super-power station at Rotherham, and they learned of a Parsons turbine there of more than double the size of that mentioned by Mr. Lane, namely, of 12 500-KW. capacity, with a guaranteed steam consumption of 11·5 lb. per KW.-hour. Then there was a 30,000-KW. turbo-generator being erected at the same station, with a guaranteed steam consumption of 11·1 lb. per KW.-hour. Thus, in South Wales they had a turbine only one-sixth the size with a consumption of 1 lb. less of steam per KW.-hour. No doubt the explanation was that in this case they were making use of exceptional steam pressures and exceptional super-heat—he imagined not less than 350 lb. per sq. in., and temperatures running up to 750° F., which must be getting near the limit of what could be attained with steel castings and steam valves such as were now available.

The Electrical Trades Benevolent Institution.—The report of the committee and accounts for the year 1919 have come to hand; the volume includes the report of the annual general meeting, 1919, and the festival held on November 12th, 1919, as well as a list of governors, members, subscribers and donors, and the rules. The report and accounts for the year were presented at the annual general meeting, of which we gave a report on p. 532 of our issue of April 30th, 1920. A special meeting will be held on June 7th at 2.30 p.m., at the secretary's office, 36-38, Kingsway, to confirm a resolution altering Rule 17 which was passed at the annual meeting.

Appointments Vacant.—Technical assistant (£804) for the London County Council Fire Brigade Department; meter repairer (mechanician) (45s. + 33s. 6d. + 12½ per cent.) for the Borough of Lancaster Electricity Department; lecturer in electrotechnics (£390—£465) for the Salt River Technical Institute, Cape Town; temporary technical assistant for the Chesterfield Corporation Electricity and Tramways Department; charge engineer (£3 + E.P.E.A. award) for the Southwark Borough Council Electricity Department; power-station engineer (£300 + £120 + 20 per cent.) for the Woolwich Borough Council Electricity Department; plumber-jointer (91s.) for the Rhyl U.D.C. Electricity Department. See our advertising pages to-day.

A general manager and engineer is required for the Tees-side Railless Traction Board at Middlesbrough (£500).

New Method of Erecting Poles.—An interesting method of erecting poles by means of a combination tractor and earth-boring machine, which digs a hole and sets the pole in about eight minutes, is mentioned in the *Telephone Engineer*. The earth-boring machine is mounted on the frame of the tractor, which carries it over any obstacles that may be encountered in an ordinary day's travel. The poles, cross arms and insulators, &c., are all assembled beforehand, and when the spot at which the pole to be erected is reached, the power from the Monarch tractor engine is switched to the earth-boring machine. This, in reality, is a giant auger which will bore a hole in the ground any size from 2 to 30 in. in diameter, and as deep as 8 ft. When the hole is bored, the steel tower in which the auger is contained is used as a crane to lift the pole and set it in position. The whole operation is remarkably expeditious, and when once it is seen at work, the manual process ordinarily used seems incredibly slow and awkward.

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The Educational Kinema.—The Dean of Worcester, speaking at a lecture, said that he considered the kinema of the greatest educational value, and he was in negotiation with the lessee of a leading kinema in Worcester to take it over for a week, when he intended to have children's days, and exhibitions which would elevate and educate adults.

Municipalisation.—Although the methods of municipalities on this side of the Atlantic are often severely criticised, it is, perhaps, comforting to reflect that public opinion on this subject

THE INFLUENCE OF THE ART OF MILLET ON THE MODERN MUNICIPAL STREET GANG.

in the United States of America, justly or otherwise, is much stronger, as the picture reproduced above will testify. This is taken from the National Electric Light Association *Bulletin*, which reproduced it from the well-known *New York Tribune*.

Alumina as a Refractory.—In *Technique Moderne* (Vol. 12, No. 3) a note on the use of products of aluminium as refractory materials is printed. While these products are not suitable for large furnaces, they serve admirably for laboratory furnaces, provided that they are prepared by the process indicated in the note, for temperatures up to 1,600° C.

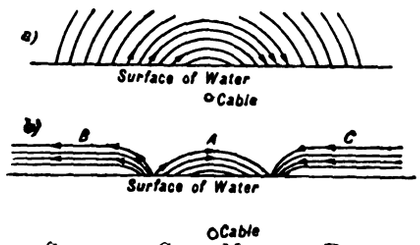
The New Motor Taxes.—The petrol world is greatly exercised over the change from a petrol tax to a vehicle tax based on horse-power or weight. The special committee appointed by the Minister of Transport to report on the matter decided to bring in all power-propelled vehicles, on a basis which would afford an approximation to the distinctive use of the road. Motor cycles are to be assessed according to category, private motor cars on horse-power, hackney vehicles on seating capacity, and commercial and agricultural vehicles on unladen weight. The new scale will not come into force until January 1st, 1921. Some editorial reflections on the matter in the current issue of the *Electric Vehicle* will not be out of place; they are:—

"So far as electric vehicles are concerned, there is little ground for complaint. The committee has, we imagine, not overlooked the fact that battery-propelled vehicles, thanks to their easy running and smooth speed control, are much less severe on road surfaces than other vehicles equivalent in weight and average speed. On this and other grounds the weight of the accumulators is to be excluded from the vehicles in ascertaining the unladen weight of commercial vehicles.

"The minimum tax for private cars is £6, and electrically-propelled cars of this class pay only this amount. Electrically or mechanically-propelled bath-chairs or other vehicles for invalids, not exceeding 5 cwt. in weight inclusive, pay five shillings. In this case the batteries are included. For commercial goods vehicles the rate proposed is from £10 for vehicles not exceeding 12 cwt. unladen weight up to £30 for vehicles over 4 tons unladen weight. Hackney vehicles (other than tramcars, which are to be chargeable as hackney carriages as at present) are to pay according to seating capacity from £15 for a vehicle with a seating capacity from one to five passengers to £84 for a vehicle with a seating capacity of over 32.

"On motor scooters and other motor assisted cycles and motor cycles, up to and including 200 lb. in weight, the tax is thirty shillings, and above that limit it is £3, with an extra £1 on all motor cycles with the right to draw a trailer or side car. These taxes seem rather heavy. A tax of 30s. on a scooter propelled by batteries is manifestly onerous, and a similar observation may be made in the case of a light car propelled electrically. If it is a three-wheeler, it will pay £4; if it is a four-wheeler, it will pay £6, no matter how trifling its efficiency as a destroyer of roads. The application of battery traction to scooters and other small vehicles is as yet in an experimental condition, but when development does occur there ought to be some concession to the electric method, on account of its reduced wear and tear on the roads. The low rating of motor bath-chairs and other vehicles for invalids is welcome, but it rather throws into relief the fact that an electric chair, similar to those used at American exhibitions, would be taxed at the rate of £4 a year, as if it were a high-speed vehicle instead of a handy means of progression at a walking pace. And when some bright genius uses a small battery to push along a perambulator he will pay handsomely for the privilege. Another form of electric traction which the committee has overlooked is the industrial truck. The great majority of industrial trucks are used on private ground—in factories, railway stations, docks, and so on—but in a few cases, notably that of the B.S.A. works in Birmingham, they traverse the public streets on their way to and from various departments. In the latter instance they bear the usual identification plates, and are otherwise regulated as motor vehicles, but it would be absurd to class them, for taxation on behalf of road wear, on the same basis as the ordinary commercial vehicle. One has only to look down the classified list of vehicles in the committee's report to realise that nobody contemplated the possibility of factory trucks using the highway occasionally in the execution of their duty. Presumably they would come under the classification of "commercial goods vehicles," and would pay a minimum of £12—£10 for the truck itself and £2 extra for the right to draw a trailer. This is a preposterous tax for a means of factory transport which involves only a trifling use of the road, and is of a totally different character from the ordinary commercial vehicle. The simplest way out of the difficulty is to exempt electric industrial trucks from taxation or to impose a merely nominal rate. We may note that locomotive ploughing engines, agricultural tractors not exceeding 5 tons unladen weight, or other agricultural engines drawing necessary gear, threshing appliances, farming implements, or supplies of fuel or water shall pay a duty of 5s. per annum only, if not used on roads for other haulage work. The addition of electric industrial trucks to this category would remove the anomaly into which the committee has fallen."

Submarine Cable Magnetic Fields.—Some experiments described in *E.T.Z.* were carried out in 1918 by the Under Water Signalling Section of the Kiel Torpedo Inspection Department, and consisted in an investigation of the magnetic field in the neighbourhood of the surface of the water covering a cable carrying alternating currents of frequencies of 50, 500, and 1,000 cycles. The current was fed in at one end by the generator and out at the other end through an earth connection, and was usually 2 amps. The field was explored by observers in boats equipped with search coils connected to amplifiers and telephones, and in the case of 50-cycle experiments the oscillations were rendered audible by a method that is not disclosed. At 50 cycles the field above the cable was of the distribution shown at (*a*) below, and just as one would expect, but at 500 and 1,000 cycles the lines of force took the form of (*b*) of the figure. It will be seen that the lines A represent the circular field due to the current in the cable, and the lines in the zones B and C are produced by eddy currents induced in the water. The double change of



SUBMARINE CABLE MAGNETIC FIELDS.

direction of the field at the junctions of the zones A and B and A and C was corroborated by various tests. If iron ships are used, it is found that the lines of force follow the direction of the sides of the ship and run at right angles to the axis of the ship—that is to say, the ship becomes a conductor of the current, which is absorbs from the water. The intensity of the field decreases inversely as the square of the distance from the cable. Proceeding along the cable from the end that is fed by the generator, both the current and the magnetic field decreased according to an exponential law. The effect of the depth of water was ascertained by laying the cable so that it gradually increased in depth from 10 m. to 100 m. in a length of 60 km. At 500 cycles the field at the surface of the water decreased to the 1/1.42nd part for each 10 m. increase in depth. At 1,000 cycles the corresponding fraction was 1/1.51. This exponential decrease points to the formation of eddy currents in the water. The electric field was examined by immersing two electrodes in the water and connecting them to a search coil electromagnetically coupled to the acoustical receiving apparatus. Only few tests were made, but it was found that the electric field decreased inversely as the square of the distance from the cable.

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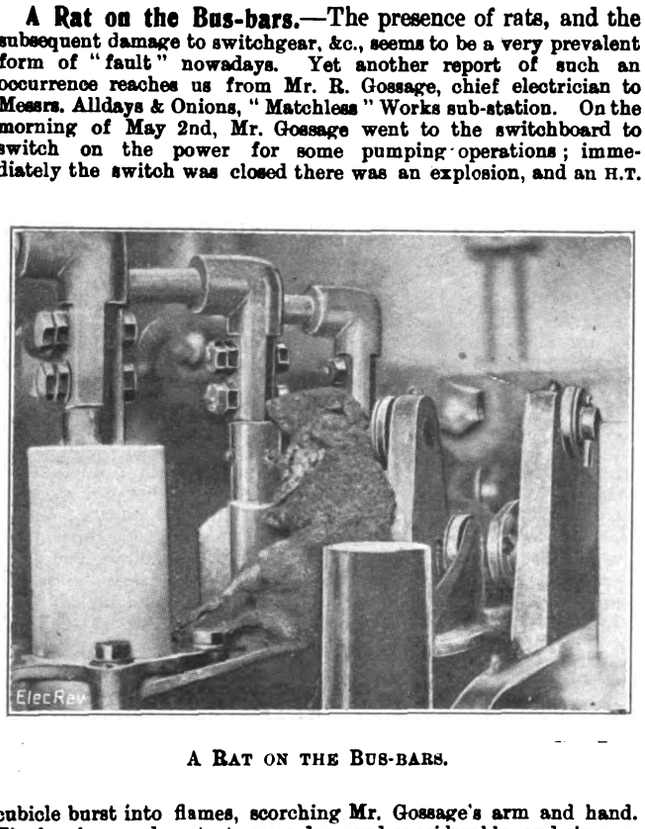
The Optophone.—Some years ago we described an instrument for enabling the blind to read ordinary print, called the "optophone." At the time the idea was considered good, but rather impracticable for ordinary purposes, and it is with great admiration for the work of Dr. E. E. Fournier d'Albe, Mr. W. Forster Brown, and Messrs. Barr & Stroud, Ltd., of Glasgow, that we read of the success attained by recent developments of the apparatus. The latest form is described in detail in a recent issue of *Nature*, and the writer, Dr. Fournier d'Albe, considers that "the problem of opening the world's literature to the blind is now definitely solved."

A Rat on the Bus-bars.—The presence of rats, and the subsequent damage to switchgear, &c., seems to be a very prevalent form of "fault" nowadays. Yet another report of such an occurrence reaches us from Mr. R. Gossage, chief electrician to Messrs. Alldays & Onions, "Matchless" Works sub-station. On the morning of May 2nd, Mr. Gossage went to the switchboard to switch on the power for some pumping operations; immediately the switch was closed there was an explosion, and an H.T.



A Rat on the Bus-bars.

cubicle burst into flames, scorching Mr. Gossage's arm and hand. The bus-bars and contacts were damaged considerably, and six H.T. insulators were smashed. Upon subsequent investigation, it was discovered that a large rat had got across the bars, as the accompanying photograph shows—with fatal results to itself, of course. It seems as though a rat-trap will soon have to be a recognised item in power-station equipment, as the present method of destroying rats is far too costly.

Fraternity.—By "Ruddigore." A little poem dedicated to the Corporation of York, which recently advertised for a jointer at a wage of £4 7s. 6d. per week, and for a mains superintendent at a wage of 6d. a week more.

When I was young and very fly
I thought the world was all awry;
I studied books on politics
Learnt all its "isms" and its tricks.
In short—I found for perfect rhythm
We all should plump for communism.

So when my father said to me,
"Now, boy, what do you choose to be?"
All his proposals I turned down—
They might bring money, fame, renown.
I answered, "I shun profiteering.
My predilection's engineering."

"For there, no matter what your age,
You always get the same low wage,
And though you rise to be the chief
It never brings you much relief.
The slide-rule calculating joker
Is just the equal of the stoker."

But now I'm nearing fifty-four
My views are not quite those of yore.
My communistic life has seemed
Not quite the heaven that I dreamed.
In fact—I fear I'm growing slacker.
I've thought of selling tripe, or 'bacca.

Corona Discharge.—Under this title a recent issue of *The Iron and Coal Trades Review* gives details of an exhaustive investigation carried out at the University of Illinois.

The authors considered that a study of the corona caused by continuous potentials may produce engineering data of value owing to the increasing development of high-tension direct-current generation and transmission, and for this reason the experiments were conducted with continuous potential.

The type of the corona discharge tube used in most of the experiments was a cylinder with a wire strung along its axis. This type of tube was chosen for several reasons:—(1) The corona phenomena occurring when this type of apparatus is used lend themselves peculiarly well to mathematical analysis. (2) The construction, manipulation, operation, and repair of the apparatus are extremely simple. (3) The field distribution is symmetrical with respect to the wire, and any irregularities in the wire are immediately recognisable in the discharge. (4) This type of apparatus has been used by other investigators; thus results could be compared with greater assurance of reliability.

As the voltage across the corona apparatus is gradually raised a point is reached when a marked increase in the current occurs, and a further increase in voltage causes the current to increase very rapidly. The voltage at which this sudden increase occurs is called the "critical voltage." "Visible glow voltage" means the voltage at which the light about the wire first appears. The visible glow voltage may be identical with, or higher than, the critical voltage.

The positive and negative coronas have entirely different appearances.

Wire Positive in Air.—For all pressures and sizes of wire used a uniform purple glow surrounds the positive wire. The wire has a tendency to vibrate at high pressures and high current densities. The thickness of the luminous film seems to be a constant for all current densities and pressures, the density or brilliance of the discharge only varying with the current and pressure.

Wire Negative in Air.—With the wire negative the appearance of the corona is changed in a very marked degree. The following properties can be observed:—(1) With a constant wire diameter and decreasing pressure the discharge gradually changes from a fairly uniform luminous mass with ragged boundaries to a beady discharge. (2) For a constant pressure and decreasing wire radii the fairly uniform luminous discharge gradually changes to the beady discharge, so that for small wires (less than 0·17 mm. in diameter) the beady discharge occurs at all pressures between atmospheric and 50 mm. of mercury. Under certain conditions of pressure and voltage these negative beads, or brushes, distribute themselves uniformly along the wire. For the lowest pressures the beads consist of a bright cylindrical core along the wire, this core being surrounded by a narrow dark space and enveloped in turn by a purple glow of relatively large diameter. For increasing pressures the central core contracts to a point on the wire, from which the discharge spreads out fanlike in a plane at right-angles to the wire. For still higher pressures the fan seems to close and finally to degenerate to a small brush.

Moisture.—To determine whether the presence of moisture in the air has an effect upon the critical voltage, a test was run as follows under a pressure of 736 mm. and humidity 68·5 per cent. Air was drawn from the room through the tube, and the voltage was noted at which the initial jump of the galvanometer occurred for the wire positive. The positive glow voltage and the negative glow voltage were then determined. Then dry air was pumped through the tube and the same measurements were taken. The results were:—

	Wet air.	Dry air.
Positive critical voltage	4,300	4,190
Positive glow voltage	4,350	4,260
Negative glow voltage	4,275	4,370

The effect of moisture apparently is to raise slightly the starting point of the positive corona, but the reverse is true for the negative polarity.

Slight differences in the starting points for the different metals were noticed; these differences, however, are of such a nature that they cannot be explained as being experimental errors. Steel and copper seem to have about the same starting point, while that for aluminium is a little higher and silver has a value still greater. The different metals not only affect the behaviour of the characteristic curves but also the starting points of the corona glow.

The voltage used for the experiments varied considerably, but did not much exceed 9,000 volts.

Naval Wireless Telegraphists.—In order to assist ratings of the wireless telegraph branch of the Royal Navy due for discharge in obtaining posts as civilian wireless telegraph operators, the Admiralty has arranged with the Postmaster-General for the issue of the latter's certificate of proficiency to such ratings on their passing an examination in the naval signal schools while still serving. It has not been possible for the Admiralty to make similar arrangements for the examination of telegraphists who have been discharged or demobilised, and such men should apply for the certificate direct to the Secretary of the General Post Office, who will inform them of the conditions of the examination.—*The Times.*

Service Notes.—The Admiralty announces that rules have been approved for determining the dates from which officers specialising in engineering shall become eligible for the higher rates of pay laid down for the engineer branch in July last, as a result of the Halsey Committee's recommendations.

Lower-deck Improvements.—A recent note in *The Times* foreshadows a great improvement in the living conditions of petty officers of some of the Navy's light cruisers. Electric lighting is to be installed in messes and reading-rooms, and electric heaters for keeping meals hot, as well as radiators and other appliances.

INSTITUTION NOTES.

Institution of Electrical Engineers.—The forty-eighth annual general meeting of the Institution was held on the 20th inst.; there was a very small attendance, and few comments were made. The President, Mr. Roger T. Smith, announced the result of the election of members of Council, as follows:—

President, Mr. Ll. B. Atkinson; vice-presidents, Dr. W. H. Eccles, Messrs. J. S. Highfield, and S. L. Pearce, C.B.E.

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hon. treasurer, Sir J. Devonshire; ordinary members of Council, Messrs. F. Gill, P. V. Hunter, A. H. W. Marshall, W. Noble, C. Vernier, and Dr. A. Russell.

Out of the total of 1,526 ballot papers that were returned, 29 were spoiled, leaving 1,497, or about 32 per cent. of those issued, which was a good improvement on past years.

The President introduced the report of the Council for the year 1919-20, an abstract of which appeared in our last issue, with a running commentary, in the course of which he mentioned that the gratifying increase in membership was to some extent an estimate, as there were a number of members whose subscriptions had lapsed, and they were not yet sure how many of them had definitely ceased to be members. He pointed out that although the number of subscribers to the Benevolent Fund had increased substantially, the amount subscribed had remained practically at the same level as before. Referring to the benefaction to the Institution announced in the report, he said that both the donation and the manner in which it was given, were admirable examples to them all, and trustees had been appointed for the Institution. To the list of territorial centres and sub-centres that had been visited by the President during the session, Loughborough could now be added. Owing to the continued increase in the cost of publication, the Council regretted that it had been compelled to increase the subscription rates for *Science Abstracts*. The premiums awarded by the Council for papers read before the Institution during the period April 10th, 1919, to April 15th, 1920, were then announced, as follows:—The Institution premium, valued at £25, to Mr. M. B. Field for his paper on "The Navigational Magnetic Compass"; Ayrton premium (£10) to Mr. W. H. Patchell for his "Notes on Operating a By-product Producer-Gas Plant for Power and Heating"; Fahie premium (£10) to Messrs. E. A. Laidlaw and W. H. Grinsted for their joint paper on "The Telephone Service of Large Cities, with Special Reference to London"; John Hopkinson premium (£10) to Mr. J. C. Thompson for his paper on "Transformers for Electric Furnaces"; Kelvin premium (£10) to Mr. H. W. Taylor for his paper on "Eddy Currents in Stator Windings"; Paris premium (£10) to Mr. G. Stead for his paper on "The Short Tungsten Filament as a Source of Light and Electrons"; Webber premium (£10) to Major A. C. Fuller for his paper on "The Fullerphone, and its Application to Military and Civil Telegraphy"; an extra premium (£5) to Captain J. M. Scott Maxwell for his paper on "Scientific Management: a Solution to the Capital and Labour Problem"; and another extra premium (£5) to Major K. Edgcumbe for his paper on "The Protection of A.C. Systems without the Use of Special Conductors."

The motion to receive the report was seconded by Mr. J. Shepherd, and, without comment, the report was adopted unanimously.

Sir James Devonshire, in moving the adoption of the accounts for the year ended December 31st, 1919, said that that was his first presentation of the accounts since the resignation of his able predecessor, Mr. Kingsbury. The cost of publication of the *Journal* continued to increase. The temporary housing of the Institution at Albemarle Street was, from a financial point of view, entirely satisfactory, as the Institution thereby benefited to the extent of nearly £4,000. Negotiations had been opened for the sale of the Tothill Street property, and he was glad to announce that there were prospects of disposing of the property on favourable terms. The accounts showed a margin to the good of £1,495, an increase of £225.

Prof. J. T. MacGregor-Morris seconded the motion; few remarks were made, and the accounts were adopted unanimously.

Messrs. Allen, Attfield & Co. were appointed hon. auditors for the year 1920-21, and the proceedings terminated with votes of thanks to the Institution of Civil Engineers for the use of its premises and library, and to the hon. officers of the Institution at home and abroad.

North Midland Centre.—The annual meeting of the Centre was held at Leeds on May 11th. The chairman (Mr. W. M. Selvey) presided. The accounts for the past year were unanimously approved. The ballot for members of the committee for the ensuing year resulted in Messrs. Furness, Jones, Spurr, Turner, Col. Vignole and Mr. Wraith being elected. Mr. Leonard Milne then read his paper on the "Electrical Equipment of Artisan Dwellings," and a discussion followed.

Local Centre in Argentina.—The first Committee is made up of the following members:—

Chairman: Vernon Lindop.

Vice-chairman: W. C. Laidler.

Members: J. T. Cornish, H. L. Randolph, L. B. Trant, and J. Wilson.

Secretary: A. C. Kelly, 783 calle Florida, Buenos Aires.

The Committee will be glad to be of assistance in any matter affecting the interests of the British Electrical Industry and of British Electrical Engineers.—*Review of the River Plate.*

Society of Chemical Industry.—Modern High-speed Electric Telpherage was the subject of a paper at a Conference of the Chemical Engineering Group (National) of the Society of Chemical Industry, at Birmingham, on April 23rd. The author, Mr. H. Blyth (Strachan & Henshaw, Bristol), pointed out that in all branches of industry there was a necessity to-day for doing everything at high speed and with the greatest all-round economy. The electric telpher was a particularly convenient and simple machine for conveying any class of goods or materials over a moderate distance with a minimum consumption of energy and at a low maintenance cost. Telpherage had been very extensively adopted in gas works for handling coke and other materials, and also in electricity works for coal and ashes.

A coal telpher, fed by crane, was installed at Stepney electricity works. It was not permissible in this case to have the telpher structure overhanging the barge, and a three-motion crane had to be used to transfer the coal from the barge, first to the hopper of the automatic weighing machine, which in turn discharged the coal to the bunker which fed the telpher skip. The supply of coal was kept up in the bunker, and the telpher operator lowered his skip in front of the automatic shoot; the skip was filled in about 10 seconds (two tons of coal), lifted 40 ft., and carried a maximum distance of about 300 ft. The capacity (guaranteed) of the plant was 40 tons per hour, but in an emergency 70 tons per hour had been handled.

In 1916 Messrs. Nobels required to unload coal from 10-ton wagons and store it evenly over an area of 350 ft. × 136 ft. × 10 ft. deep, and it was necessary to provide for a storage of 12,000 tons. The coal trucks are emptied by a Fraser & Chalmers tipper, at the rate of eight to ten per hour, into a pit which has a partition at a depth of 15 ft. and a chamber 7 ft. deep below this partition. Coal can be lifted by the telpher and grab from the upper portion of the pit at the rate of 40 to 50 tons per hour, and conveyed to store, and simultaneously conducted at about the same rate by means of a rotary feed table, below the partitions, to an elevator, and thence by a band conveyor to the boiler-house bunkers. The special feature of the telpher installation lies in the fact that the track itself is made to travel the full length of the store ground, and by means of a running switch maintains contact with the fixed track leading to the grabbing pit. The telpher machine can thus lift the coal from the pit and convey it directly to any part of the store ground, and similarly pick up from any point of the store and carry it back to the pit for feeding the elevator and conveyor for the boiler house. It was not possible in this case to run the track through to the boiler house, as the structure for the latter had already been determined when the telpher was ordered for the store.

The telpher has a lifting motor of 20 H.P. and a travel motor of 8 H.P., the energy consumption per hour being 6 units—that is, 0·15 unit per ton. The present-day labour cost would be ¾d. to ¼d. per ton. The elevator is driven by a 10-H.P. motor, and the band conveyor, 5 H.P.; total consumption, 11 units per hour.

Societe des Ingenieurs Civils de France.—This institution is organising a tour in France, from June 22nd to 25th, primarily for its British section, but it has been decided to admit members of any recognised British engineering institution. The tour, which embraces Paris and the factories and mines of the north-eastern war area, including Amiens, Lens, Lille and Vimy, will cost about £12, and a programme has been arranged and can be obtained from the Hon. Secretary of the British Section, 45, Great Marlborough Street, W. 1.

Institute of Transport.—Reading a paper on "Some Railway Operating Problems," on May 17th, Major-General Sir H. W. Thornton, general manager and engineer-in-chief of the G.E. Railway, said he hoped to increase the already heavy train service during the rush periods by 40 per cent. The trend of thought was towards private ownership and administration under Government regulations. To deal with the London traffic problem, in addition to other improvements, they must employ electricity in the suburban zone on a very large scale.

British Science Guild.—At the annual meeting of the Guild, to be held at the Goldsmiths' Hall, Foster Lane, E.C., on Tuesday, June 8th, at 3 p.m., Lord Sydenham, G.C.S.I., F.R.S., in vacating a Presidency marked by two most successful Scientific Products Exhibitions, will deliver an address on "Science and the Nation," and this will be followed by an address on "Some National Aspects of Transport," by the incoming President, Lord Montagu of Beaulieu. Lord Bledisloe and Sir Gilbert Parker will indicate what has been done in the past year in this connection, and describe the significant efforts now contemplated by the Guild. Applications for invitations to the meeting should be addressed to the Secretary of the British Science Guild, 6, John Street, Adelphi, W.C. 2.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Mr. Weston has resigned from the Sterling Telephone and Electric Co., Ltd., and has joined Cryselco, Ltd., as London representative, with office at Craven House, Kingsway.

Mr. E. G. Phillips, M.I.E.E., who for the last 12 years has been chief engineer to Messrs. Boots Chemists, Nottingham, has resigned that position and opened offices at Queen's Chambers, King Street, Nottingham, as a consulting engineer, specialising in power plants working against back pressures, and utilising the exhaust for "process" work. On Friday last at the Island Street works, over 100 of the power house staff and engineering department presented Mr. Phillips with a secretarial desk. Mr. T. S. Ratcliffe, general manager, made the presentation, and Mr. H. B. Clarke, chief technical assistant, expressed the staff's esteem and appreciation.

Recent changes in the civilian staff at the Admiralty outports, include the following:—Electrical Engineering Department—Mr. H. Martin, to Electrical Engineer, Lower Grade, Portsmouth

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Yard (Acting); Mr. W. A. Knight, to 1st Assistant Electrical Engineer, Portsmouth Yard; Mr. G. R. Davies, to 1st Assistant Electrical Engineer, Dover Yard (Acting).

Mr. J. W. A. Renshaw, assistant electrical engineer of Fleetwood, has been granted an additional bonus of £30 per annum.

On May 21st, Mr. F. C. Edgars, foreman armature winder to the Halifax Tramways Committee, was presented with a silver flower vase by the members of the staff. He is about to start business in the electrical trade on his own account. He had been with the Corporation over 20 years.

Lieut. H. Foster Smith, R.E., M.C., has been appointed chief engineer to the Electric Lighting and Tramways Co, Para, North Brazil.

Lieut. Breeds, of Morecambe, has been appointed traffic manager to the Morecambe Corporation.

A Reuter dispatch states that Sir Auckland Geddes, on May 19th, received the Franklin Medal from the Franklin Institute for Sir Charles Parsons.

Messrs. Charles P. Sparks & Partners have changed their address to Blackfriars House, New Bridge Street, London, E.C. 4. Telephone Nos. "4725 and 4726 Central."

Mr. T. MacLennan, first engineer at Lake Coleridge hydro-electric station, New Zealand, has been appointed public works electrical engineer at Hamilton (N.Z.), and will take charge of the Hora Hora works. Mr. H. S. Dix, engineer and manager of the Prahran and Malvern tramways trust, has been appointed acting chief manager and acting chief engineer of the Melbourne Tramways Board, which controls the cable and electric tramway services of the metropolitan and suburban areas.—*Commonwealth Engineer.*

Obituary.—Mr. R. Sharp.—The death has taken place of Mr. Robert Sharp, of Briercliffe Road, Burnley, who had been for many years in business as an electrician. He was in his 59th year.

CITY NOTES.

London and Suburban Traction Co., Ltd.

Lord Ashfield presided at the annual meeting on May 19th. He said that the result was disappointing, but no other result could have been expected considering the expenses and how little the fares, &c., had been advanced. Increased operating expenses more than counterbalanced the increase in revenue of the three companies. There were no signs of any decrease in the price of materials necessary for the operation and upkeep of the undertakings, and further demands were received for increases in the wages of the operating staff. It was therefore essential that more revenue should be earned. The Government had introduced the Tramways (Temporary Increase of Charges) Bill, which, while it did not afford a permanent measure of relief, would give the companies an opportunity of increasing their revenue by bringing the fares more into relation with the present economic position and with the expenses of carrying the traffic. It remained to be seen to what extent the public would accept this additional burden, but he could not but believe that they would be willing to pay such fares as might be necessary to meet reasonable working expenses and to provide adequate sums for depreciation and a fair return on capital. There was a rate of fare which would secure the maximum earnings, and to go beyond that rate of fare would reduce the earnings and bring disaster to the undertakings. He would, therefore, take that opportunity of warning those who were constantly agitating for increased wages that they could overburden the undertakings and bring disaster to themselves and to all those associated with them. The tramway and omnibus undertakings in which their company was interested were not earning sufficient to meet their actual expenses, and until fares had been increased and it was known definitely just how much the public would pay, and whether sufficient revenue could be obtained to meet even the present expenses, including depreciation and a reasonable return on capital, it was difficult to see how further increases in expenses could be incurred.

Calcutta Electric Supply Corporation, Ltd.

The report for 1919 shows as follows: Units sold 31,881,710, as against 30,431,132 in 1918. Houses connected 10,271, an increase of 374. Gross revenue £359,949, against £304,955. Net revenue £237,206, against £173,949. The net profit for 1919, plus balance brought forward and interest received, totalled £298,459. £34,408 has been placed to the credit of the depreciation and renewals account. The balance of excess profits duty in respect of 1917-18 £27,724, and an estimated liability in respect of 1919 for similar duty £34,070, is provided for. £55,000 is put to reserve, £5,000 to the insurance fund, £5,000 to the pension fund, and a final dividend is recommended on the ordinary shares for the second half-year of 6 per cent. actual, making 10 per cent. for the year. Further, it is recommended that, subject to the shareholders' approval and to the alteration of the articles of association, one fully-paid preference share shall be issued as bonus for each 10 ordinary shares held, fractions to be paid in cash. A balance estimated at £45,693 is carried forward after providing for the directors' additional remuneration of £4,000. Expenditure on capital account last year £51,653. Total outlay to December 31st last £1,48,000. The demand for electrical energy still continues to increase. In order to meet the same, after considering a report on the situation from their consulting engineers in conjunction with the company's engineer, that the capital should be increased, the directors find themselves inevitably committed to an increase of the system involving 1½ millions sterling. The power station must be more than doubled, and the network of distribution in proportion; they therefore recommend that the capital shall be increased from £1,500,000 to £3,000,000 by the issue of 300,000 additional shares of £5 each, also that the rate of dividend payable in respect of the preference shares be increased from 5 to 6½ per cent.

Swedish Companies.

The Elektriska Aktiebolag Volta reports that a total loss of 1,129,000 kr. was incurred in 1919, of which 656,000 kr. concerned the manufacturing departments, as compared with net profits of 555,000 kr. in the previous year on a share capital of 5,000,000 kr. All the subsidiary companies are being liquidated, and the Volta company itself is to be reorganised by the formation of a new company with a share capital of 6,500,000 kr.

The directors of the *Telefon A.B. Cedergren, of Stockholm*, reporting on the past year, states that the network in Warsaw was for the most part restored after the damages caused during the German occupation. The company's concession expired on November 14th, 1919, and a provisional agreement was entered into with the Polish Ministry to continue working until July 1st, 1920, whilst negotiations were proceeding as to the conditions for further maintaining the service. The total loss for the year amounts to 1,889,000 kr., of which 883,000 kr. represents the writing down of Russian debts.

The report of the *A.B. Elektraverken* states that the situation of the market in 1919 was not satisfactory for the company's manufactures. The unfavourable conditions of exchange facilitated foreign competition, and compelled the company for the present to cease the production of batteries and thermo flasks, and rendered impossible the export of other manufactures. The results were also prejudicially affected by a three months' strike at the installation materials factory, and the great advance in wages. As net profits the accounts show the sum of 557,000 kr., as against 713,000 kr. in 1918, when a dividend at the rate of 10 per cent. was paid. It is, however, not proposed to make any distribution for last year, but to dispose of the surplus available by allocations to the renewal and reserve funds, and by the carrying forward of 318,000 kr., as compared with 157,000 kr. in 1918.

French Companies.

The Compagnie de Telegraphie Sans Fil reports net profits of 2,525,000 fr. for 1919 and a dividend of 40 fr. per share, this comparing with 27.22 fr. per share for the eleven months comprising the previous financial year.

The Société d'Electro-Chemie de Bozel has declared a dividend at the rate of 22 fr. per share out of net profits of 762,000 fr. in 1919, as against 22 fr. and 766,000 fr. respectively in the previous year.

The net profits of the *Société Gramme* in 1919 are reported at 697,000 fr., as compared with 703,000 fr. in the previous year. After making allocations to the legal reserve fund and provision for the tax on war profits, there remains a balance of 402,000 fr., permitting of the payment of a dividend of 50 fr., as against 48 fr. per old share and 25 fr. per new share in 1918.

The Société d'Electro-Chimie et d'Electro-Métallurgie, which last year absorbed the Electro-Chimique du Giffre et des Carbures Métallurgiques and increased the share capital from 18 to 35 millions of francs, reports net profits of 3,855,000 fr. for 1919 as compared with 1,546,000 fr. in 1918. It has been decided to pay a dividend of 45 fr. per share on the augmented capital, this contrasting with 50 fr. per share in the previous year.

Babcock & Wilcox, Ltd.

The net profit for 1919 was £455,089, plus £92,089 brought forward. After paying the interim dividends of 3 per cent. and 2½ per cent. on the preference shares, and 6 per cent. on the ordinary, further dividends at the same rates on the preference and 9 per cent., free of income tax, on the ordinary shares, are to be paid; £150,000 is to be put to reserve; £10,000 is to be put to staff pension fund; and £123,225 carried forward. The capital has been increased by 500,000 ordinary shares, but these do not rank for the dividend now announced on the old ordinary shares. The construction of the works of the Sociedad Espanola de Construcciones Babcock & Wilcox will be completed this year. The company is equipping auxiliary works in Australia and Italy, and is extending its Japanese works. The French B. & W. works, in which the company is interested, have been enlarged and the capital of that company increased. At Renfrew considerable extensions are being undertaken; a new foundry and pipe shop are being built, the crane making department is being enlarged, and new offices are being erected. Extensions are in progress at the Dumbarton works. The use of B. & W. marine boilers is increasing, and the amount of orders in hand for all the company's manufactures is satisfactory. "Whilst there is some improvement noticeable in the output of our workmen, it is still below the pre-war standard, and there are also continual interruptions, through trade disputes, to contend with."

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Belgian Companies.

The accounts of the *Ateliers de Constructions Electriques de Charleroi* show total profits of 2,703,000 fr. for 1919. It is therefore possible to extinguish the provisional debit balance of 2,337,000 fr. which existed at the end of 1918, pay interest on the loans, and carry 209,000 fr. forward.

The Compagnie des Railways et de l'Electricité reports net profits of 359,000 fr. for 1919, which sum has been carried forward. At the recent general meeting the chairman stated that the company hoped to resume the payment of dividends next year, and the directors were devoting special attention to industrial undertakings which were more remunerative than tramways and supply works.

The Société Générale Belge d'Entreprises Electriques reports net profits of 784,000 fr. for 1919, and a dividend at the rate of 25 fr. per share has been declared on the old capital and 1.67 fr. per share on the partly-paid shares. The report states that the supply works in which the company is interested have profited in general by the resumption of industrial activity, especially as the use of electricity is becoming general, and electric motors are being increasingly adopted both by small and big industries. At the same time, the public authorities in most cases have sanctioned an advance in supply tariffs and in tramway fares.

German Companies.

The directors of *Voigt & Haeffner A.G., of Frankfort-on-Main*, recommend a dividend at the rate of 18 per cent. for 1919, being the same as in the previous year.

The accounts of the *Elektro-Salpeterwerks A.G., of Berlin*, show net profits for 1919 which permits of the reduction of the debit balance from 1,420,000 marks to 1,380,000 marks.

The *Norddeutsche Seekabel Werke A.G., of Nordenham*, after making provision for depreciation and losses on investments, reports a loss of 47,000 marks for 1919, as compared with net profits of 291,000 marks in 1918.

The *Ver. Isolatoren Werke A.G., of Berlin-Pankow*, after making provision for depreciation, reports net profits of 166,000 marks for 1919, as compared with 126,000 marks in the preceding year. The directors recommend a dividend at the rate of 12 per cent., this comparing with 10 per cent. in 1918.

The accounts of the *Elektrochemische Werke, of Berlin*, after writing off 2,100,000 marks for special depreciation on new plant in 1919, as against 900,000 marks in 1918, show net profits of 2,629,000 marks, as compared with 1,926,000 marks in the previous year. It is intended to distribute a rate of 15 per cent., this comparing with 12 per cent. in 1918.

The accounts of the *Bergmann Elektrizitats Werke A.G., of Berlin*, show gross profits of 22,162,000 marks for 1919, as compared with 23,683,000 marks in the preceding year. After providing 1,937,000 for depreciation, as against 2,578,000 marks, the net profits are returned at 7,448,000 marks, as compared with 7,149,000 marks in 1918. It is proposed to pay a dividend of 12 per cent. on the paid capital of 47,750,000 marks as in the previous year. The unpaid capital is to be called up, and the share capital then increased by 28,000,000 marks to 80,000,000 marks.

Neuhausen Aluminium Industry Co.

The report for 1919 of the Aluminium Industrie A.G., of Neuhausen, states that the expectations that with the conclusion of peace the conditions of production and sale would revert to normal paths, and relief take place in the provision of raw materials, had not been fulfilled. On the contrary, increased difficulties had to be contended with in order to supply the works with raw materials. With the exception of the Lend works in German Austria it was possible to maintain restricted working at all the manufacturing plants, and the production under these circumstances was less than in the preceding year. In addition to the large decline in the output, the unfavourable conditions of exchange, the enormously increased wages, and the advance in the cost of raw materials and freights, were the causes of the less favourable results as contrasted with the preceding year. The gross profits, including the balance forward declined from 38,062,000 fr. in 1918 to 16,390,000 fr. last year. After considerably reducing the amount provided for depreciation as compared with 1918, the net profits have fallen from 12,093,000 fr. in the latter year to 8,821,000 fr. in 1919. As recently mentioned, the dividend is at the rate of 18 per cent. on ordinary share capital of 42,000,000 fr., this comparing with 20 per cent. in 1918 and 20 per cent. in each of the three preceding years on considerably less capital. The report further states that the seizure of the works in France had not yet been raised, although speedy settlement was to be foreseen. The Hungarian Bauxite Co. had to suspend activity after the revolution, and had not yet been able to resume. Nevertheless the Neuhausen Co. possessed large stocks of bauxite which would last a long time forward.

Edison Swan Electric Co., Ltd.—The financial Press states that the directors propose to increase the borrowing powers of the company.

Brisbane Electric Tramways Investment Co., Ltd.—Dividend of 8 per cent. per annum, free of tax, on ordinary shares for half-year, making 8 per cent. for the year; £20,000 to reserve; £38,876 carried forward.

Potteries Electric Traction Co., Ltd.—Mr. R. J. Howley, presiding at the annual meeting, said that the traffic receipts amounted to £251,745, an increase of £46,221, due to a small increase in traffic and a further increase in fares. The administration and general expenses increased by £5,022. The introduction of the 48-hour week in April, 1919, had caused the largest single increase in wages which they had had to meet in any year, being equivalent to 13s. per man per week on the old basis of a 60-hour week. In November a further 4s. a week had been granted by an award of the Committee on Production. A further increase of 8s. per man per week, which would rise to 9s. on June 1st next, recently recommended by the National Industrial Council, was now being paid. Increases in wages during the year had out-distanced the increased cost of living, and there must be some finality to the increases which could be granted. Wages continued to advance, and the raising of additional revenue became more difficult. Their efforts had not been unsuccessful during the year under review in maintaining the balance available for distribution, but there was a limit to which fares could be raised.

Richardsons, Westgarth & Co., Ltd.—The profit for the year ended December 31st, after providing for estimated liabilities to the Government, amounts to £185,040, against £133,275 in 1918, to which is added £23,818 brought forward. One year's arrears of preference dividend to April 30th, 1912, paid June 17th, absorbed £21,000; two years' arrears of preference dividend to April 30th, 1914, paid November 28th, £42,000. It is proposed to allocate £45,000 to depreciation for 1919; portion of capital expenditure in 1919, written off, £13,565; leaving a credit balance of £48,842. The company's liability for excess profits duty for the past four years has not yet been finally adjusted, but it is estimated, says the *Times*, that out of the retainable profits for the year 1919 a total payment of £105,000 can be made to the preference shareholders. Of this sum, a distribution of £63,000, as shown above, has already been made, and it is now proposed to pay £42,000 out of the balance of profit remaining; the dividend on the preference shares will then have been paid to April 30th, 1916.

Arbroath Electric Light and Power Co., Ltd.—Mr. George Balfour, M.P., said at the annual meeting that the present consumption of current was about 30 per cent. greater than that of a year ago. Naturally this increase of business, he said, required an extension of their plant and machinery and cables, and each, of course, meant additional capital. After referring to the arrangements for the increase of capital, he said it was not the intention to issue all the new shares at one time, but the directors had thought it wise to make ample provision, and shares would be issued as and when fresh capital was required. A special vote of thanks was passed to the engineer (Mr. J. Cathcart Christie) and his staff.

Anglo-American Telegraph Co., Ltd.—The three quarterly interim dividends on the preferred and ordinary stock absorbed £157,500, and the directors on January 31st last paid the final dividend of 30s. per cent. for the year on these shares and on the deferred stock. These payments absorbed altogether £262,500, being the rent paid by the Western Union Telegraph Co. for the year, equal to 3¾ per cent. on the ordinary stock, 6 per cent. on the preferred stock, and 1¼ per cent. on the deferred stock. The balance at credit of revenue account (£68,822) includes £3,197 interest received, and the balance of £65,625 is available for the payment of dividends for the quarter to March 31st, 1920.

Stock Exchange Notices.—The Committee has ordered the undermentioned to be officially quoted:—

Erinoid, Ltd.—100,000 shares of 5s. each fully paid (Nos. 600,001 to 700,000).

Greenwood & Batley, Ltd.—168,000 ordinary shares of £1 each, fully paid (Nos. 1 to 168,000); and 96,000 7 per cent. cumulative preference shares of £1 each, fully paid (Nos. 1 to 96,000).

The Committee has specially allowed dealing in the following under temporary regulation 4 (3):—

River Plate Electricity Co., Ltd.—122,440 ordinary shares of £1 each, fully paid (Nos. 175,001 to 297,440).

Ramsgate & District Electric Supply Co., Ltd.—Profit for 1919 £4,247, as against £2,026 for 1918. After deducting interest on outstanding accounts due to contractors (£1,132) and adding £743 brought forward, the balance is £3,857. Dividend 5 per cent.; £2,000 to reserve; £857 carried forward. Mr. A. N. Rye has been elected a director in place of Mr. A. D. Chamen, resigned.

Mirrlees Bickerton & Day, Ltd.—The report for the year ended March, 1920, states that the net profit, after providing for depreciation and excess profits duty, &c., is £41,842, plus £5,720 brought forward. It is proposed to pay a dividend on the ordinary shares, making 12½ per cent., free of tax, placing £5,000 to reserve, and carrying forward £7,510.

British Mannesmann Tube Co., Ltd.—Interim dividend of 4 per cent., less tax.

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Dublin and Lucan Electric Railway Co.—At the annual meeting Mr. J. W. Hill said that the gross income had largely exceeded that of any previous year. The increase was accounted for to a certain extent by the increased passenger fares, but the increase in the number of passengers as against those carried in the previous year was almost 52,000. The service was still curtailed, but it was hoped to improve it. As to expenditure, wages were double the amount of 1918 and coal was dearer, while the coal supply prospects were anything but reassuring.

Companies Struck off the Register.—The following have been struck off the register and are dissolved:—

Faringdon Electric Light and Power Co., Ltd.
Star Vacuum Cleaner Co., Ltd.

Western Telegraph Co., Ltd.—Interim dividend of 5s. per share, free of tax.

STOCKS AND SHARES.

TUESDAY EVENING.

STOCK EXCHANGE markets appear to be the better for their Whitsun holiday, and a fair amount of business rewarded those who were sufficiently conscientious to return to town to-day (Tuesday). The holiday passed without giving rise to any unexpected complications at home and abroad, so there was nothing to check the mildly better tone established at the end of last week.

The dramatic drop in many prices in the commodity, food and metal markets is regarded from various points of view. New York sends apprehensions as to its further course being undesirable in view of possible slump consequences in the market for Government and other securities, and this aspect naturally occurs to the holder of stocks and shares, the prices of which are bound to suffer if forced liquidation goes to extremes. At the same time, it is well recognised that the fall in Stock Exchange prices has been extremely severe during the past two months, and that the forced selling has been accomplished to no small extent already. The City, therefore, is not alarmed at the outlook, and the manner in which gilt-edged stocks are supported is evidence of the investors' frame of mind.

People are buying preference shares and fixed interest stocks to-day on the ground that dividends on ordinary shares are likely to be eaten into by the additional E.P.D., and that this may make material difference to the dividends on ordinary shares. In these circumstances, the attractions stand out from such investments as General Electric 7½ per cent. B preference, which can be bought at about 19s. 3d., and are representative of the class of shares for which the investor is now asking. No doubt the course of time will bring the ordinary shares into favour again, but—equally no doubt—preference issues are more popular with the public at present.

Electricity Supply shares are weaker on account of several decreased accounts which have come to market this week. County ordinary and preference have felt this more particularly, but London Electrics and Metropolitans also gave way. City Lights are quoted in their £1 (instead of £10) guise, the ordinary being called 1⅛ and the preference 17s. At these prices the former give a return of nearly 9 per cent. on the money, and the preference offer a little over 7 per cent. Calcutta Electric Supply are 5s. lower at 8, although the report is regarded as being quite a good one.

Edisons at 23s. 9d. have hardened up; otherwise the manufacturing group is dullish, with General Electrics easier at 31s. 3d., and Siemens at 26s. Henleys shed 1-16 to 40s. Castner Kellners recovered to 4 on the declaration of an interim dividend at the rate of 20 per cent.

The International, which took over a large part of the Automatic Telephone shares, issues a report dealing with the share capital and other figures, but which is otherwise colourless. American and other dollar securities are lower in many cases, the New York Stock Exchange being subject to depressing conditions due to causes not unlike those which have made prices dull over here. Cuban Telephone 6 per cent. preference fell 2 to 120, and American Telephone and Telegraph capital stock dropped to 117¼. Rio Tramways 1st mortgage bonds weakened to 82½. Brazilian Tractions reacted to 49½, after being above 50. The Anglo-Argentine Tramways list is rather firmer, the first preference hardening to 3⅛. Mexican Light and Power firsts at 41 are 5 points better on the fortnight. The death of President Carranza has had little effect other than this upon Mexican issues. Stock Exchange opinion, already quoted, persists that no change can be for the worse in Mexico.

Cable stocks are as langourous as the weather. Anglo-American deferred continues its downward course. Globe ordinary shares are 5s. lower. West India and Panama have given away further to 10s. owing to the poor report. Shares changed hands down to 8s. 6d. Marconis remain a firm market at 3½, but the new ordinary are still at 2s. 6d. discount, and Marines are 1-16 better at 38s. 9d.

Reference was made here last week to Atkin's "Manual." To quote further from its pages may appear to savour of laziness on the part of the commentator, yet, in these kaleidoscopic days, it is very interesting to have a lucid reminder of the Electricity Bill (1919) which is now law. Risking the charge just mentioned, we repeat from the Manual before us: "This Bill, owing to strong opposition in the House of Lords, directed specially against its financial proposals, was considerably modified . . . all its compulsory features withdrawn, and the proposals relating to the appointment of Commissioners and the control and advice which they are enabled by the Act to give in connection with the development of electricity were retained." The power enjoyed by the London County Council to purchase in 1931 the undertakings of all the companies together for fair market value without goodwill (Electric Lighting Act, 1888) is now transferred to the Joint Electricity Authorities for the area in which a company operates. This is how the position stands at present, and the element of uncertainty which obviously continues to exist is sometimes held responsible for the reluctance that many investors entertain in regard to putting money into electric lighting shares.

Home Railway stocks are more or less moribund. The vast numbers of passengers carried by the motor-'buses during the Whitsun holiday has failed to infuse any interest into the market for the Underground Railways group. Armament shares make a fairly good showing, with Vickers hardening slightly. Rubber shares rallied on the raw material picking up to a florin per lb., which brought in a few buyers and a great many inquiries.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1918.	Dividend 1919.	Price May 25, 1920.	Rise or fall.	Yield p.c.
HOME ELECTRICITY COMPANIES.					
Brompton Ordinary	8	12	6½	—	£5 8 1
Charing Cross Ordinary	4	7	3½	—	9 6 8
do. do. do 4½ Pref.	4½	4½	2¾	—	8 3 3
Chelsea	8	4	3	—	6 8 4
City of London	8	10	11½	—	8 17 10
do. do. 6 per cent. Pref.	6	6	17/-	-1/-	7 1 1
County of London	7	8	8½	— ⅛	9 11 1
do do. 6 per cent. Pref.	6	6	8½	— ¼	7 3 4
Kensington Ordinary	6	7	4⅜	—	7 11 5
London Electric	Nil	2½	1½	— ⅛	6 0 0
do. do. 6 per cent. Pref.	6	6	8½	—	9 4 0
Metropolitan	6	6	2½	— ⅛	10 8 8
do. 4½ per cent. Pref.	4½	4½	2⅛	—	8 0 0
St. James' and Pall Mall	10	12	6⅜	—	8 16 10
South London	5	6	2½	—	9 12 0
South Metropolitan Pref.	7	7	16/9	—	7 0 0
Westminster Ordinary	8	10	5	—	10 0 0
TELEGRAPHS AND TELEPHONES.					
Anglo-Am. Tel. Pref.	6	6	77½	—	£7 14 10
do. Def.	33/6	1½	15½	— ¼	8 2 1
Chile Telephone	6	6	6½	—	£4 12 3
Cuba Sub. Ord.	7	7	9½	—	£7 7 4
Eastern Extension	8	10	15	—	£6 13 4
Eastern Tel. Ord.	8	10	15¾	—	£6 11 4
Globe Tel. and T. Ord.	8	10	15½	— ¼	£6 7 8
do. do. Pref.	6	6	8½	—	7 1 3
Great Northern Tel.	22	—	21½	—	9 15 6
Indo-European	13	10	40	—	6 6 0
Marconi	25	—	3½	—	8 0 0
Oriental Telephone Ord.	10	12	2½	— ⅛	£4 16 0
United R. Plate Tel.	8	—	7½	— ⅛	£5 6 8
West India and Panama	1/8	—	8	— ⅛	—
Western Telegraph	8	10	15½	—	£6 7 0
HOME RAILS.					
Central London Ord. Assented	4	4	44½	—	8 19 9
Metropolitan	1	1½	20	+½	5 0 0
do. District	Nil	Nil	15½	—	Nil
Underground Electric Ordinary	Nil	Nil	1⅛	—	Nil
do. do. "A"	Nil	Nil	4/-	—6d.	Nil
do. do. Income	5	4	60½	—	6 13 0
FOREIGN TRAMS, &c.					
Anglo-Arg. Trams. First Pref.	Nil	Nil	8¾	+ ⅛	—
do. do. 2nd Pref.	—	—	2	—	—
do. do. 5 Deb.	5	5	57½	—	8 13 10
Brazil Tractions	—	—	49½	—	—
Bombay Electric Pref.	6	6	13½	—	4 11 3
British Columbia Elec. Rly. Pfds.	5	5	55½	—	9 3 0
do. do. Preferrred	2½	5	48½	—	10 6 2
do. do. Deferred	Nil	3	44½	—	6 14 10
do. do. Deb.	4½	4½	53	—	8 3 6
Mexico Trams 5 per cent. Bonds	Nil	Nil	28½	—	Nil
do. 6 per cent. Bonds	Nil	Nil	20	—	Nil
Mexican Light Common	Nil	Nil	12½	—	Nil
do. Pref.	Nil	Nil	2½	—	Nil
do. 1st Bonds	Nil	Nil	41	+2	—
MANUFACTURING COMPANIES.					
Babcock & Wilcox	15	—	9¾	—	£5 4 6
British Aluminium Ord.	10	10	1⅞	—	9 6 9
British Insulated Ord.	12½	15	1⅛	—	7 14 8
Callenders	25	—	8	—	7 16 0
,, 6½ Pref.	6½	6½	4¾	—	6 16 10
Castner-Kellner	20	—	4	+ ¼	5 0 0
Crompton Ord.	10	—	21/6	—	9 6 0
Edison-Swan, "A"	10	—	1⅜	+ ⅛	8 8 0
do. do. 5 per cent. Deb.	5	5	79½	—	6 5 9
Electric Construction	10	—	21/-	—	9 10 6
Gen. Elec. Pref.	6½	6½	18/-	+6d.	7 4 5
do. Ord.	10	—	1⅛	— ⅛	£6 8 0
Henley	25	15	2	— ⅛	7 10 0
do. 4½ Pref.	4½	4½	3½	—	6 18 6
India-Rubber	10	—	13½	—	£7 11 0
Met.-Vickers Pref.	—	8	2⅛	—	6 16 6
Siemens Ord.	10	10	26/-	—6d.	£7 13 10
Telegraph Con.	20	20	22½	—	£5 6 8

* Dividends paid free of Income Tax.

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THE LOWER SEVERN ELECTRICITY DISTRICT.

By H. M. S.

(*Concluded from page* 647.)

If the Commissioners sought for an area in which the industrial and population factors vary widely with a large proportion electrically undeveloped, so that their first scheme may be tested through a considerable range of conditions, this area seems to offer a good opportunity. It may be only a coincidence that Hereford, which is in the district, has the only supply undertaking which has definitely tried to cater for agricultural demands. There are those who think that electric supply in rural districts will prove of social and economic value, providing some encouragement to the development of village and home industries, some social amenities, as well as assistance to the agriculturist, and thereby promote an increase in the rural populations which social reformers agree to be desirable.

This district gives the Commissioners an opportunity of testing the theory, if they or others can finance the enterprise.

Another feature of the district is that outside Bristol and Bath the existing supply stations are on the small side, situated in small towns, each isolated from its colleagues by relatively considerable distances, so that interlinking is hardly practicable or of advantage. Also, no part of the area, excepting the Severn shore, appears to offer any facilities for the operation of a large economical station, whilst all parts of it can be reached by transmission lines not exceeding about 50 miles in length, a length which is very moderate compared with American and Continental practice. The conditions, therefore, give a super-station a rather better opening to show its utility, than will be the case in some other areas. It may prove that some of the small isolated stations will find a bulk supply cheaper than their own generating costs, especially as regards any increase in load.

Clearly, if this idea is in the Commissioners' minds, its success depends very much upon the way in which the possibility of supply stimulates the growth of demand throughout the district. As so much of it, including many large villages and small towns, is without a supply now, it is safe to suppose that there is already some unsatisfied demand to start with.

Authorised undertakers within the proposed district will naturally wish to know how the proposals of the Commissioners will affect them, and may bring forward a scheme which will propose the formation of a joint electricity authority with the proposers as the undertaker members. It would not be surprising to hear that such a scheme has already been put before the Commissioners in some form, though this is only guesswork.

But two things may be kept in mind. The first is that if a joint electricity authority is set up, that authority becomes an authorised undertaker for the whole of the district not covered by the areas of supply of existing undertakers, and is under the general obligation of an authorised undertaker to give supplies in the area. This obligation is not unlimited, but may be made mandatory by the Commissioners in respect of any area. It is, therefore, distinctly onerous.

The other is that the Commissioners may not accept any scheme submitted to them, but may amend it or formulate one of their own, and give effect to the amended or substituted scheme. These facts may have a considerable bearing upon the future of existing undertakings. The authorised undertakings in the district are somewhat scattered. Some of them are quite isolated, surrounded by rural territory outside their areas of supply, which does not tempt them to obtain extended powers. The extended power to use overhead lines, and the power of the Commissioners to make orders having the effect of provisional orders, may modify the conditions. What steps can they take to safeguard their interests? Circumstances differ so much in different cases that it would be foolish to offer any general advice. The owners of each undertaking should consider whether the organisation of the supply throughout the district is likely to benefit them, or whether they have anything to fear from it, and shape their course accordingly. The 1919 Act is not very difficult to understand, and a careful perusal of it will reveal the powers, duties, and responsibilities of the authority with reference to individual undertakings.

As before stated, it is known that some of the most important undertakings have conferred, with a view to co-operation in establishing a joint authority, and it may be expected that such a scheme will be put forward with Bristol in the forefront. Any authorised undertakers may, jointly or separately, propose schemes. Whilst other bodies than authorised undertakers may submit schemes, it does not seem likely that any such will propose schemes for this particular district.

The point is that no undertaker can be sure of being left outside the operations of a joint authority by merely refraining from acting with others in preparing a scheme. If such an authority is set up, every undertaking in the district will become subject to its supervision, and at the same time have a right to such benefits as the authority may be able to dispense.

There is, however, nothing to prevent any authorised undertaker from submitting a scheme for the improvement of the supply in its own vicinity.

If all the authorised undertakers in the district can agree upon a scheme in which their separate interests will be equitably treated, and the supply organisation demonstrably improved, the Commissioners will have to give such an agreed scheme very serious consideration. Naturally, in such an event, they will examine it rather closely from the public point of view, but the fact of unanimity will be a strong point. If discussion between the undertakers leaves some of them dissatisfied with the arrangement favoured by the majority, the dissentients will at least have the advantage of knowing what case they will have to meet at the local inquiry, and be prepared to set out their own objections and proposals for amendment.

Some of the undertakers, especially those who are most isolated, may fail to see any advantages to themselves from the operations of a Joint Authority. It appears to be open to them to submit schemes for local improvements, including the extensions of their own areas of supply. The powers given by the Act for the use of overhead lines and the compulsory acquisition of wayleaves may in some cases make this course quite attractive. But the Commissioners cannot grant them an extension of tenure, the one thing needful for small companies.

Another course open to any undertaker is to ask that the proposed area of the district may be altered by excluding the undertaker's area of supply. This can be done by submitting an objection or representation to the delimitation notice under Section 5, Sub-section (1), or the point can be raised at the local inquiry to be held under Sub-sec. (2). The prudent course is to submit an objection. The success of such an objection seems to be the only way in which an undertaking preferring to be left alone can attain that object. But success does not seem very likely, unless it can be shown that the isolation desired will enable the said undertaking to serve the public better than when working under a joint authority. The Commissioners may be expected to examine such a proposition very critically.

It must be remembered that the Commissioners may approve one of the schemes submitted with or without modification, or if no scheme submitted is approved, the Commissioners may themselves formulate such a scheme. Also that the scheme approved does not necessarily include the formation of a joint authority. But as the Commissioners have formally stated that it appears to them that the existing organisation for the supply should be

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improved, it is extremely unlikely that things will be left in *statu quo*. That would be an admission by the Commissioners that what they have said should be done, cannot be done.

Under the Act of 1919 no generating station or other property of an authorised undertaker can be acquired by a joint electricity authority without the consent of the owner. But the amending Bill of this Session proposes to empower the Commissioners to establish either a joint electricity authority or a District Electricity Board in any district. A District Electricity Board will take over all the generating stations in the district by compulsory purchase on the terms which were so strongly opposed in the discussions on the 1919 Bill. The opposition last session, and the pressure of time, led to the Government withdrawing these provisions. The 1920 Bill seeks to restore them, with the very important addition that the compulsory purchase powers may (but not shall) be conferred on joint electricity authorities, as well as district electricity boards.

Whether the Commissioners will be in possession of these additional powers when they come to approve or formulate a scheme for the Lower Severn district, cannot yet be said. The Bill has not yet passed its second reading in the House of Commons, a good deal of opposition has been organised, largely on the Government side of the House, and the Irish Bill will block the way for some weeks.

But as the local inquiry will take place after July 31st—one would say in September at the earliest—the fate of the Bill will be decided before the Commissioners have to approve or formulate a scheme. It is not uncharitable to suppose that this fact had something to do with the fixing of the date. It is, however, rather embarrassing for the undertakers who do not know whether the Commissioners will, or will not, have the power to make a scheme with compulsory purchasing powers. It may conceivably make all the difference to their attitude towards any scheme which may be discussed among themselves.

There is this to be said about it. If the authorised undertakers, or a substantial majority of them, can agree upon a scheme which is calculated to meet the public requirements without the introduction of compulsory purchase powers, there seems no particular reason why the Commissioners should put in those powers, supposing that the present Bill has been passed. And if any undertaker considers that it would be to his advantage to transfer a part, or the whole, of his undertaking to the Joint Authority, the scheme may include provision for such transfer on agreed terms.

The weak point of the 1919 Act is that there is no provision for financing Joint Electricity Authorities. Whilst the Act contemplates that these bodies may purchase land, generating stations, and whole undertakings, and prescribes that the consent of the Electricity Commissioners shall be obtained to any proposed capital expenditure, there is not a word showing how the authorities are to raise the necessary capital. It is true that the scheme setting up an authority "may contain any consequential, incidental, and supplemental provisions which appear to be expedient or proper for the purpose of the scheme," and perhaps borrowing and other financial powers may be held to be covered by the words quoted. Also the scheme may provide for the exercise by the Joint Authority "of all or any of the powers of the authorised undertakers within the electricity district," which certainly seems to cover borrowing and other financial powers, including the borrowing powers of municipal undertakings on the security of the rates.

It seems, therefore, that any scheme approved or formulated by the Commissioners must incorporate provisions for financing the authority, with sufficient elasticity to allow for future development. This part of the scheme will not be the easiest to arrange.

To revert to procedure. When the Electricity Commissioners have approved or formulated a scheme, they are to publish it, and to hold a public inquiry on it. After that, they make an order giving effect to the scheme, possibly with modifications resulting from the last-named inquiry, present it to the Ministry of Transport, which may confirm the order, with or without modifications. The order has then to be laid before each House of Parliament, and is not to come into operation until it has been approved—with or without modification—by a resolution passed by each House. With these approvals the order giving effect to the scheme will have the validity of an Act of Parliament. It may be altered at any future date by an order which has passed through the same procedure.

It may be useful to recapitulate the steps of this procedure :—

1. Notice of provisional delimitation of electricity district by the Commissioners.

Objections or representations regarding the inclusion or exclusion of any area in the proposed district may be submitted, and if such are submitted the Commissioners have to hold a Local Inquiry No. 1.

2. Notice that it appears to the Commissioners that the organisation of supply in the district should be improved, and inviting authorised undertakers and certain other bodies to submit schemes for its improvement within a definite time.

The Commissioners have to hold a Local Inquiry No. 2 into this matter. At this inquiry questions of the inclusion or exclusion of any area in the district may be raised, whether Local Inquiry No. 1 has been held, or not, and it is only after No. 2 inquiry that the area is to be finally determined.

The Commissioners evidently consider that these two notices may be issued simultaneously.

3. Publication by the Commissioners of any scheme which they may have approved or formulated, and the holding of Local Inquiry No. 3 thereon.

4. Presentation by the Commissioners of an order giving effect to the scheme decided on as the result of Inquiry No. 3 to the Ministry of Transport.

5. Confirmation, with or without modification, of an order so presented, by the Ministry of Transport.

6. Approval by each House of Parliament by a resolution of an order so confirmed, with or without modification.

There will be opportunities for parties interested to present their case :—

1. As to the inclusion or exclusion of any area, by objection or representation, at Local Inquiry No. 1 ; and at Local Inquiry No. 2.

2. As to schemes for the improvement of supply, by the submission of such schemes, at Local Inquiry No. 2, and at Local Inquiry No. 3.

3. Generally by representations to the Ministry of Transport with respect to an order giving effect to any scheme, before the Ministry confirm it.

4. Generally, in discussion in Parliament on the resolution to confirm any order, if they can find a member of either or both Houses to put forward their views.

The Commissioners and the Ministry of Transport may make rules in relation to the various inquiries and other proceedings above summarised. Until these rules—which have to be laid before Parliament—have been made, nothing more definite can be said as to how action is to be taken under headings 1, 2 and 3. As to No. 4, there are no rules, but there are manners.

The Electrical Resistivity of Iron.—At the annual meeting of the Iron and Steel Institute, Mr. A. L. Norbury discussed the effect of various elements on the electrical resistivity of iron, and gave a *résumé* of the most important papers on the subject, up to and including that of Benedicks in 1902. He showed that Benedicks's method of plotting the resistivity values of quenched carbon steels on a straight line, and extrapolating to 7·6 microhms as the resistivity of pure iron, could not be considered correct. Recent determinations gave 9·9 microhms per centimetre cube as the resistivity of pure iron at 20°. The results obtained by recent investigators showed that equi-atomic quantities of different elements dissolved in iron did not increase the electrical resistivity to exactly the same amount. A new factor depending on the electronic properties of the particular element in solution determined the atomic resistivity increase in each case. The problem of calculating the electrical resistivity of a steel from its chemical composition was briefly discussed.

In a paper by Prof. C. A. Edwards and Mr. A. L. Norbury on the effect of heat treatment on electrical resistivity, it was stated that in the annealed condition the effect of chromium was to raise the resistivity of iron by 3·75 microhms for each 1·0 per cent. in excess of 4·3 times the carbon content. It appeared that the effect of chromium upon the resistivity of iron was to cause an increase of about 5·1 microhms per cubic centimetre for 1·0 per cent. held in solid solution.

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THE ELECTRIC PROPULSION OF SHIPS.

By R. J. BUTLER, M.I.N.A.

(*Abstract of paper read before the* Greenock Association of Engineers and Shipbuilders.)

It is the purpose of this paper to consider some aspects of what appears to the author to be the logical outcome of the geared turbine for ship propulsion, namely, the substitution for the mechanical means of speed reduction of a method which shall be more in keeping with developments in the transmission of power in other industries, *i.e.*, an electrical one. In putting forward a proposition, no matter how great the technical merits of the scheme may be, it is necessary to offer the prospective buyer either a cheaper price or to produce indisputable evidence that an extra outlay will be more than recouped in a short period; and that definite advantages result from this increased initial expenditure. To the shipowner the cost per ton-mile of goods carried is the criterion by which his machinery is judged, always, of course, assuming reliability of the equipment.

In the original paper a list of the electrically-propelled vessels so far completed is given, besides which there have been six other installations completed, including three 3,000-h.p. set by Japanese firms, some smaller repeat vessels for Swedish owners, and some 40 vessels aggregating about 70,000 h.p., are under construction, principally for Scandinavian owners; all these sets are equipped with Ljungstrom type generators. It must be conceded that there is another side to the picture, and the principal objections levelled against the system are:—

1. Additional first cost. It may be stated broadly that the average increase of cost over, say, double mechanical reduction turbines should not exceed 20-25 per cent. for a tramp steamer of moderate size and diminishes with an increase of power.

2. Difficulties of cooling the generators and motors. This is a serious problem, as 5 to 6 per cent. of the total energy through the machines is dissipated in heat, but can be much assisted by intelligent grappling with the ventilation system. Sir Charles Parsons employed water to cool the rotors of generators some years ago, with very successful results. For marine propulsion the provision of cooling water to the stator also appears to be a very desirable object, and Mr. J. Shepherd has shown how this can be arranged.* Practically the whole of the heat so generated can be returned to the boiler. Further, the system would practically eliminate fire risks; at present a flash over is fed by the forced draught of the cooling air. It is realised that very careful construction would be necessary to obviate damage to the electrical parts by water leakage, but the system appears feasible, and, moreover, prevents deterioration and other troubles from salt air, which is extremely destructive when moist and warm.

3. Speed regulation and drop in motor efficiency. This cannot be strictly alleged as a disadvantage, and will be touched upon later.

4. The effect of helm on propelling motors running at synchronous speeds. In a twin screw vessel, when the helm is put over, the revolutions of one of the propellers show a large drop, depending on the direction of turning or, in other words, to keep up the revolutions requires a large increase of power. In the case of A.C. motors running at approximately synchronous speed, the effect of this is equivalent to an increase of propeller torque, and the motors must be designed to meet this virtual overload. Moreover, when going astern, full motor torque will be available, seeing that the synchronous speed will be maintained or nearly so. At the same time, induction motors could not lose their speed to the same extent as a steam turbine, without falling out, but trial results on the point are, as far as I know, not yet published. As an offset to this, if the load be removed, for example, by shedding a blade or breaking a shaft, the motor will not race.

5. The loss involved in transmission due to the inherent principle of converting mechanical into electrical energy and then back again to mechanical. Whilst it may be conceded that the loss is to some extent greater than with straight mechanical transmission, yet the disparity is very small, and is more than balanced by the advantages obtained. The average figure taken for single reduction gear loss is 2 per cent., and it has been common practice to assume 4 to 5 per cent. for double reduction gearing. This figure is, probably, too low, particularly at fractional loads. Some experiments carried out by the G.E. Co. of America showed an efficiency of 94½ per cent. for double reduction gearing, and a figure of 93 per cent. is attainable with the electric drive if properly designed. Bearing in mind that a considerable gain accrues from not having to drive an astern turbine whilst running ahead, 1½-2 per cent. should be about the difference involved. Further, mechanical gearing can hardly be expected to maintain its prime efficiency over a number of years of working.

It appears that the greatest scope for the system is in large vessels of the battleship and cruiser type where economy is vital at reduced powers and speeds and where the military and strategic aspects of the installation are unequalled by any other. Also in the case of high-powered mercantile vessels the system offers advantages in weight and space occupied. The case of small steamers of the tramp type is not so attractive, although the steam and fuel consumption of vessels tried out is certainly excellent. In the case of the *Wulsty Castle*,* the results of three long voyages come out at 1.05 lb. of coal of poor quality per I.H.P.-hour for all propelling purposes, which is some 9-10 tons better per day than a reciprocater of the same size. This, together with the increased cargo capacity attainable by placing the motors aft, the most prominent feature.

One of the objections urged against electrical driving is that it involves the carrying of skilled electrical as well as steam engineers. All engineers, if worthy of the name, have at least a smattering of electrical knowledge, and provided the gear be made of the simplest character and as fool proof as possible, and of the same general nature as is already found on ships, it is submitted that this argument does not carry a great deal of weight.

As regards reversibility, the writer himself saw the ease with which this was done on the *Wulsty Castle*, the average time being 7 seconds ahead to astern, whilst the *New Mexico*† is stated to take from 7 to 9 seconds for the same operation. The turbines can also be started from cold in about 12 minutes, a vast difference from the old lengthy period of warming up.

D.C. is neither technically nor commercially a sound proposition for any but the smallest installations. The limitation of pressure means that very high current densities must be carried, and the size of the cables, commutators, brush gear, and windings becomes so large as to make the expense prohibitive. Moreover, large commutators and brush gear limit again the speed of the prime movers, so that, unless mechanical gearing is introduced, the turbine speed necessary is not the most economical one, and the turbine is itself of increased size, due to the restricted rate of revolution. With large commutators, moreover, a flash over might possibly stop the ship. These considerations, together with the heavy upkeep of commutators and brushes, have ruled out the D.C. machine for all but submarines, where current is supplied from storage batteries. All other installations have employed A.C. to date.

The main turbo generators will not differ largely from land practice, until the advent of water cooling mentioned earlier; they are usually of the 3-phase bipolar type with, in small machines, an integral type exciter, and in large sets with separate source of supply for this purpose. The number of turbines should, in any case, be two, and in all installations so far no stand-by generator has been provided, but both generators operate in parallel. In the case of the *New Mexico* the machines are of two phase design, but this is the only example of the type I am aware of. The voltage at which the machines work is partially determined by the method of driving auxiliaries, but in practice the pressure has been increasing up to 4,242 volts in the *New Mexico*; 3,000 volts would appear to be the most suitable figure, giving moderate size cables, but there seems to be no reason why, in the future on large vessels, pressures of 6,600 volts or even higher should not be employed.

The turbines should be arranged for as high a superheat as is possible without unduly affecting the economy of the steam generators, so as to take every advantage of the absence of an astern turbine, and it is in this respect that the Ljungstrom type with its known capability of standing any practicable temperature without distortion is so satisfactory, irrespective of its high economy.

The vacuum should be as high as is obtainable compatible with the sea temperature conditions of the waters traded in and provided that the power expended in obtaining it does not neutralise the gain in efficiency.

In designing both the generators and motors, it must be borne in mind that a large overload torque is necessary to pull up the ship when going full ahead and then suddenly reversed. In the case of the *New Mexico*, this condition was met by temporary over-excitation of the generator fields, a booster being put in for this purpose. As this overload only occurs for a very short period, and is automatically cut out, there is no danger of overheating, and the generators can be designed for normal load, if provision for this condition is made. The main motors can be either of the squirrel cage or slip ring type.

If motors of the squirrel cage type are desired, the rotor conductors must be specially arranged so as to provide the characteristic of starting on load, which the ordinary squirrel-cage motor will not do. In the *New Mexico* the rotors are provided with inner and outer conductors, one of high

* Elec. Rev., January 16th, 1920, *et seq.*

* Elec. Rev., May 17th, 1918.

† Elec. Rev., May 10th, 1918.

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resistance and one of low resistance with a deep air gap between the windings; this, however, is the only modern example of this method. The advantages thereof are so great, viz., it eliminates the necessity of fitting liquid resistance in the circuit, that it is thought the scheme will be more generally adopted. In the case of other vessels, the slip-ring type of motor is used with liquid variable resistances in the circuit for providing the necessary starting torque. If two economical speeds are required double windings on the motors will be provided, but this should only be necessary in the case of battleships, and will not, of course, be required in the case of mechant steamers running at constant speed, for which the motors can be wound of the ordinary induction type. In some cases of high power and low propeller revolutions, it may be necessary to insert a helical gear reduction between the motors and the shaft, but this should be avoided if at all possible.

Speed regulation is at present accomplished by: (*a*) Changing the speed of the turbine, *i.e.*, altering the periodicity and voltage. (*b*) Insertion of resistances. (*c*) Change of voltage without change of generator speed. (*a*) and (*b*) are the usual methods in modern ships, and can be done readily on all A.C. installations. In ordinary land practice, the revolutions are maintained constant with change of load and steam consumptions of turbo-alternators are given by makers at full and fractional loads with the speed constant. This condition does not apply at sea, the revolutions being a function of the ship's speed required to overcome the resistance to movement through the water. Information concerning alternator and motor efficiency under these conditions is practically impossible to obtain. In this connection, when the *New Mexico* was built a propeller model was made and the torque and speed plotted; the motors were then designed from the information so obtained, one of the figures obtained being the overload torque on rapid reversal already discussed. In most cases, it is to be presumed, the motors have been made of amply large size, without elaborate investigation, and the appearance of existing sets goes to confirm this supposition.

Much yet remains to be done in the evolution of the control gear suitable for use on shipboard, where the conditions are so very different from those obtaining in power stations. Great care in the design and fitting up of all switchgear, instruments, &c., must be exercised to exclude wet salt air, and sometimes coal dust. The provision for running cables where out of reach, but readily accessible for examination, must be very carefully considered, and they should be placed in positions where there is no danger of flooding; particularly should they be kept out of bilges.

The Diesel engine is now rapidly overcoming prejudice and gaining the confidence of shipowners, and for reasonably low powers, say, up to 3,000 B.H.P., is a powerful rival to the steam equipment.

The disadvantages of the lack of experience of builders leading to breakdown at sea; the weight of machinery per B.H.P. developed, and the comparatively high price of the equipment compared with steam plant, are being steadily reduced, and the day appears not far distant when the two systems will have drawn level on all three scores.

The average consumption of ½ lb. of oil per B.H.P.-hr. cannot be approached by steam, although the consumption of lubricating oil to some extent offsets the saving in running costs. With direct-connected Diesel engines, where the speed of rotation is moderately low, say, 125 for 1,000 B.H.P., the weight heretofore has been excessive, and should higher speeds be adopted with a view to cutting weight and price, a diminished propeller efficiency results. Mechanical gear has been fitted in one or two recent American vessels, with apparently successful results, but the insertion of an electrical reduction appears preferable, in that it abolishes the great bugbear of starting and reversing the Diesel engine. The maximum speed of, say, 500 R.P.M., corresponding to highest submarine practice, is eminently suitable for D.C. generation so that in this respect D.C. generators and Diesel engines approach their maximum suitable power and speed together. It is doubtful, however, if this fast-running type will ever prove to have the necessary reliability, which it must have in the rough and tumble of commercial work; submarine engines being notoriously of a kind that require much nursing and tuning up.

It will be seen, then, that the Diesel electric combination drive has not the attractions of a turbo-electric drive, where both turbine and alternator essentially need high speed for operating at maximum efficiency. It should be added that no electrical difficulty should arise, except that overload conditions cannot be met so readily as in the turbo-driven plant, especially when the boilers are oil fired.

Turning now to a consideration of the auxiliary machinery, an enormous saving of fuel consumption results from the ability to drive these electrically, at a cost of, say, 15 lb. of steam per H.P.-hr. (including all losses), against some 40 lb. (a very conservative figure) for the direct steam-driven machines. It will be noted that the source of supply of exhaust steam for feed heating is removed, but as shown above, either the water-cooled alternators themselves can be arranged as feed heaters, or if cooling air is adhered to, a supply of low-pressure steam can be bled from the turbines at a stage where the pressure is appropriate. The absence of auxiliary steam and exhaust pipes, with their accompanying radiation losses, is a source of further economy, and relieves space congestion.

It has always appeared remarkable that the electric driving of auxiliaries in ordinary vessels, with an internal combustion engine generator, has not appealed to superintending engineers as a fuel-saving proposition of high merit. It remains to be discussed whether the auxiliary plant motors should be D.C. or A.C., and at what voltage. These are questions which must be dealt with on the merits of each specific case. In the first place, in a small vessel, where the percentage of auxiliary power to propelling power is high, the demand for energy in harbour will be the determining factor, and it would probably pay to run one of the main generators (there should never be less than two installed) at reduced load, rather than fit a separate unit for auxiliary purposes.

In larger ships where the power required for auxiliary purposes is fairly considerable, but a small percentage of that of one of the main generators, it would pay to install one or more machines solely for this purpose, and if the auxiliaries are to be run with D.C. motors, these supplementary sets may be arranged to excite the main fields also, with, of course, provision for regulating independently.

In any case, we are confronted with fitting the auxiliary motors to take a supply either: (*a*) A.C. direct at voltage of the main or auxiliary generator. (*b*) A.C. at reduced voltage through static transformers, either from main or auxiliary sets. (*c*) D.C. at reduced voltage through a motor converter, either from main or auxiliary sets. (*d*) D.C. at any desired voltage direct from separate D.C. machines.

(*a*) Unless the propelling power is very small, the generator voltage will not be sufficiently low to enable it to be used on the corresponding small A.C. motors direct. Moreover, high-voltage A.C. motors of small H.P. are difficult to build and maintain, have not very flexible characteristics, nor in the case of a breakdown can they be readily repaired or replaced from stock, unless the voltage and periodicity are the standard of the country in which the ship happens to be. This system is fitted in the *Wulsty Castle*, but has little except simplicity to recommend it; in this case the voltage is 650 and periodicity 60, which voltage is not a standard in any country.

(*b*) This is a more satisfactory method. The periodicity question still holds here, and in both cases (*a*) and (*b*) when annual survey is being carried out and all steam raising plant is out of operation, it is very unlikely that the shore supply would be of the same voltage and frequency as that provided on board.

The control of small motors, *e.g.*, for air and circulating pumps, where flexibility is such a desideratum, is not so readily effected with A.C. motors, so that whilst (*b*) is superior to method (*a*), (*c*) appeals to me as readily meeting all the conditions. As far as is known the system is not yet fitted in any ship, and it suffers from the introduction of another moving link in the chain, and whilst the efficiency of the converter is not so high, nor is it so cheap as the static transformer, yet seeing that the auxiliary current will usually be some 6-8 per cent. of the main, the loss of economy will not be serious, and there are very great advantages to be derived from its employment.

Method (*d*) is that fitted in the American battleships, and fulfils the same requirements as (*c*). Two 300-KW. sets of which 60 KW. are used for exciting, are fitted, and their exhaust is led either to the feed heater or main turbines.

So far as weight and fuel consumption are concerned, there appears on paper very little to choose between the rival electric and mechanical double reduction gears, but reliable consumption data for the double reduction gear drive are not yet to hand, and such figures as have been quoted certainly do not bear out the glowing estimates which have been made.

In the opinion of the writer, the system of electrically-propelling ships has come to stay, particularly for large high-powered vessels. The Scandinavian nations and the U.S.A. are going ahead vigorously. Unfortunately the war dislocated all the British plans, but a revival should appear in the near future.

National Health Insurance.—The Ministry of Health makes the following announcement:—

The National Health Insurance Bill, which has just received the Royal Assent, makes important changes in the benefits and contributions under the National Health Insurance Scheme, to operate from July 5th next.

The object of the changes is to provide for an increase in the rates of benefit in view of the fall in the value of money. The normal rate of sickness benefit will be raised from 10s. to 15s. a week in the case of men, and from 7s. 6d. to 12s. in the case of women; disablement benefit will be raised from 5s. a week to 7s. 6d. for both men and women; and the amount of maternity benefit will be raised from 30s. to 40s.

In order to provide for the increase of benefits, the joint weekly contribution is to be increased from 7d. to 10d. in the case of men, and from 6d. to 9d. in the case of women, of which the employer's portion will normally be 5d. in each case. In certain cases where low wages are paid the employer will pay a larger, and the worker a smaller, portion of the joint contribution. The contribution cards from the week beginning July 5th next must in all cases be stamped at the rate of 10d. a week for men and 9d. for women; stamps of these values will be on sale at post offices.

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A NEW TYPE OF SHIPYARD CRANE.

By W. HOK.

(*Abstract of paper read before the* Institution of Engineers and Shipbuilders in Scotland.)

Some eight years ago it was decided by the Lindholmen Shipbuilding and Engineering Co., of Gothenburg, to lay down three new berths for the construction of ships up to 12,000 tons deadweight. It became imperative to decide what kind of hoisting appliances should be adopted for the new berths, and in 1913 I set out to visit about 40 shipyards. I found that a large number of very efficient yards adhered to the ordinary mast and derrick arrangement. Invariably the hoisting winch, whether steam or electric, common to two or more derricks, was placed on the ground level, with the attendant trouble of having the hoisting rope leading from the winch to the derrick mast always entangled in bars and plates, staging uprights, and all sorts of rubbish. Besides, signal men placed here and there were part of this equipment, as the winch operator could not as a rule see what he was doing. Other yards were equipped with all kinds of expensive overhead travelling cranes, cantilever cranes, and revolving cranes.

Nobody seemed entirely satisfied with the crane arrangements he possessed. On the whole the tendency was to discard very expensive crane sheds, covered in or not, and to substitute cheaper arrangements.

I came to the following broad conclusions:—

1. The mast and derrick arrangement is quite satisfactory, provided it can be so arranged that all side staying of masts can be done away with.

2. The operator's platform should be placed high up above the ground so that the operator can see what he is doing, thus obviating the necessity of using signal men.

3. The lead from the hoisting winch to the derrick mast should be free from all obstructions.

4. A space or passage-way is desirable between contiguous ships to enable building material to be brought down between

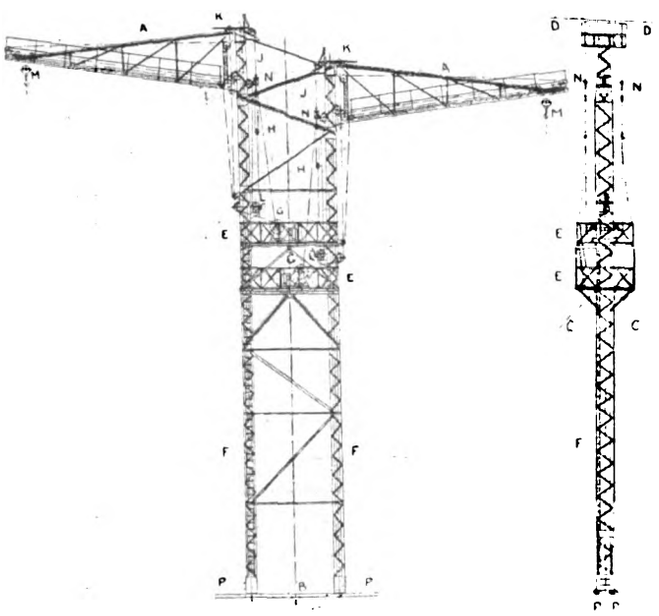

Fig. 1.—Side and End Elevations of the Hok Shipyard Crane.

ships and hoisted on board from the nearest point at the ship's side, and not from the ship's end only.

Guided by the leading features just mentioned, I designed the stationary building-berth crane here illustrated, eight of which are erected at the Lindholmen Works, and have been in good use since 1914.

It will be seen that the new type of berth crane is chiefly composed of a stationary main structure and two swinging arms, the former consisting of two lattice-work masts placed about 15 ft. 3 in. apart from centre to centre, and rigidly connected to one another by cross stays and trusses, making the main structure stable in the thwartship direction, thus obviating the necessity of fitting the objectionable side-stays which are an inevitable essential of the ordinary mast and derrick arrangement.

Each derrick frame carries two derricks or arms A, fig. 1, as shown, which can swing about 120 degrees to each side of a vertical thwartship plane through the derrick frame, *i.e.*, well past the centre line of railway B, laid down in the passage-way between contiguous ships. The derrick frame is held in place by fore and aft wire stays only, as shown in figs. 1 and 2, *i.e.*, by two sets of stays, the lower ones C being fitted, partly for giving rigidity to the frames in a fore and aft direction, partly for preventing collapse of a whole group of interconnected cranes in case for some reason the top end stays R, fig. 2, or some of the top stays D, figs. 1 and 2, fitted from crane top to crane top of that group should give way.

At a suitable place above the ground two operators' or winch platforms E, are built into the derrick frame, one above the other, access to which is obtained by ladders inside the frame legs F.

Each crane arm and the load are in the present case controlled from their appropriate platform E by a single ordinary A.C. electric shipyard-winch G, that is to say, controlled by one electric motor only. Hoisting and lowering are done with the winch centre barrel in the ordinary way, and slewing with the extended winch ends by taking a couple of turns round the appropriate extended winch end with the loose end of a tackle H, actuating the wire J which is carried round and fastened to the rim of the horizontal wheel K on top of the crane. The wheel is fixed to the top centre pin of the crane arm.

A spiral spring N is introduced above the slewing tackle for the purpose of taking up the inertia of the crane arm when it arrives at the extreme end of the swing, in this way preventing damage and unnecessary straining of the connections in case of rough usage or ignorance on the part of the man handling the crane; for the crane is so easy to manipulate that any ordinary platers' helper or labourer can officiate.

Racking is done with a small hand winch L. It will be noticed that the lower member of the arm along which the trolley moves is not horizontal, but slightly sloping. It is in this case purposely so arranged in order to make it comparatively easy to move the trolley towards the outer point of the arm, when there is no weight on the crane hook, and to make it very easy to move the trolley towards the derrick frame when the load is on; and for these reasons the trolley M is always moved, before the weight is on, as far out towards the extreme end of the arm as considered necessary in each individual case, after which it is a very simple matter to adjust the trolley in the direction of the derrick frame, if necessary, after the load is on. In practice this method has shown itself to be satisfactory and quite sufficient. If it should be preferred to manipulate the crane with three motors, one for hoisting, one for slewing, and one for racking (the member on which the trolley travels being in that case horizontal); it can, of course, be easily done.

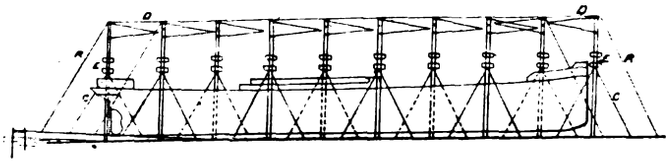

Fig. 2.—Berth Equipped with Cranes.

The frame legs stand on joists P, laid thwartship, and about 3 ft. apart—*i.e.*, the fore and aft dimension of the frame legs apart. These two joists are securely fixed to the solid rock, and the frame legs are securely bolted to the upper flanges of the joists. In this way is the transverse stability of the crane doubly secured.

The present cranes were built flat on the ground. When the arms had been fitted on to the frames and secured, the cranes were raised into a vertical position, and then screw-jacked into their absolute position. The frames have a height above the ground of 110 ft.; the section of each frame leg is 22 in. wide and 36 in. in a fore and aft direction. The crane arms are about 40 ft. long; the upper winch platform is about 60 ft. above the ground, the lower platform about 8 ft. below the upper one, and the height from the ground to the underside of crane hook in its highest position is about 90 ft. Ball bearings are fitted throughout. The clear distance between the frame legs is 13 ft. 6 in., thus admitting one or perhaps even two parallel railways between the frame legs and between contiguous ships. With these cranes 22 ft. only are required between contiguous hulls.

They were built to lift 2½ tons at the extreme end of the arm, but it was found that with a slight strengthening they could be made to lift 5 tons at the extreme end of the arm and 10 tons at about 10 ft. from the derrick frame.

One or both groups of cranes surrounding a ship can be shifted sideways without great difficulty.

Each crane, including one complete frame and two arms, but excluding winches and hoisting wire, weighs about 33 tons. These cranes are cheaper than any other existing hoisting appliance with the exception of the ordinary mast and derrick arrangement.

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THE BRITISH ELECTRICAL AND ALLIED MANUFACTURERS' ASSOCIATION'S DINNER.

ON Thursday last week the annual dinner of the Association was held at the Savoy Hotel. The Right Hon. Lord Ampthill, G.C.S.I., President of the Association, was in the chair, and there was a very large attendance, some 400 members and guests being present. Amongst the guests were Sir J. Fortescue Flannery, M.P., Mr. George Balfour, M.P., Sir John Wormald, C.B.E., Mr. C. Hamilton Wickes, C.B.E., Lord Carmichael, G.C.S.I., Sir John Snell, Lord Vaux of Harrowden, Engineer Vice-Admiral Sir George Goodwin, K.C.B., Rear-Admiral F. L. Field, C.B., Lord Ashfield, Lieut.-Col. Sir J. Dunlop Smith, K.C.S.I., Lord Sydenham, G.C.S.I., Mr. Andrew Fisher, Sir John A. Aspinall, Mr. James Swinburne, F.R.S., Mr. Roger T. Smith, President I.E.E., Sir Allan Smith, K.B.E., M.P., Sir Richard Redmayne, K.C.B., Sir J. E. Petavel, K.B.E., Sir Philip Nash, K.C.M.G., Sir William Clark, K.C.S.I., Mr. W. W. Lackie, Sir Harry Haward, Mr. C. H. Wordingham, C.B.E., Sir Frank H. Heath, K.C.B., Mr. G. Scott Ram, Mr. Archibald Page, Mr. C. Le Maistre, C.B.E., Mr. P. F. Rowell, Mr. Summers Hunter, C.B.E., Lieut.-Col. Mervyn O'Gorman, Mr. Michael Longridge, C.B.E., Mr. S. L. Pearce, C.B.E., Sir Thomas Robinson, C.B.E., M.P., and many other well-known engineers and leaders of industry.

Proposing "The King," the CHAIRMAN described him as the keystone of the arch of the constitution, and the bond of Empire, and eulogised his high qualities; he also drew attention, when introducing the following toast, to the splendid work of the Prince of Wales.

SIR JOHN SNELL proposed "The Industry," remarking that since 1916 no fewer than seven departmental committees had been appointed, on six of which he had served. The Electrical Trades Committee under Sir Charles Parsons showed that electricity was a key industry; combination at home was essential to successful competition abroad. The Electricity Supply Committee gave rise to the Electricity Supply Act, which was regarded on all hands as the great charter of electricity. The Coal Conservation and Water-Power Resources Committees showed how the national stores of energy could be better utilised, and the Committee on Electroculture had shown that an increased yield of 30 to 40 per cent. of grain and straw was obtainable. These committees, together with those on Imperial Wireless Communication and the Electrification of Railways, covered the whole gamut of electrical enterprise, and their work would bring about an era of prosperity in the electrical world such as had never been dreamt of in the old days. The output of energy from British electricity works rose from 1,300,000,000 units in 1913 to 4,500,000,000 units in 1919; five years of war had shown what an essential necessity electricity supply was, and in the next five years the output would be more than doubled again. The accompanying increased output of plant would bring improved methods of manufacture and lower the costs, besides developing export trade, and he predicted in ten years an unimagined prosperity for the whole electrical industry. He was glad to see that the Association was promoting the cause of education and research; we should train our own water-power engineers, for if the designing was done at home the trade would be kept at home—as a rule work followed the engineer. He was grateful to the Government for the colleagues given him as Electricity Commissioners. So far they were an extremely harmonious and hard-working body. No one could realise the immense amount of work that had accumulated; they had to perform all the electrical duties of the L.G.B., Board of Trade, L.C.C., &c., and in addition they had to develop their new procedure, bring the electricity regulations up to date (they were rather behind the times), study the whole country, and divide it into districts, promote new legislation, and deal with an immense number of extensions of plant. They had got under way with some celerity—the first district was published two weeks ago, the next was about to issue—but the industry must be patient till they had overcome the accumulation of five years. They had no idea of sweeping away all the existing stations and substituting 16 new ones, as the lay Press had it; they would weed out the bad ones, improve others, and add large complementary ones as required to meet industrial needs.

Sir C. ELLIS (Vice-president), in his reply, emphasised the importance of education and the provision of scholarships.

Mr. W. L. HICHENS proposed "The Profession," describing consulting engineers as the watch-dogs who prevented undue inflation of prices, and thereby benefited the industry, for it was important to keep prices low in order to retain the export trade. The Research Committee of the Association, he said, was doing excellent work, but every business should do some research of its own, and that was the soundest argument in support of the big amalgamations that had been taking place. The industry should also support research work at the universities more generously. He paid a tribute of admiration to the work of Mr. A. P. M. Fleming and his committee, which had produced a report on engineering training which everyone ought to read. They needed also a research into the ultimate aims of industry. Was it to amass private riches, or to produce the maximum wealth for the benefit of the community, or was it to promote the glory of God and the advancement of humanity? The root cause of industrial unrest was that they had no common ideal; co-operation was essential to the country's progress, but how could they expect it without an ideal?

Mr. ROGER T. SMITH, President I.E.E., replied, and pointed out that the war made it clear that science and research were the mainsprings of electrical industry. Only production was required in addition. The industrial engineer and the consulting engineer were of equal merit; the Institution of Electrical Engineers had for many years ceased to be a professional institution, and sought to represent every section of the industry, none more than the manufacturers' section. Their association, in connection with the Department of Scientific and Industrial Research, was a most important step; the Association and the Institution were also jointly represented on the Committees of the British Engineering Standards Association, whose specifications were a form of "protection" to which no party could take exception, and ought to become national standards.

Mr. JAMES SWINBURNE also replied, putting in a strong plea on behalf of the salaried members of the industry. He accused the Government of blank ignorance of the fundamental principles of the currency problem; it first debased the currency to half its pre-war value, and then, when an engineer was paid at double the pre-war rate to compensate for this, it took away one-third of his income by taxation. People had little idea how badly off the unfortunate salaried man was; let those who were in control of salaries realise that the Bradbury was only worth half a sovereign, if as much as that.

The CHAIRMAN proposed "The Guests," remarking upon the happy relations which prevailed between the buyers and sellers at that table.

Rear-Admiral F. L. FIELD, in reply, said that nothing had increased so rapidly in the Navy in the last few years as electrical plant. The Navy was now to be reduced, but he maintained that the smaller it was, the more perfect the material must be, and they must spend more money on research than ever before.

Sir ALLAN SMITH also replied, remarking that as the industry had survived seven committees, he was confident in its ability to continue to prosper.

Mr. W. O. SMITH (Chairman of Council), proposing "The Chairman," said that the absence of Lord Ampthill on military service for five years had been a serious loss to the B.E.A.M.A., but during the war their membership had doubled.

The CHAIRMAN, in reply, expressed his pride in presiding over the Association, which was helping to "win the peace." National security depended on economic security, which involved the ability of the nation to provide for itself all essential commodities without dependence on any foreign nation. The electrical industry, the handmaid to all other industries, was a key industry—and the B.E.A.M.A. was going to see that that key remained in the hands of Britain.

During the evening the band of H.M. Scots Guards played a programme of music, and all the arrangements were admirably conceived and carried out. The gathering will rank as one of the most important social functions of the electrical industry.

REVIEWS.

Telephonic Transmission, Theoretical and Applied. By J. G. HILL, Assistant Staff Engineer, General Post Office, London. Pp. xvi+308, 196 diagrams. London: Longmans, Green & Co. Price 21s. net.

This volume on telephonic transmission is the first of a series of manuals on telegraph and telephone engineering edited by the late Engineer-in-Chief of the Post Office, and now in course of preparation. If those which are yet to appear are analogous to the present one in their general structure and method of treatment, we shall be provided with material which will be of immense service to all telegraph and telephone engineers in everything appertaining to the lines and apparatus with which they have to deal.

Following a plan which a number of recent writers of text books involving somewhat advanced mathematics have adopted, the author gives a preliminary chapter to a statement of the more important formulæ which are brought into use throughout the book. This chapter will be particularly helpful to the student by the clearness with which the structure of the various formulæ, particularly those of hyperbolic functions is arrived at, although it is to be feared that the reader whose knowledge is confined to algebra up to the theory of indices, and a knowledge of ordinary trigonometrical formulæ, will have some difficulty in recognising $e^{jx}=\cos x + j \sin x$ as de Moivre's theorem.

The succeeding thirteen chapters deal with the "infinite" line and equivalent circuit, the loading and design of cables (all from the direct current standpoint), the human voice in telephony, application of alternating currents to lines, reflection and power in telephone circuits, the constants of telephone circuits, the loading of circuits, measurements on transmission lines, the standard cable and its uses, cost problems in transmission, transmission formulæ for lines in

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series with apparatus in series and in leak, and the thermionic valve as a telephone relay. It will thus be seen that Mr. Hill covers a wide field in his treatment of the subject.

The student, however, will find it necessary, before commencing a serious study of the transmission problems to thoroughly acquaint himself with the mathematical proofs given in the appendices at the end of the volume, having done which he will be in a position to follow the mathematical portions of the book. These portions are more or less restatements of the work done by the pioneers in the subject, along with their application, in illustrative examples, to present day problems.

In Chapter IX the author deals with the loading of telephone circuits comprising overhead, underground, and submarine lines, and the three types of loading, viz., continuous, series, and leak. Much useful information is given on this extremely important branch of telephonic transmission which has contributed so largely to the extension of the limits over which ordinary commercial speech was practicable. Not only has Mr. Hill dealt exhaustively with the advantages incidental to the several types of loading, but he also enumerates the disadvantages which may likewise be operative, *e.g.*, in the case of continuous loading, the limitations of the method are set forth seriatim. It would be interesting to know, in this connection, if the unequal ageing of the iron windings is still a possible objection to the method or whether it has been borne out by actual experience.

Chapter X is a particularly useful one, inasmuch as it is devoted to the measurement of impedance, and line constants; worked examples being freely interspersed in the text. A full description of the Franke machine, and its application to impedance measurements, is also given. An interesting account follows of the W.E. Co.'s cross-talk meter, and the method of using it in the estimation of cross talk from any disturbing source.

Not the least interesting chapter in the book is that dealing with cost problems in telephonic transmission, and here the author has not confined himself to purely academic statements or generalities. Starting from the electrical constants of some specific type of line, the equations of cost are built up, and curves are given which embody the results arrived at.

The final chapter is appropriately devoted to the latest development in the field of practical telephony, viz., the thermionic valve and its use as a telephone relay. Many attempts have been made since the telephone became a commercial success to introduce repeating devices, such as in the case of the telegraph, that would enable signals to be repeated at one or more points, and hence extend the limit to which it was possible to communicate; but all have proved more or less unsatisfactory. With the advent of the thermionic valve, however, new possibilities suggested themselves, and telephone engineers were not slow to avail themselves of the solution of a problem that had so long baffled them, which the valve offered them. Much good work has been done in the application of the valve amplifier as a telephone relay by the British Post Office; and although finality cannot be said to have been reached, even with Mr. Hill's anticipated 27 miles of standard cable improvement, we are nevertheless in possession of an agent which has given an entirely new trend to the efforts of those who are dealing with long distance telephony, and which in its revolutionary aspect, as regards existing means of communication, appears to be fraught with far-reaching consequences.

In seven appendices are given the mathematical proofs of the formulæ employed throughout, and an eighth appendix shows graphically the relation between x and e^{-x} from $x = 0$ to $x = 13.8$, and from $e^{-x} = 1$ to $e^{-x} = 1 \times 10^{-6}$ which will be found useful.

The book appears to be extremely free from typographical errors, but attention is drawn to page 166, fourth line from bottom, where "171 miles" should read "171 mils"; and on page 224, eleventh line from top, the final "d" of "designed" is inverted.

We expect that this volume will have a wide circulation, not only for its own intrinsic merits but because it is the production of one who has already done so much careful and extensive work in the field of telephonic transmission; and if the remaining volumes of the series promised by Messrs. Longmans are at all similar to the present one, in so far as letterpress and illustrations are concerned, little will have been left to be desired. A. F.

Guide to the Study of the Ionic Valve. By W. D. Owen, A.M.I.E.E. London: Sir Isaac Pitman & Sons. Pp. vii +58. Price 2s. 6d. net.

At a time when technical education is of such paramount importance, every new publication which will increase popular knowledge in the accomplishments of science has its value. During the war, the progress of wireless telegraphy was very rapid, and, owing to the conditions, the general public and the amateurs interested in wireless have had little opportunity of studying the new advances. The result is that there is now a general thirst for knowledge. That it helps to supply this knowledge to a slight extent appears to be the only excuse for the publication of this booklet.

The price of the book seems rather high for about fifty small pages of large type. There are fifteen chapters, each of them very elementary and discursive. The first contains the statement that "the assumption that electricity travels from positive to negative is incorrect." This sweeping assertion in capital letters is likely to give the elementary reader an unnecessarily rude shock, especially since no real explanation is given for the dramatic statement.

On page 11, after discussing the Fleming valve as a hot-to-cold electrode rectifier, the reader is directed to fig. 3. A plate battery, however, is shown in this figure, and the beginner for whom the book is written will undoubtedly wonder what object it serves. It is only later that rectification due to non-linear plate current variation is explained.

No mention is made of rectification at the saturation bend of the curve.

Referring to the use of a grid, the author states that "the additional electrode must be such as to have capacity with respect to the filament." As a matter of fact, the smaller the capacity of the grid the less will be the energy required to charge it to a given potential. It is an advantage to have the grid capacity as small as possible.

In chapter VII the author opens his remarks by an extraordinary demonstration of the principle of the valve as an amplifier. Two lines are drawn, one a steep one representing the straight portion of the grid voltage-plate current curve of a 3-electrode valve, and the other a straight line at 45 deg. representing Ohm's equation $C = E/R$. The explanation is that the valve "curve," being steeper, gives an amplifying effect. It is hoped that the reader will realise that the slope of the $C = E/R$ curve depends merely on the value of the R chosen. In any case, it is not possible to compare the result of Ohm's law with the effect of voltage in one circuit on current in another.

On page 39 the author tells his readers that the various types of tubes now used vary intentionally in degrees of vacuum. With the exception of admittedly soft valves, every attempt is made to exhaust valves to the highest possible degree in all cases.

The second half of the booklet contains practically no information, but is a hurried attempt to say *something* about each of the different applications of the valve. If published in 1917, the book might have been of some slight use, but now, when so much more complete information has been published in book form, there seems no need for a sketchy introduction to the subject.—John Scott Taggart.

Diesel Engine Design. By H. F. P. Purday. London: Constable & Co. Pp. xiii+301, 271 figs. 1919. Price 21s. net.

This book, based on 12 years' experience of Diesel engines, mainly from the drawing office point of view, presents an account of the main considerations which control the design of these engines.

The design of Diesel engines is now long past the rule-of-thumb stage; designers have agreed on many fundamental principles and general ideas of construction, and these same principles are not likely to be greatly changed. It is now possible to compute with accuracy the various stresses occurring in the component parts, and results can be foretold almost as closely as with the steam engine and turbine.

The progress made in the manufacture of Diesel engines can be seen from the fact that one foreign firm has built over 30 sets with an average indicated horse-power of 2,700, and is now building sets of engines up to 8,000 indicated horse-power, also one English firm is constructing four-cycle engines having an indicated horse-power of 6,600, which are proving a great success.

The first two chapters of the book deal with first principles and thermal efficiency. These provide a useful introduction to engine design and detail, and will be read with advantage by the student and engineering draughtsman.

Exhaust, suction and scavenge are dealt with very thoroughly, and the methods used in calculating areas are fully shown.

The principle of similitude, a very important subject when considering new types of engines, is dealt with in Chapter IV. The figures and tables given are based on a practical knowledge of modern engine design, and are very reliable.

Chapter V deals with crank shafts, and a considerable amount of space is devoted to the arrangement of cranks, order of firing, proportions of journals, twisting moments, and lubrication.

The design of fly wheels, and their application to Diesel engines, is fully considered, and a large number of examples are worked out

Framework, design of cylinders and cylinder covers, and running gear are all dealt with in a very able manner, and fully illustrated.

A description of the various fuel oil systems, both as regards the storage tanks and piping which are external to the engine, and the organs of the engine itself which are directly concerned with the delivery of the fuel to the working cylinder, is given and illustrated with useful line drawings.

Air and exhaust systems and valve gears are dealt with at the end of the book.

Mr. Purday's book is an extremely valuable and practical contribution to the literature on the Diesel engine; it is a pleasure to read, and can be strongly recommended to both students and designers for its completeness, conciseness, and

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intelligent selection of examples and illustrations. The whole book points to a thorough practical knowledge of the subject. The reference to literature (authors and publishers) which is inserted at the end of each chapter is to be commended.

E. P.

NEW PATENTS APPLIED FOR, 1920.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. Sefton-Jones, O'Dell and Stephens, Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

12,812. "Dynamo-electric generators for lighting cycles, &c." A. Bevitt and W. A. Hymas. May 8th.

12,819. "Circuit-controllers for internal-combustion engines." G. Fuegel and H. Schmid. May 8th. (United States, July 18th, 1917.)

12,820. "Magnetos for internal-combustion engines." G. Fuegel and H. Schmid. May 8th. (United States, July 18th, 1917.)

12,831. "Apparatus for rectifying high and low frequency alternating currents." J. Niesthold. May 8th. (Germany, May 15th, 1917.)

12,833. "Positive electrodes for electric accumulators." A. Pouchain. May 8th.

12,834. "Electric accumulators." A. Pouchain. May 8th.

12,835. "Rectifiers of alternating currents." Naamlooze Vencootschap Philips' Gloeilampenfabrieken. May 8th. (Holland, December 2nd, 1919.)

12,868. "Secondary or storage batteries." R. C. Houston. May 10th.

12,871. "Device for testing electric ignition plugs of internal-combustion engines." T. Marshall and J. Murtagh. May 10th.

12,879. "Apparatus for testing sparking plugs and induction coils." F. H. Clegg. May 10th.

12,909. "Selector apparatus for automatic, &c., telephone system." T. Lenaghan. May 10th.

12,929. "Means for measuring voltage variation in electric circuits." T. H. Harris. May 10th.

12,931. "Producing alternating currents." British Thomson-Houston Co. (General Electric Co.). May 10th.

12,934. "Apparatus for electrical transmission of power." J. H. McKenzie and A. H. Sproule. May 10th.

12,935. "Variable electrical resistance." J. H. McKenzie and A. H. Sproule. May 10th.

12,939. "Positive electrodes of electric accumulators." A. Pouchain. May 10th.

12,940. "Primary electric battery." A. Pouchain. May 10th.

12,943. "Electrical connectors." Western Electric Co. May 10th. (France, August 16th, 1918.)

12,945. "Telegraph cables." H. W. Sullivan. May 10th.

12,947. "Electric glow discharge lamps." H. Filippo, D. Lely and Naamlooze Vennootschap Philips' Gloeilampen-fabrieken. May 10th. (Holland, June 20th, 1919.)

12,953. "Electric furnaces having resistance conduits." J. R. de Zubiria y Smith. May 10th. (Spain, May 21st, 1919.)

12,954. "Electric furnaces having resistance conduits." J. R. de Zubiria y Smith. May 10th. (Spain, May 22nd, 1919.)

12,970. "Thermo-electric apparatus." W. H. Wilson. May 10th.

12,975. "Electrical mechanism and drive for gramophones, &c." R. H. Taylor. May 11th.

12,985. "Insulation for electrical conductors, &c." W. A. Powell. May 11th.

12,986. "Electrical heating and cooking apparatus." W. H. Miller. May 11th.

12,990. "Grips for electric lamp wire-holders." A. B. Goldsmith. May 11th.

12,999. "Electric lighting generator for cycles, &c." Exact Manufacturing, Ltd., and H. T. Moores. May 11th.

13,026. "Magneto drive for tractors." J. W. Thompson. May 11th.

13,029. "Device for testing and adjusting ignition coils and sparking plugs." J. Napier. May 11th.

13,039. "Telephone systems." Western Electric Co. May 11th. (United States, June 5th, 1919.)

13,042. "Means for producing alternating currents." British Thomson-Houston Co. (General Electric Co.). May 11th.

13,053. "Electric switches, &c." T. Watson. May 11th.

13,067. "Apparatus for extracting fuses or links on electric circuits." Callender's Cable & Construction Co. and A. E. Wilson. May 11th.

13,070. "Electrolysers." J. F. Webb. May 11th.

13,071. "Telephone systems." Western Electric Co. May 11th. (United States, September 10th, 1919.)

13,077. "Sparking plugs, &c." C. W. V. Harris, C. Johnson, A. W. Smith, T. E. Taylor and The Universal Welding & Engineering Co. May 11th.

13,086. "Thermionic valve transmitting circuits for wireless telegraphy and telephony." A. K. Mackorie and G. Shearing. May 11th.

13,154. "Telegraphic transmitter." Siemens & Halske Akt. Ges. May 12th. (Germany, February 28th, 1919.)

13,159. "Dynamo-electric generators and motors." F. R. F. Ramsay. May 12th.

13,160. "Radiogoniometers for wireless direction-finding, &c." G. M. Wright. May 12th.

13,166. "Electrically operated cranes, hoists, &c." J. Bentley and W. H. Scott. May 12th.

13,171. "Electric time-controlled switches." L. J. Larsen. May 12th.

13,182. "Electric switches." M. Mansell. May 12th.

13,184. "Electric reading lamps." Soc. Valenduco Freres et Dubois. May 12th. (France, May 30th, 1914.)

13,185. "Device for bonding and linking up steel tubing of electrical installations." C. Ferguson and A. E. Ryland. May 12th.

13,194. "Telegraph printing systems." Automatic Telephone Manufacturing Co., H. H. Harrison and S. R. Smith. May 13th.

13,212. "Glass reflector for electric safety lamps." A. G. Gulliford. May 13th.

13,216. "Electric switches." S. E. & W. Hall. May 13th.

13,217. "Short-circuiting electrical devices." A. A. T. Creser. May 13th.

13,239. "Signalling apparatus." D. M. & W. Ritchie and J. Smith. May 13th.

13,240. "Electro-plating by electrolytic thermic means." J. Hess and F. Kirschner. May 13th. (Austria, October 10th, 1917.)

13,245. "Electric burglar alarm." L. J. & W. J. Allbright. May 13th.

13,257. "Incandescent electric lamps." E. Bergery. May 13th.

13,262. "Galvanic batteries." L. Fuller and Fuller's United Electric Works. May 13th.

13,272. "Apparatus for electro-deposition of metals." S. O. Cowper-Coles. May 13th.

13,275. "Self-induction coils for telephone circuits." Soc. Industrielle des Telephones. May 13th. (France, May 22nd, 1919.)

13,276. "Electric heating devices for treatment of hair." F. Kerr and Marcel's Permanent, Ltd. May 13th.

13,277/8/9/0. "Resistance switches for controlling intensity of electric currents." N. C. Francis, A. E. Quennell and J. Watkinson. May 13th.

13,281. "Receiving-apparatus for wireless telegraphy." C. T. Hughes. May 13th.

13,298. "Sparking plugs." C. M. E. L. Monnier. May 13th. (France, March 26th, 1919.)

13,300. "Thermo-electric apparatus." W. H. Wilson. May 13th.

13,309. "Electro-plating barrels, dipping baskets, &c." F. R. Tubbs. May 14th.

13,327. "Electrically-operated motor vehicles." Hanso-Lloyd Werke. May 14th. (Germany, July 8th, 1919.)

13,330. "Means for connecting ends of electric, &c., cables." H. Sprofield. May 14th.

13,340. "Wireless telegraph and telephone circuits." C. Rover. May 14th.

13,352. "Thermionic devices." Western Electric Co. May 14th. (United States, November 1st, 1916.)

13,359. "Electric switches." E. T. R. Murray and G. F. Shotter. May 14th. (United States, May 14th, 1919.)

13,379. "Electrical cells." Ever-Ready Co. and C. S. Mummery. May 14th.

13,410. "Electric lanterns, &c." F. W. Thorpe and Veritys, Ltd. May 15th.

13,417. "Electric switches." R. H. Baker and C. W. Parsons. May 15th.

13,418. "Portable electric lamps." F. Bentley. May 15th.

13,428. "Electric heater for perforating, &c., devices." A. B. Cantell. May 15th.

13,431. "Magneto motor." D. Suchostawer. May 15th.

13,437. "Electric switches." British Thomson-Houston Co. (General Electric Co.). May 15th.

13,438. "Multiple electric cables." H. Bevis and Pirelli General Cable Works. May 15th.

13,455. "Devices for causing electricity to be supplied to instruments or circuits." A. R. Angus. May 15th.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1918.

14,567. Signalling apparatus. British Thomson-Houston Co. (General Electric Co.). September 7th, 1918. (141,764.)

17,650. Method of and apparatus for electrolysing a solution of nickel salt. C. Heberlein. October 29th, 1918. (141,766.)

1919.

1,420. Telephonic systems. E. A. Graham. January 20th, 1919. (141,776.)

1,457. Electric signalling apparatus. P. Francois. January 20th, 1919. (141,803.)

1,552. Arc-rupturing devices for electric switches. T. Zweigbergk. January 21st, 1919. (141,808.)

1,571. Electrically heated crucibles for use in type-casting. W. J. Mellersh-Jackson (Cutler Hammer Manufacturing Co.). January 21st, 1919. (141,812.)

1,643. Electric motors. British Thomson-Houston Co. and J. Martin. January 22nd, 1919. (141,814.)

1,668. Electric motor control systems. T. Zweigbergk. January 22nd, 1919. (141,816.)

1,747. Means operated by a rise in temperature for cutting-out electrical apparatus and for effecting mechanical operations. A. Dunhill. January 23rd, 1919. (141,820.)

2,054. Electro-magnetic variable-speed mechanism. E. Whiteley and R. Whiteley. January 28th, 1919. (141,823.)

2,810. Governors or speed-regulators for electric motors and other machines. H. G. Turnell. February 5th, 1919. (141,830.)

4,836. Electric lock-out switches. A. West & Co., V. Breeze and R. P. Bossom. February 26th, 1919. (141,849.)

6,140. Electrically-heated domestic or laundry irons. W. Cross & Son and J. I. Kirby. March 12th, 1919. (141,862.)

6,987. Systems of electric power transmission. British Thomson-Houston Co. (General Electric Co.). March 20th, 1919. (141,867.)

7,173. Control of electric motors. W. Brooke and E. M. Kerr. March 22nd, 1919. (141,870.)

7,478. Means for ensuring ignition of the working charges and preventing carbonising of the sparking plugs of internal-combustion engines. Auto-niters, Ltd., F. W. Hudlass and H. D. Smith. March 25th, 1919. (141,877.)

8,944. Brush-holders of dynamo-electric generators and electric motors. Efandem Co., W. Owen and F. E. Cutler. April 9th, 1919. (141,892.)

9,003. Electric time-indicating apparatus. H. E. Warren. April 15th, 1918. (125,953.)

9,655. Thermionic relay valves. R. Whiddington. April 15th, 1919. (141,900.)

10,158. Electrical connector for engine sparking plugs and other purposes. V. Bardin. January 16th, 1919. (137,803.)

10,770. Methods of and apparatus for automatically removing gases from electric discharge tubes and the like. British Thomson-Houston Co. (General Electric Co.). April 30th, 1919. (141,913.)

13,494. Oil-immersed water-cooled electric transformers. W. Lulofs & Ferranti, Ltd. May 28th, 1919. (141,946.)

14,790/1. Magneto-electric machines. C. Olivetti. June 11th, 1919. (14,554/5.)

17,276. Tool for use in cleaning sparking plugs. H. R. Wilks. July 10th, 1919. (141,975.)

18,632. Starting mechanism for magnetos of internal-combustion engines. W. Whiteley and F. Smith. July 28th, 1919. (141,986.)

23,108. Electric terminal-plates, terminal-sockets, and the like. A. Parkinson and F. & A. Parkinson. September 19th, 1919. (142,022.)

23,933. Electric switches. S. de P. Gorsky. November 9th, 1918. (135,167.)

24,719. Electric pocket lamps. Galvanophoren Werke S. Szubert Kommandit Ges. October 10th, 1918. (133,699.)

25,285. Electric pocket lamps. Cosmophos-Werke Akt. Ges. C. Boltshauser. October 15th, 1919. (142,031.)

27,250. Winding machine for the manufacture of hollow-insulating cylinders for electro-technical purposes. E. Haefeley et Cie. September 2nd, 1919. (142,039.)

28,160. Measured service telephone systems. Automatic Telephone Manufacturing Co. February 12th, 1919. (138,857.)

31,164. Ignition systems. Dayton Engineering Laboratories Co. February 22nd, 1917. (Divided application on 21,177/18.). (138,566.)

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THE

ELECTRICAL REVIEW.

VOL. LXXXVI. JUNE 4, 1920. No. 2,219.

ELECTRICAL REVIEW.

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THE ELECTRO-DEPOSITION OF IRON.

ALL users of machinery have been concerned on occasions at the necessity for scrapping important and valuable parts owing to a small portion having become worn. In high-speed machinery, such as aeroplanes and internal-combustion engines, and also in connection with guns, during the war, this became a serious problem, and considerable progress was made in developing the process of the electro-deposition of iron upon the worn parts. This not only had the effect of saving valuable parts from the scrap heap, but the saving in time and the greater speed in getting aeroplanes, guns, &c., back again into action, was of even greater importance. In commercial engineering of all kinds the process of electro-deposition of iron should find an important place, although, so far as we have been able to ascertain, the application of the process on a commercial scale is only being attempted to a small extent.

Yet quite a considerable amount of research has been carried out upon it, and much valuable practical experience was obtained in the Motor Transport and R.A.F. repair depôts in France, and also at Farnborough. The practical repair work by means of the process in the field was necessarily of a more or less unscientific nature viewed from the standpoint of the laboratory research worker, but the greatest possible credit is due to certain officers whose enthusiasm led to really wonderful results in the face of difficulties from both outside and inside. It was found possible, for instance, to deposit a layer of iron up to about 2 mm. in thickness on any simple cylindrical surface of wrought iron or steel, mild or cast, and although, in a paper just read before the Iron and Steel Institute*, Mr. W. E. Hughes, late chief research chemist to the Electro-Metallurgical Committee of the Ministry of Munitions, points out that the work was not done under proper scientific control, and that the results, although apparently satisfactory, were very far from being so in fact, an earlier paper before the Institution of Automobile Engineers, by Major B. H. Thomas, described the conditions under which the work in the field was carried out, which were very different from those obtaining in a laboratory. At the same time, Mr. Hughes did not intend his comment to be taken as adverse criticism, but only as pointing out some of the defects which may occur unless workshop conditions, in commercial practice, are much more scientific than they were, of necessity, under war conditions.

The necessity for quickly building up worn parts made itself felt in 1915, and in the third heavy motor transport repair shop in France, the process was applied under difficulties. The solution which was found to yield the best results was made up of ferrous ammonium sulphate at a strength of 75 grammes per litre of water, with a current density of 0·1 ampere per 30 sq. cm. The rate of deposition was 0·005 mm. thickness per hour, and the operation was carried out in separate vats of approximately 30 litres capacity. The general method of operation was to suspend the work in a vertical position in the vat,

* ELECTRICAL REVIEW, May 28th, p. 681.

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by means of standards fixed to the bench, which were provided with universally jointed arms fitted with clamps at the end to hold the work. The anode was then suspended from a rocker arm, and made to surround the work concentrically as, especially with thick deposits, it appears to be important to keep the anode as nearly as possible equidistant from the work at all points. The anodes were made of Swedish iron wire about 16 S.W.G., thoroughly annealed and wound into the form of a woven cylinder. They were suspended and stiffened by means of a ¼-in. iron rod on one side, which was attached at the top to the rocker arm. The anodes were fitted, in addition, with two celluloid cones to produce an upward pumping action. The effect of this action was found to be important, as it is essential to avoid having stagnant solution in contact with the work, and it is also desirable to keep the ferrous carbonate in the solution in a state of suspension. Some difference of opinion existed between the motor transport repair officers and the R.A.F. repair officers as to whether it was better to deposit the metal direct or on a thin film of copper. The latter view was held by the R.A.F., but on the other side, the efficacy of such a method was contested. The R.A.F. people apparently found that good results followed the practice of applying a thin film of copper and then a layer of iron, repeating the process when greater thicknesses were required. However, the advantages of one method over another are subjects for investigation and experiment. The point is that the work which was carried out during the war has opened up a prospect of considerable economies for machinery users by electro-deposition, and it is to be hoped that this valuable experience, gained at the public expense, will not be allowed to be wasted. It is improbable that private individuals in normal times would have been able to undertake such work, and good use should now be made of it.

German Electric Tramways.

It has been known for a long time past that conditions in connection with the electric tramways in Germany have been going from bad to worse, and the situation with regard to many undertakings is now becoming desperate. The chairman of one of the principal electrical manufacturing companies, which is also interested in a number of tramways, recently stated that nothing further could be gained by increasing fares. This statement is more than confirmed by the directors of a tramway company in Rhineland. They point out that it has been necessary to have recourse to raising fares in order to meet the increase in working expenses, but in this respect they have been opposed by the local authorities, who have placed great difficulties in the way of the introduction of higher fares. On the other hand, the municipal tramway fares have been advanced time after time, and in some cases the municipal councils have also increased the rates in order to endeavour to relieve the tramways—at the expense of the ratepayers in general. It is now proposed to attempt to solve the question of fares by arbitration, as in the case of the fixing of charges for the supply of energy, but experience has shown lately that increases in fares, far from yielding a larger revenue, are actually resulting in a decreased income.

The new advances made in the prices of coal with the consequential rise in the prices of materials, &c., will further prejudicially affect the working of the tramways. The charge made for power before the war to tramways not having their own generating stations, ranged from 5 to 10 pfennigs per KW.-hour; it now amounts to 40 to 50 pfennigs, and will further advance in the next few weeks, owing to the higher cost of coal. The question of introducing minimum fares of 60, 70, or even 80 pfennigs has been discussed by a number of tramway managements, but these have been vetoed by municipal bodies, on the ground of political considerations, recourse being again had to the indirect method of increased rates and taxes.

Some interesting examples are given in order to demonstrate the great increase in the cost of permanent-way material, rolling stock, &c., during the war. For instance, the sale price of tramway rails, which amounted to 139 marks (£6 19s.) per ton on the outbreak of war, reached 300 marks in March, 1919, and is now 3,200 marks per ton. The price of copper has risen from 1·50 to 52 marks per kilogramme in the same period of years; and the cost of a motor-tramcar has advanced from 15,000 to 200,000 marks, while the cost of maintaining or renewing the surface of the tramway tracks has also enormously increased. It is contended that the tramways can no longer continue to meet the heavy expenditure, and that they will be brought to a standstill in the near future—as has already taken place in the case of both private and municipal lines of minor importance—unless an improvement is brought about in some form or another.

"Situations Vacant."

In our "Correspondence" columns to-day, "J. C." approaches the vexed question of "Box numbers" and their associations from a somewhat novel point of view. As regards the inability of the applicant to guess at the identity of the advertiser, we may point out that our Advertising Department makes provision for the case in which the applicant desires that, if the advertiser is, say, "Mr. X," his letter shall not be forwarded to that quarter—such letters are destroyed. Again, the failure to acknowledge the receipt of replies to an advertisement, and to inform unsuccessful applicants as to the result, shows a lack of ordinary courtesy to which we have previously drawn attention; why should a man who answers an advertisement, but fails to secure selection, be treated as though he were a dog? To our mind the practice is a serious breach of good manners. The neglect to communicate with an applicant who has been granted an interview, and whose hopes have been raised thereby, is a still graver discourtesy, and may involve serious injury to the victim's interests, for he may refuse good openings whilst waiting in the confident expectation of securing the appointment. He has a clear right to be informed of his fate as soon as possible after the decision is made.

But the main point which our correspondent makes is of graver import. The suspicion that employers who are members of certain great associations have secret arrangements for preventing members of their staffs from moving from one firm to another within the same association, whether well-founded or not, has in the past given rise to much bitter feeling, and if it were justified in fact, would constitute not only a gross and illegal infraction of the rights of a free man, but also would be fraught with dire results to British industry in the long run. Our best and most worthy engineers and artisans would miss no opportunity of transferring their services to some country where freedom could still be found; to remain here under such a tyrannical *régime* would be unbearable.

Such suspicions, as our correspondent says, if not true should be allayed, and his suggestion that the subject should be brought to the notice of the Joint Industrial Councils is very commendable. It can, however, apply only to the case of members of Trade Unions, for the Councils as yet afford no representation to members of technical staffs, and the only instance in which this omission has been rectified is that of the staffs of power stations, who now have their Joint Industrial Board. So far as the field remains uncovered, apparently, we must look to the Society of Technical Engineers for appropriate action; and we are so frequently asked nowadays what that society is and what it is doing, that we suggest to its directors the desirability, or even the necessity, of its abandoning, at least in part, its customary secretiveness and telling the public something more of its aims and work.

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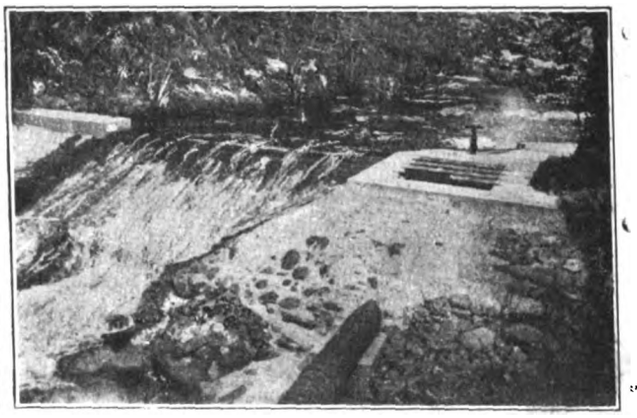
A MODERN ALL-ELECTRIC COUNTRY HOUSE.

By THOS. B. WRIGHT, A.M.I.E.E.

In December, 1918, the writer was instructed to prepare a scheme for lighting, heating and cooking required at a large country house, and told that it was all to be done with water power. In January, 1919, a few days were spent on the job, taking particulars, and principally surveying and levelling off the various alternative water-power schemes. Work was actually started early in February, and the installation was working on August 4th, 1919.

So far as we know, this is the first large completely electrical country house in the kingdom.

The Dam, from Up-stream side.



View of Dam, showing Overflow and Intake Tank.

The river passes near the house and is fast flowing, running in a rocky ravine, and is subject to very rapid rise and fall. It is fed by many good springs and a large hill loch.

A 6-ft. dam wall is built across the river, about 25 ft. thick at bottom and sloping up to about 6 ft. thick at top. The overall length is about 65 ft., and both ends are securely built into the solid rock. At the high end of the dam, starting behind the centre line is built a large concrete intake tank measuring 11 ft. 4 in. by 8 ft. 3 in., connected to the reservoir by a concrete duct about 6 ft. long by 4 ft. wide and 2 ft. 6 in. high. A heavy rough bar iron strainer of about 80 sq. ft. area is fitted outside this duct, in addition to a large cast-iron gate sluice. Inside the intake tank is the fine strainer made of perforated cast-iron plates.

From the intake tank about 260 ft. of 26-in. bore riveted steel pipe is carried on stone piers built on the river bank to a concrete connection tank, with manhole, and from this tank about 800 ft. of 27-in. bare special rock concrete pipes are carried underground to a second concrete tank with manhole. The head of water on this tank is about 20 ft. The relief pressure open-ended concrete pipe is taken from the base of this tank.

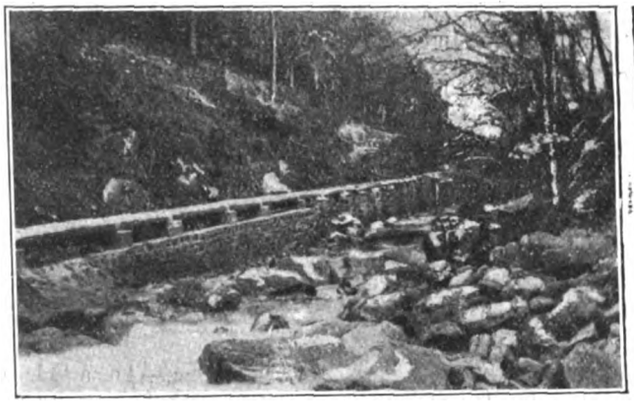
About 200 ft. of 26-in. bore riveted steel piping is carried on concrete piers downhill to the power house, special anchorage arrangements being made for the piping, which ends in a large cast-iron "Y" bend, each tail having a large slow-acting sluice-valve fitted.

The measured head is 96 ft., including 17 ft. of suction tail piping. The suction pipe discharges vertically into a concrete duct, from which the water returns to the river.

At present one turbo-dynamo set of 110 B.H.P., consisting of a Gilkes Francis turbine and an E.C.C. dynamo, is installed, and a second set of 50 B.H.P. is on order. The working pressure is 250 volts, but the generators are over-compounded to give from 250 volts at light load to 265 at full load. An oil governor is provided.

The main power house switchboard is built up of heavy marble slabs mounted in angle-iron framework, two panels control the generators, and a third panel the outgoing mains. The usual meters, switches, and fuse gear, &c., are fitted on each panel.

Three pairs of V.I.R. cables in tubing connect the switchboard with the outside overhead line. This line consists of three pairs of 37/14 S.W.G. bare copper wires run on poles about 20 ft. above ground level, protected at both ends by lightning arresters. The overhead line is about 300 yards in length, after which a pair of 0·5 sq. in. bitumen cables are laid solid to the house, a distance of about 210 yards.



Steel Pipe Line below Intake.

Concrete Pipe Line.

At the house the cables terminate at the main switchboard. This board has four heavy main switches (controlling the lighting, radiators, power, and cooking panels), and separate panels for the various meters, switchgear, and sub-fuses. A recording ampere-meter is fitted, from which most interesting records are being taken.

The switchboard is of polished white marble, and is

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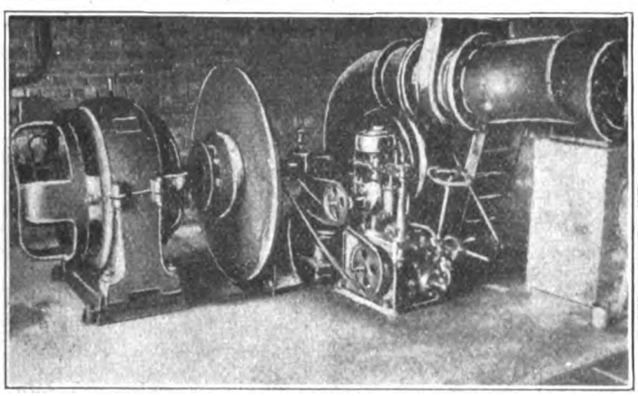
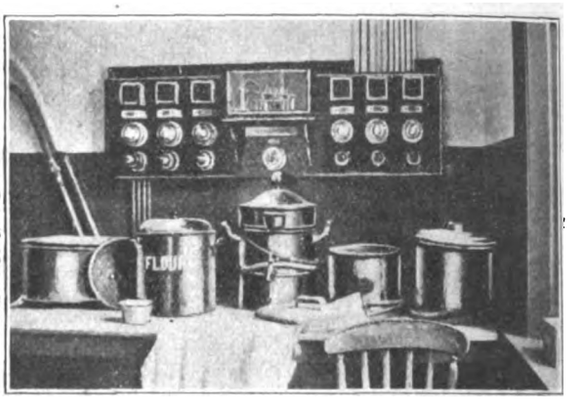
mounted with free access to all parts both back and front. The whole of the wiring work is carried out with C.M.A. cables run in heavy screwed steel tube in the contractor's usual standard manner.

The heating installation consists of about thirty 20-amp. radiator sockets and switches, fitted in all cases in special iron boxes in the skirtings, with brass face plates. Double-pole diamond H switches are used throughout. Each radiator socket forms a separate circuit from the main board. The radiators are generally of 3-KW. capacity each, with three-heat control, having elements made up of flat wire wound on mica. The heating of the house is much better than when coal fires were used. Normally the radiators are turned on full for from half an hour to an hour, then turned to half heat.



GILKES-E.C.C. TURBO-DYNAMO, WITH OIL GOVERNOR.

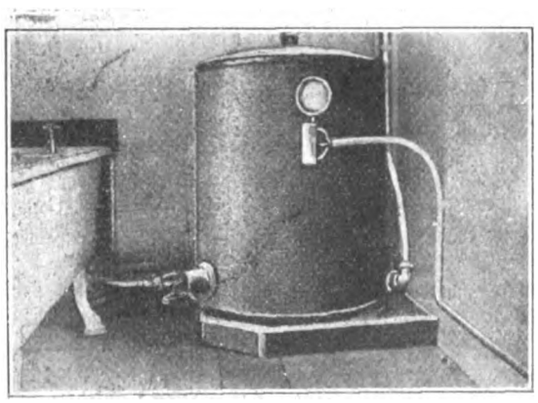


SCULLERY SWITCHBOARD FOR COOKING APPARATUS, AND CALORIFIER RELAY.

For water heating four calorifiers are used. One of 70 gallons capacity supplies hot water to the kitchen, scullery, wash-house, pantry, and to two dressing rooms and bathroom overhead. Another of 70 gallons capacity is erected in a clothes drying-room—where its waste heat is used—and supplies two bathrooms and four lavatory basins.

One of 50 gallons capacity is fitted in the principal dressing-room, supplying bath, basin, &c., and another of 50 gallons capacity is fitted on the top floor, supplying a bathroom and basins there. Two instantaneous water-heating geysers are fitted experimentally, but these are not needed.

The 70-gallon calorifiers are each fitted with immersers of 8 KW., but normally only 6 KW. are used. The 50-gallon calorifiers are each fitted with immersers of 6 KW. All the calorifiers are fitted with thermo-control double-action



FIFTY-GALLON CALORIFIER.

switchgear, combined with a double-coil relay which makes and breaks the main current in mercury cups. The thermo-switch and relay are operated by means of a battery of dry cells. The water is always maintained at a constant pre-arranged temperature of 170° F., night and day, but could equally well be kept at any desired temperature less than boiling point.

The cooking apparatus consists of one double oven range, each oven being provided with three-heat regulation. Each oven is loaded to 3 KW. capacity, and the internal size is 18 in. × 18 in. × 14 in. The hot table above is fitted with four 8-in. 1,100-watt and two 6-in. 600-watt hot-plates in addition to a plate-warmer and a 15-in. by 10-in. grill loaded to 2,000 watts. Each separate unit has three-heat regulation fitted. All switches, fuses, and indicators are mounted on iron barrel standards above the range. Two fish kettles or stewing pans are fitted, one of 18 in. size, and one of 22 in. size, and in addition a baker plate and various sizes of boiling pans, both lined and unlined, are provided. A hot closet loaded to 1 KW. is fitted in the pantry, close to the dining-room service door. Small table sets of toasters, egg boilers, coffee pots, &c., are also in use.

Special circuits are fitted for the motor washing machine, ironing machine, mangle and drying room, and in the laundry for the usual hand electric irons. The heating apparatus is mostly of the Falkirk make.

The estate cottages and offices are also being lighted and heated in the same way, and provided with electric cooking.

The whole of the arrangements have been worked out in such a way that one of the estate men is able to attend to the running of the installation, in addition to his other duties. The turbines run night and day. The running cost, therefore, is very small, and is made up of part of this man's wages plus the cost of lubricating oil, and a periodical inspection visit of a skilled man every four months.

The maintenance cost so far has been nothing, no renewals of any kind having been supplied. All the elements used for heating are of the easily replaceable type, so that when any do burn out they can be replaced by the man on the job.

The domestics are highly delighted with the working arrangements, and in the course of a few days were working the electrical apparatus freely and confidently. One of the first things found out was that instead of having to get up before 6 a.m. in order to be ready for breakfast time, they do not require to be down till after 7 a.m. This is owing principally to having no fires to clean and lay, hot water always being ready, and the absence of dirt.

The contractors for the whole survey, design, and carrying out of the complete installation were Messrs. Anderson and Munro, Ltd., electrical engineers, Glasgow. It is interesting to note that this most modern electrical installation was carried out by the oldest firm of electrical engineers and contractors in the kingdom.

Anglo-Swiss Commercial Relations.—An article on this subject is contributed to the first number of the *Anglo-Swiss Review* (May 1st) published at Basle. The author is Mr. J. B. Cahill, the British Commercial Attaché at Berne. He gives tabulated statistics relating to trade between Switzerland and the British Empire, discusses where British methods of dealing with the market have fallen short in the past, and refers to the recently established British Chamber of Commerce for Switzerland, and the service which it should be able to render. He states that the effort on the British side to secure Swiss business has been sadly wanting in the past, and urges British firms to explore more minutely the potentialities of the market, and to make organised efforts on settled lines to start or to develop trade. Membership of the new Chamber of Commerce should greatly assist them to that end. Among the other articles in the *Review* is one on "Mutual Interests of British and Swiss Machine Industries," by O. Cattani, and one on "University Matters: the Case for Exchange of Swiss and English Students," by J. H. Smith.

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CABLE-FAULT LOCALISATION.*

By EDWARD RAYMOND-BARKER

To the "Correspondence" columns of the ELECTRICAL REVIEW of May 7th, 1920, a writer communicated a decidedly instructive inquiry as to a quick and correct method of localising a certain unusual type of cable fault. Advisedly is the adjective "instructive" here used, for few data are more so than those descriptive of some fresh, puzzling experience; an experience utilised—may-be—by an intelligent observer, to arouse sympathetic interest of, and further inquiry from, some fellow-reader of the ELECTRICAL REVIEW, with ultimate acquisition of corroborative data and—perhaps—assistance.

The correspondent has written over the appropriate pseudonym "Kon Denser," as if, in pursuing elucidation of his problem, he, with true instinct, already scented the track of his cable's own electrostatic inductive capacity.

"Kon Denser's" inquiry has brought to the present writer—across a quarter of a century of time—a salt-laden gust, or two, from stormy seas, with distinct recollection of curious characteristics evinced by a fault (of a hitherto unheard-of species) in cable coiled in a ship's tank—a fault, however, now seen to be not without certain points of resemblance to that which has caused our fellow-reader "Kon Denser" to send out a somewhat urgent S O S.

Almost exactly 25 years ago, during a fairly long voyage from port to port, through—as it happened—heavy seas and generally bad weather, we had to turn over cable and bring about redistribution of cable in the ship's tanks.

One section of india-rubber core cable was 43·684 N.M. in length, and consisted of 23·980 N.M. spliced on to 19·704. This length, at an observed temperature of 58° F., ought to have shown a conductor resistance of just over 463 ohms, and an inductive capacity of a little over 14 mfds.

Yet tests on this piece of cable presented curious, and, at first sight, inconsistent features.

Insulation.—Whether test was applied to top end in tank while bottom end *free*, or *vice versâ*, or into both ends looped, insulation was good, and showed normal dielectric resistance for the whole 43·684 N.M.

Capacity.—(Whether by comparison of deflection throws, or by the Kelvin method.)

Results of tests (1) into top end while bottom end *free*, or (2) *vice versâ*, or (3) with ends looped, always gave the correct total capacity of just over 14 mfds.

Conductor Resistance.—Here was the mystery. Tested by various methods the C R of this piece of cable, instead of being what it ought to have been, namely, about 463 ohms, persistently gave a steady three hundred and fourteen thousand ohms (314,000ω).

All this appeared to point to a broken conductor with ends separated within the rubber covering. Yet with some degree of continuity through, perhaps, a conducting film, on the inner surface of the rubber, sufficient for passage of static charges in the inductive-capacity tests.

How, then, if capacity charges always got past the break, over the film, was the break in the conductor to be localised?

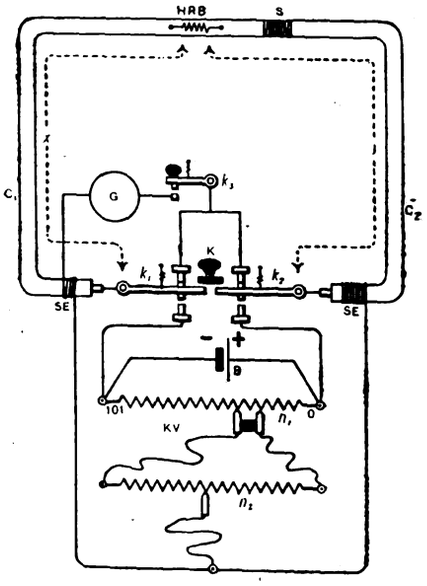
The late Mr. C. N. C. Evers, then acting, on board, as the present writer's senior assistant, made a very good suggestion as to the possibility of obtaining by the use of slides, relative distances from the two ends of the 43·684 N.M. cable by means of charging simultaneously the two ends of the cable from opposite *sign* potentials, from some very low E.M.F.

This happy suggestion, due to Mr. C. N. C. Evers, was successfully effected by the present writer using Kelvin capacity test connections with Kelvin-Varley slides.

Instead of the cable being balanced against a standard condenser, one cable end of the 43·684 N.M. was balanced against the other, the high-resistance film at the break being, in this case, of a resistance sufficiently high to keep separate the two adjacent but opposite *sign* charges.

In this manner, then, two charges were to be adjusted, by means of the Kelvin-Varley slides, to balance each other when blended or mixed, the slide-reading then indicating not only relative charging potentials, but also the relative amounts of the two cable charges in the two portions of the total length of 43·684 N.M. This, of course, is tantamount to giving the relative lengths on either side of the fault. Thus the fault is localised.

The connections as arranged by the present writer are shown in the accompanying diagram:—



C_1 = 23·980 N.M. of I.R. cable.
C_2 = 19·704 „ „ „ „

43·684 „ total cable section joined through at splice S, and coiled in ship's cable-tank.

H R B = High-resistance break of conductor inside dielectric.

S E = Cable-sheathing "earth" connection.

B = One Leclanché cell.

G = Sullivan mirror galvanometer ("Marine" pattern).

K V = Kelvin-Varley slide resistances = 100,000ω.

K k_1 k_2 k_3 = Lambert mixing key for Kelvin capacity tests.

K depressed causes k_1 k_2 to connect up C_1 and C_2 respectively to opposite sign battery potentials.

K raised causes k_1 and k_2 to rise and to connect and blend converse electrical cable charges balanced by means of the K V slides till depression of k_3, after the said mixing, gives deflection throw *nil* on G.

[*Note.*—The Lambert mixing key is shown here as it lends itself well, in the various stages of the test, to diagrammatic clearness. See H. R. Kempe's "Handbook of Electrical Testing." Seventh edition, p. 405. The key actually used by the present writer was W. A. Price's excellent (Silvertown) mixing key, as shown in H. D. Wilkinson's "Submarine Cable Laying and Repairing." Latest edition, p. 483.]

Dotted lines *x* and *y* show relative position of high-resistance break (H R B) as deduced from test with K V slides, n_1 n_2 = slide reading of 2,559, *i.e.*, 2,559 out of 100 × 100 = 10,000 total subdivisions of the slides

* On May 20th this article was posted to the Editors of the ELECTRICAL REVIEW. On May 23rd the writer received privately from "Kon Denser" interesting data and incidental proof that, at 3 p.m. on April 24th, he was called upon to tackle the fault-localisation, and that, by capacity methods, not only was the fault successfully localised, but by 6 p.m. the repair had been effected, and the plant was again running O K. Owing to academic and theoretical interest attaching to an unusual type of fault, "Kon Denser" wrote to the ELECTRICAL REVIEW the letter which appeared on May 7th. On his own initiative does the present writer add this note to show that, after all, it was "off his own bat" that "Kon Denser" attained success.—E. R.-B.

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causing relative charges on each side of the high-resistance interior fault H R B to neutralise each other, so that deflection throw on G when k_3 is depressed becomes *nil*.

The slide-reading 2,559 gives the proportion :—

2,559 : 10,000 :: x : 43·684 N.M. or x = 11·179 N.M.
7,441 : 10,000 :: y : 43·684 N.M. or y = 32·505 N.M.

10,000 43·684 N.M.

Distance of fault from splice = 23·980 N.M. − 11·179
= 12·801 N.M.

This merely approximate value was sufficiently accurate to point to the fault being at the sixth joint in this length of cable, which joint, by section-book, was 12·111 N.M. from splice S.

This cable was then turned over from one tank to another. When the cable was purposely bent at the sixth joint-mark, the electrical control test gave indications of the fault being there. On the cable being cut, the conductor was found to have been broken at the braze of the sixth joint. Although the conductor, together with its lapping of fine copper wire, had been severed, and the two portions of the braze slightly drawn apart, a high-resistance, but nevertheless conducting film (= 314,000 ohms), due to chemical action between the braze and the surrounding india-rubber, had formed on the inner surface of the rubber, just, in fact, as the curious behaviour of the cable when first tested successively for insulation, capacity and conductor resistance, had led one to suspect.

To sum up :—It appears to the present writer that, in certain respects, the foregoing instance is somewhat analogous to the case cited by "Kon Denser."

In the latter instance, one of the copper conductors of a twin cable embedded in glazed troughing run in with pitch and capped with tiles, had developed a fault owing, apparently, to water getting through the pitch and eating away the copper strand. The resulting sulphate of copper at the fault gradually came to constitute a comparatively non-conductive block, this block virtually insulating, one from the other, each side of the severed copper strand.

Except that, in this instance, the insulation of the cable appears to have been affected primarily, from the outside, by water—whereas in the case cited by the present writer, cable insulation remained unimpaired—the two cases seem fairly analogous.

Hence it would be most interesting to know if electrical tests on lines similar to those afore-described—namely, by balancing, in the Kelvin mixing method, the two cable capacities separated by the copper sulphate crystal block—have helped in any way to solve the problems so interestingly described by the ELECTRICAL REVIEW correspondent "Kon Denser." To him, by the kind courtesy of the Editors of the ELECTRICAL REVIEW, the present writer has already been privileged to communicate some suggestions.

Since the above matter was written the writer has heard that "Kon Denser's" two cables are without any metallic sheathing or wire armouring.

This leaves one rather in doubt (1) as to the inductive capacity of the two braided wires laid in glazed troughing run in with pitch, the nature of the bed in which the trough lies being doubtful, and (2) as to whether the inductive capacity conditions—whatever they may be—*are uniform* along the entire length of "Kon Denser's" two braided conductors.

If conditions be not uniform, the difficulty of localising an insulated break is much greater than it would otherwise be.

It might, however, be feasible to act in the following manner: Earth the good cable, and, with one pole of testing cell likewise to earth, measure relative inductive capacities between the faulty line (respectively on each side of the high-resistance break fault) and the good line which has been earthed.

Actual capacities in terms of microfarads would not be necessary. Relative discharge throws, in terms of scale divisions on a mirror galvanometer scale, from the two cable ends would be sufficient so long as exactly similar testing conditions prevailed at both ends of the faulty line.

Relative charge, or discharge, deflection throws—from any really insulated break—would indicate relative cable lengths out of the total length of 100 yards which, according to "Kon Denser," is the length of his twin cables.

Similarly, with the faulty cable earthed at both ends, a charge, or discharge, deflection from the good cable (insulated at the far end) in terms of galvanometer-scale divisions, ought to be equivalent to the sum of the two deflection throws from the two separated sections of the faulty cable, when the good cable was earthed.

"WIRED WIRELESS" TELEGRAPHY AND TELEPHONY.

REFERENCE has from time to time been made in our pages to the experiments that have been carried out by the U.S.A. Signal Corps in connection with multiplex telephony and telegraphy over open-circuit bare wires laid in the earth or under water. A paper on this subject presented to the National Academy of Sciences in April last by Major-Genl. G. O. Squier, chief signal officer, U.S. War Department, was recently abstracted by *Science*, from which the following particulars are taken.

The "key problem" in the procurement of essential Signal Corps supplies in the United States during the war, curiously enough turned out to be the production of the necessary braiding machines for finishing insulated wire. The bare wire itself and the insulating materials could be obtained, but the necessary machinery for braiding the thread was never anything like adequate for the enormous supplies required in the field.

The braiding capacity of the entire United States, at September 1st, 1918, was about 8,000 miles of twisted pair insulated wire per month, while the requirements for the American forces alone at that date were about 40,000 miles a month. The Allied Council decided that beginning March 1st, 1919, the United States should furnish all of this type of wire used by the Allied armies in the field. To supply this amount of insulated wire would have required cargo space for overseas shipment to the amount of 14,000 ship tons a month, but had it been possible to use single conductor bare wire in place of the twisted pair insulated wire, the space required would have been reduced to 2,500 ship tons a month, thus releasing the balance for transportation of other vitally necessary supplies.

The above facts show the necessity of developing, if possible, new methods by which a reduction may be effected in the enormous quantities of expensive and bulky insulated wire, which was so difficult to procure, and which must now be buried in the earth to a depth of 8 or 10 ft. throughout the advance sectors of the front line of a modern army.

The following reasoning led to the carrying out of the experiments to be described :—

1. Since we can already communicate by radio means between one submarine and another submarine both completely submerged, it was considered that connecting two such stations by a submerged copper wire could have no other effect than to facilitate the propagation of the electric waves between the stations.

2. It was considered possible that the behaviour of earth or water under the action of high frequency currents might exhibit greatly different properties from those with which we are familiar at direct or low frequency currents.

3. It was realised that whatever high frequency energy losses might occur in the case of bare wires laid in earth or water, yet the over-all efficiency would be higher than in the case of radio space transmission where the plant efficiency is so very low.

4. It was noted by the writer in September, 1910, that the three-electrode audion could be used as a potentially operated device on open circuits. This arrangement was considered reliable for the reception of the signals over bare wires in earth or water.

The first experiment was a simple one: A bare No. 18 phosphor bronze wire was laid across the Washington Channel of the Potomac river. It was paid out with sufficient slack to lie on the bottom of the river. A standard Signal Corps wireless telephone and telegraph set, SCR 76, was directly connected to each end of the wire, one set serving as a transmitter and the other as a receiver. At the receiving end of the line the bare wire was directly connected to the grid of the receiving set and the usual ground connection left open. A frequency of about 600,000 cycles a second was used, and the line tuned at each end by the usual methods. Excellent telegraphy and telephony were obtained. Care was taken to make this preliminary experiment as simple and basic as possible and precaution taken to ensure that the wire itself

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should be bright and clean and entirely free from any grease or other insulating material.

This success immediately led to more thorough consideration of the entire subject. The following experiment was made:—

A strip of wire netting was buried in the snow outside an office in Washington and a wire attached thereto leading to the second story of the building. The upper end of this wire was connected directly to the grid of an electron tube, which was to be used as a potentially operated device. It was necessary for maximum sensitiveness to connect it to the point of maximum potential of the antenna which in the case of a linear oscillator occurs at the open end. By this arrangement, messages were readily received from distant points in the United States.

These two simple experiments demonstrated the possibility of transmitting electromagnetic waves along bare wires submerged in water and the use of an electron tube as a potentially operated device for the reception of signals. The Signal Corps has recently undertaken certain investigations in the phenomena connected with the transmission of high-frequency electromagnetic waves over bare wires in earth and in water. In attacking the problems from various angles, the research staff of the Signal Corps laboratory at Camp Alfred Vail, Little Silver, New Jersey, was directed to carry out experiments on bare wires laid on the surface of moist ground and also buried in earth. The Signal Corps research laboratory at the Bureau of Standards was directed to investigate fundamentally the transmission of electromagnetic waves over bare wires in fresh water. In addition to this, the office of the Chief Signal Officer has carried out from time to time certain experiments of a more or less crucial character which have come up for solution in the prosecution of this work at the other laboratories. The phenomena associated with the transmission of high-frequency waves over bare wires in earth or water are obscure and complex, and the writer has formulated no definite theory at the present time.

The results obtained are as follows:—

1. Telephone and telegraph communication has been established across the Potomac river, below the city of Washington, over a distance of about three-quarters of a mile, by the use of a bare No. 12 phosphor bronze wire laid in the water to connect the stations. The transmitter consisted of an electron tube oscillator which delivered a current of about 270 milliamperes to the line at a frequency of about 600,000 cycles a second. At the receiving end of the line an electron tube and a 6-stage amplifier were used without any ground connection. With this arrangement good tuning was obtained at both ends of the line, and telegraphic and telephonic transmission secured over the bare wires immersed in fresh water.

2. A resonance wave coil has been developed in the form of a long helix wound with a large number of turns on which stationary waves are produced by the incoming wireless signals. An electron tube is used as the detector, the grid being connected to the point of maximum potential on the coil. The wave coil may be used either as a part of the usual antenna system or a part of a line wire, or it may act itself as the antenna for picking up the energy of the signals. In the latter case the coil may be either free at both ends or grounded at one end. Good results have been obtained in either case. It has been also found that the open coil has directional properties and can be used as a goniometer not only for horizontal measurements, but for vertical measurements as well. This form of wireless goniometer has the great advantage that it permits not only of determining the plane where the signals are strongest, but also the direction from which such signals proceed.

Telegraph and telephone communication has been also established between two stations at Camp Alfred Vail, using a bare No. 16 copper wire buried in the earth to a depth of about 8 in. to connect the stations. The distance between the two stations was three-quarters of a mile. Frequencies as high as one million cycles a second were used. Similar communication has been carried on over a bare wire one and three-quarter miles long laid on the surface of moist earth. The current at the transmitting station in these installations was about 100 milliamperes. It has been shown that a bare wire buried in moist earth with the distant end open can be tuned both at the transmitting end and at the receiving end.

In the older art of ocean telegraphy, the elaborateness of line construction has already reached a practical limit. The most promising hope of improving the line construction for ocean cables is believed to be to abandon the present method of design and construction, and to start with the simple case of bare wires in water, using high-frequency currents, and study the necessary changes to produce optimum transmission. The use of a high-frequency "carrier" has the inherent advantage that the distortion phenomena accompanying present methods of long-distance transmission are eliminated, and we are principally concerned with the problem of reducing attenuation. The most suitable voltage may be employed and present multiplex methods may be utilised. The electron tube is available for both the generation and the reception of the waves.

During the last few years an intensive study has been made of the surface conditions of wires necessary to produce the emission of electrons, and to this intensive study, both by universities and industrial research laboratories, is due the high state of efficiency of the present electron tube. Nothing short of a similar study of the surface conditions of wires for preventing the emission of electrons instead of producing them, will finally give us the wire conductor of the future.

The development of types of resonance wave coils, both open at one end and at both ends, for general wireless work offers an interesting field for investigation. This involves the study of the electron tube as a potentially operated device. The application of such coils properly designed for specific purposes may lead to the practical solution of a number of wireless problems such as directional effects, and wave coil antennæ of very small dimensions.

THE ELECTRIFICATION OF HOLLAND.

A NATIONAL SCHEME.

One of Holland's greatest difficulties as an industrial country has been the high cost and consumption of coal in all her industrial undertakings. This it is now proposed to remedy by an extensive scheme of electrification, embracing practically the whole country. According to the *Board of Trade Journal*, a network of H.T. transmission lines has been planned (fig. 8), and it is hoped that in due course Dutch industries shall enjoy the advantages of cheap power in order to be more favourably placed for export purposes against more fortunate competitors. In any case, it is considered that great economies will be effected by concentrating the various electricity supply undertakings into a national scheme which, at the same time, will be useful to develop the smaller manufactories all over the country.

Fig. 1.—Electric Winder.

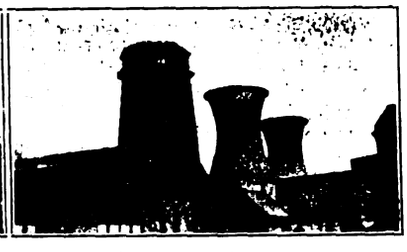

Fig. 2.—Cooling Towers. Limburg State Coal Mines.

The scheme, as at present estimated, is to cost 125,000,000 florins, and it is understood that as Dutch manufacturers are not in a position to tender for all the plant required, a fair proportion of this will be placed abroad. Already orders amounting to over £1,000,000 have been secured in this country.

There are several companies in Holland supplying electrical power, &c., in various localities. Their activities, under the new scheme, will be allied to those of the State—the former being charged with the 10,000-volt, and the latter undertaking the 50,000-volt distribution. Such a scheme will necessitate the surmounting of many difficulties in such a country as Holland, which lacks any assistance from water power.

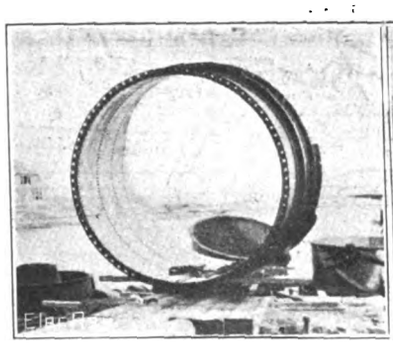

Fig. 3.—Large Pump Casing.

Fig. 4.—Outdoor 3,000-volt Switch at a Farm.

The following table illustrates the very considerable increase that has taken place in the consumption of electrical power, &c., in Holland since 1913:—

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	Max. load on station. KW.	Total consumption per annum. KWH.
1913	45,600 ...	114,000,000
1914	53,600 ...	134,000,000
1915	69,600 ...	173,000,000
1916	88,400 ...	221,000,000
1917	90,000 ...	216,000,000
1918	100,000 ...	240,000,000

To meet present requirements the Government Committee reporting on the question under the present scheme is of opinion that it is necessary to arrange for a total load on the electrical power stations of 4,000,000 KW., giving a total capacity of 1,000,000,000 KW.-hours per annum. Such a supply will mean, with an anticipated population of 10,000,000 inhabitants in the next 30 years, a consumption of 100 KW.-hours per head per annum, as against 35 to 40 at present. This will compare with a present approximate consumption in the United States of America of 176 KW.-hours per head, 140 for Switzerland, 60 for England, 50 for Germany. The estimate does not take into account the electrification of railways and the replacing of all steam traction by electric traction, for which it is provisionally estimated that 250,000 KW. will be necessary, although not more than one-third of this amount will be required for the next 15 years.

The construction of the transmission lines for the whole country may take from 5 to 10 years. For the H.T. network three-phase current, 50 cycles, is to be adopted, the minimum voltage being 50,000. The capacity recommended for the power stations supplying the system is approximately 30,000-75,000 KW. Each station will be equipped with generators developing 15,000 KW. As the first step in the scheme, certain

FIG. 8.—PROPOSED H.T. NETWORK IN HOLLAND.

legislation is necessary to empower the Government to take over those electrical supply undertakings which are necessary for incorporation in the scheme. These are:—

1. The power station at Geertruidenberg, with the 50,000-volt lines in the Province of North Brabant belonging to that power station.

2. The recently-built power station of the municipality of Amsterdam.

It is also recommended that the construction of H.T. lines should commence immediately as under:—

1. Roosendaal-Flushing or Middelburg.
2. Helmond or Uden—South Limburg.
3. Geertruidenberg-Rotterdam-The Hague-Amsterdam, with a branch line to Utrecht.
4. Uden-Nymegen-Arnhem-Zwolle.

The cost of the above is estimated at 35,000,000 to 40,000,000 florins.

As far as is known at present, a special Administration is to be created for this service. Several alternatives have been under consideration, particularly a proposal under which the State would hold a large block of shares in a company registered for the purpose. Preference has been given to a State enterprise under which the supply of electricity is to be a direct Governmental service endowed with a large measure of freedom. Working agreements will be made as to the supply of electricity and the sharing of profits with municipal and other companies administering the scheme.

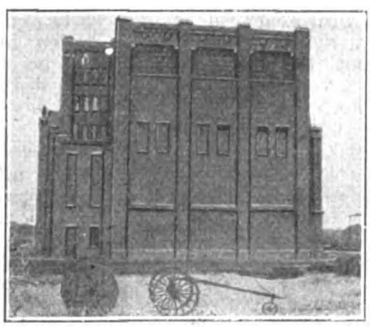

FIG. 5.—50,000-VOLT SUB-STATION.

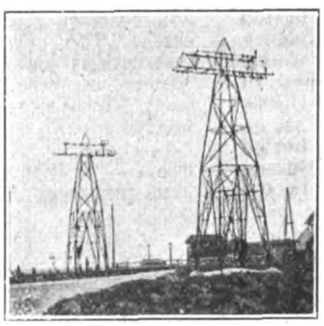

FIG. 6.—50,000-VOLT LINE CROSSING RAILWAY.

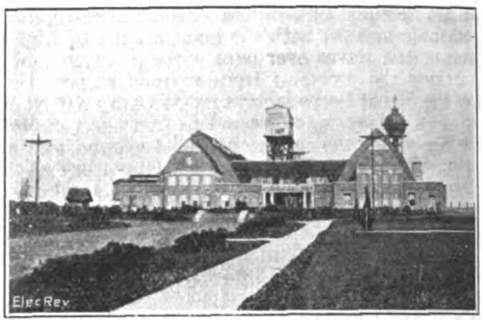

FIG. 7.—LIMBURG STATE COAL MINE.

A committee, formed by the Society of Directors of Electricity Supply Undertakings in Holland, has been investigating this proposal for some time past, and is to publish a report in eleven parts, four of which have been issued up to the time of writing. The first deals with the question of determining the positions of the H.T. transformer stations. The committee has calculated that for loads of 7 to 20 KW. per sq. km., the feeding of the 10,000-volt cables with 50,000 as well as with 100,000 volts will be secured in the most economical way if the transformer stations are 20 to 30 km. apart.

In the second, the feeding of the high-tension transformer stations (determining the area of wires, &c.) is reported on. The average distance of the feeding points of the 10,000-volt distribution cables having been fixed, there remains the question of voltage and the cross-section of the H.T. lines, which have to feed the 50 transformer stations. The calculations are based upon the supposition that the transformer stations are situated at regular distances of 25 km., and that they are all equally loaded. The results of these calculations are shown in graphs, added to the report.

These graphs also show that for large but sparsely populated districts a very high voltage is most economical, whereas for heavily-loaded industrial centres a lower voltage is to be preferred. It is furthermore evident from this report that the concentration of the generation of electricity has its limits, and it will be preferable, above a certain amount of power (*e.g.*, 30,000 to 50,000 KW.) to erect more power stations instead of making a heavier H.T. distribution system.

So the second part of the report gives an idea not only of the voltages and cross-sections of wire, but to a certain extent also of the number of power stations wanted. The third report deals with the scheme from the point of view of national defence.

In the last, the transmission of electrical energy from the mining district is outlined. It is stated that in addition to feeding the transformer stations the H.T. lines should also be capable of performing other functions. They should, for example, be able to transmit electricity from places where, for some reason or other, the costs of generating electricity are very low. The question of feeding a part of the network from the South Limburg mining district is then specifically examined.

For the accompanying views of electrical installations in Holland we are indebted to Mr. C. H. Wordingham; they were taken during the I.E.E. tour in Holland in September last, of which an account was given in our issue of October 24th, 1919.

Strike at Sheffield.—Through a strike of the National Amalgamated Union of Enginemen and Firemen against the three-shift system, a number of big works in Sheffield were closed down almost completely on Monday. Messrs Hadfields and other works together had 20,000 employés thrown idle.

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ALL-BRITISH SWITCHGEAR.

MESSRS. A. REYROLLE & CO., LTD., HEBBURN-ON-TYNE.

THE now well-known business of Messrs. Reyrolle was opened in 1901 with the manufacture of ordinary designs of open-type switchgear and accessories, including motor starters, knife switches, tubular fuses, wall plugs, &c. At that time it supplied a much-felt want for electrical apparatus of a more substantial design and sounder workmanship than was usually procurable, and as the late Mr. Reyrolle had in his earlier works in London already established a reputation for these qualities, the business was soon thriving.

Two or three years later, other experts were added to the staff, and attention was given to the production of special forms of switchgear and protective systems which were found to be necessary as more experience was gained on larger power supply systems and the uses of higher electrical pressures. Certain novel principles of design were introduced, including the complete enclosure and immersion of all conductors, for safety to life and plant. New methods of locating and isolating faults were developed and successfully applied to the power station and sub-station equipment of the enterprising local power companies, which were thus assisted in maintaining continuity of supply to their consumers.

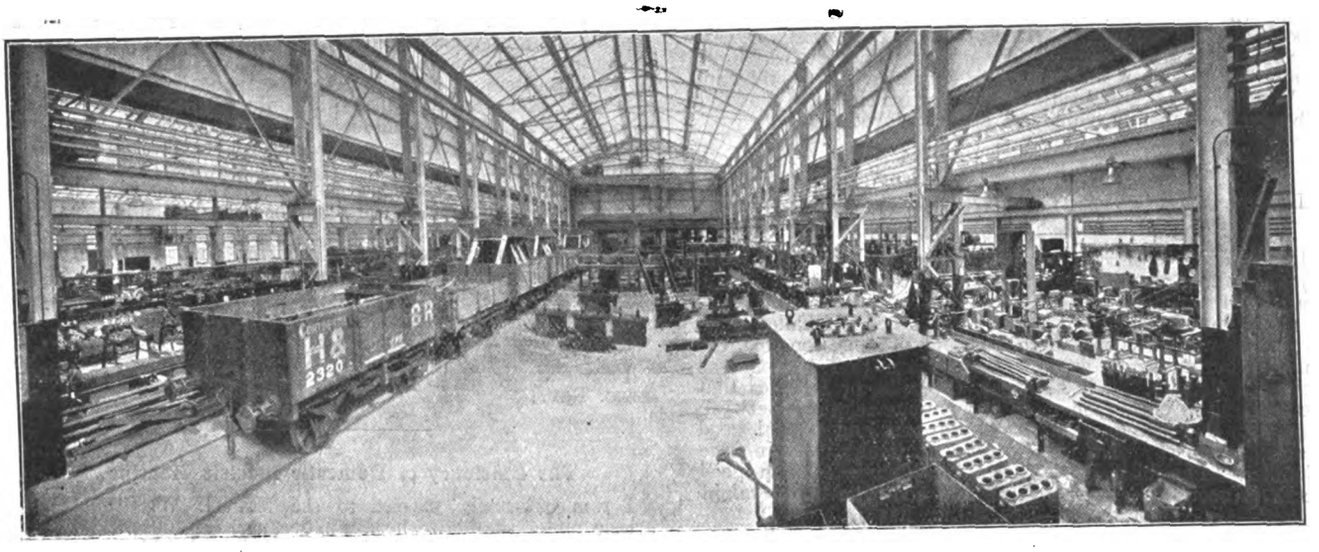
For many years these local users absorbed practically the whole of the output of this special design from this company's works, and in the meantime much valuable information was obtained of working conditions, progress was made, and designs were strengthened as required to withstand the increased stresses which were met with as the generating plant of the power companies grew in dimensions. Thus a very sound foundation of experience was quietly laid, prior to putting the new principles to the test of the market outside this district. This was first successfully attempted on a scale large enough to be of importance, in reply to a call for tenders issued by the Stepney Corporation. Notwithstanding the substantial nature of the Reyrolle apparatus, it was found possible to offer it in the open market at a competitive price.

Since that time a demand has consistently grown from the largest power supply undertakings in this country, including the Corporations of Sheffield and Glasgow. The designs have become firmly established in British practice, and one frequently hears that whatever may be thought of the general electrical engineering developments of foreign countries, at least the switchgear standards set by this company without doubt testify to the superiority of British origin.

The orders at present in hand include the largest and most important contracts ever placed for switchgear for use in Great Britain. For instance, one is for the main 20,000-volt controlling apparatus at Dalmarnock power station, one of the first super-power stations of this new electrical era. Another is for similar apparatus for Nechells, the future great generating station of the Birmingham Corporation. The fact that both these important contracts were placed at higher prices than those of competitors bears witness to the merits of the designs and the quality of the workmanship, but these of themselves might not be sufficient to satisfy a large public body if they were not also backed up by economies effected in other ways, such as reduced costs of building accommodation, every-day operation, and general maintenance.

The restricted size of the works, and the difficulties of manufacture, have, to a great extent, limited the scope of the supplies to the home market, and even there many new fields are untapped, but some time and material has been reserved to keep in touch with the fringe of the Colonial and foreign markets: for instance, switch panels for many years have been supplied to the Rand, South Africa, and to the Durban Corporation, and some important 10,000-volt sub-station apparatus to Capetown Corporation. Other work includes sub-station switchgear for railway electrification in South America; power and sub-station switchgear for the Corporations of Shanghai and Madras; and track feed and signal pillars and 20,000-volt sub-station switchgear for the Melbourne railways. As an example of the influence of this British practice on the Continent, much interest is evinced in Holland, whose engineers for the Government interlinking scheme (described elsewhere in this issue) have visited this country and have ordered armour-clad switchgear.

Messrs. Reyrolle & Co. have taken full advantage of their opportunities in all but quantity and speed of production; this exception is due only to want of material, room, and plant. As to material, improvements have been made in the organisation to ensure supplies as and when required by the shops; the handicap of limited room and plant has created the need for increased capital. New shops have recently been opened, of which we give a view, and with more adequate facilities for production, a more fruitful effort to supply the increasing demands will become possible.



MESSRS. A. REYROLLE & CO.'S NEW SHOPS.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Composition v. Porcelain Insulators.

There has recently come into my hands a brochure, published by Thos. de La Rue, upon a composition insulator named "Telenduron," in which this material is compared with porcelain, to the disparagement of the latter.

It is granted, of course, that almost any composition material is less brittle than porcelain, though good English porcelain is much tougher and more resistant to breakage than many people imagine, more especially when the porcelain is fairly thick, as used in transmission work.

In this brochure, however, porcelain is condemned as depending upon its glaze for its insulation, and it is stated that upon the failure of the glaze by hair cracks the porcelain absorbs moisture (*sic*). This may be true of rubbish, mostly foreign, styled porcelain, but it is surprising that it should still be necessary to inform some people that proper English porcelain as made by reputable firms for the purposes mentioned (all of which porcelain is made by the wet process) does not depend upon the glaze for insulation, the porcelain being vitreous and homogeneous, and the glaze being added merely for finish and possibly colour.

"Telenduron" is set up as being non-hygroscopic and of marked superiority to porcelain, but this is not corroborated by the tests which they publish, made by the National Physical Laboratory, as shown in the following comparison:—

Tests on Post Office small insulator.	Telenduron.	Porcelain.
Flash-over voltage, dry....	40 K.V.	40 K.V.
Puncture voltage... ...	25 K.V.*	Immeasurably small.
Absorption...	·1 to ·3%	Certainly below ·01%

* NOTE.—It is important that the puncture test of any insulator should be greater than the flash-over dry. This is so with the porcelain insulator, but as the above tests show, is not so with "Telenduron."

Whatever advantage this material may have in respect of lesser liability to breakage is obtained, therefore, at the ex-

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pense of its electrical characteristics. This, no doubt, is justified in many cases, but I note that in their covering letter they make reference to the use of this material for high-voltage transmission work; in this connection, electrical considerations are the primary considerations, and all others are secondary.

Then there is the question of durability, having regard to the deleterious atmospheric conditions which obtain in some manufacturing districts in which insulators have to work. No tests are given here, but in this respect a composite material (which often incorporates vegetable and animal substances) can scarcely be expected to compare with porcelain, which is made from rocks of the earth itself.

Twiss Engineering & Transmission, Ltd.
G. W. V. TWISS, M.I.E.E.,
Managing Director.

London, E.C., *May 26th*, 1920.

Mutual Discussion.

My attention has been drawn to the enclosed report published in your last issue with regard to the National Alliance of Employers and Employed. In the section which I have underlined you will note it is stated: "The National Alliance justly claims to be the only organisation which can provide the machinery for a round-table conference of employers and employed."

I feel sure this has been inserted in error, and should therefore be greatly obliged if you would point out in your next issue that the Industrial League and Council, which is engaged in this work, has been in existence since 1915, and is an organisation well known to the public, its presidents being the Rt. Hon. G. H. Roberts, M.P. (ex-Minister of Food), and the Rt. Hon. J. H. Whitley, M.P. (Deputy Speaker of the House of Commons). The primary work on which the Industrial League is engaged is to encourage the establishing of Whitley Councils, which are the effective channels of round-table conferences of employers and employed.

John Ames,
General Secretary,
Industrial League and Council.

London, S.W.1.
May 29th, 1920.

[Why does our correspondent misquote us? The word "justly" does not appear in the ELECTRICAL REVIEW ("Mutual Discussion," May 21st, p. 653). The Alliance is entitled to make any *claim* that it likes. We do not feel called upon to decide which is the more suitable organisation for the purpose indicated; it was for that reason that we omitted the word "justly." All Alliances, Councils, or Leagues that are working to encourage more harmonious relations between employers and employed have our support and cordial good wishes. But why this jarring note of rivalry, evoking the rejoinder "Physician Heal Thyself"? Competition in good works is good; co-operation is better; complete union might be *best*—we do not know.—EDS. ELEC. REV.]

The Policy of the E.P.E.A.

My attention has been drawn to the letter signed by our Mr. W. E. Weston, and I would like to point out that in the opinion of myself and my committee this letter is very ill-advised, and is only the personal opinion of our Mr. W. E. Weston, and in no way represents the policy of my committee.

W. J. Webb,
London District Secretary,
Electrical Trades Union.

London, E.C., *June 1st*, 1920.

"Situations Vacant."

The above heading I have no doubt will be very familiar to most readers of your journal, for it has as long as I remember been famous as the heading of a column eagerly watched and criticised by those in the electrical industry. The criticism is, of course, of a varied nature, and I have known readers who have been highly annoyed and somewhat amused at the scandalously low salaries offered by employers (usually represented by a box number). There have been many letters in your "Correspondence" column pointing out the unfairness to the employé of the Box No. system, and while this is not the point I am getting at, I should like to point out that the employé is as necessary to the State as the employer; each depends upon the other. Therefore it should not be made so difficult for the employé to get comfortably through this life as compared with the employer (generally speaking). For instance, an employé wishes to better himself, or even to change his job; he answers an advertisement, but has to send his history to a Box No. He is expected to do this, and is not allowed to know to whom he has written, and in some cases, if he only knew it, he has applied to his present employer. Then again, after taking this trouble, he frequently hears nothing, and simply wonders where his application landed. I consider that no just mind can consider this matter thoroughly without coming to one conclusion. I will come to my point and suggestion. This point I do not think has been quite so much considered. In some cases an applicant will receive an acknowledgment and an interview; he leaves the employer's office after being treated very nicely, and often given many details of the new duties connected with the post, with a promise that he will in due course hear the result of the interview, and he feels confident that he has given satisfaction, and will get the post. He, however, waits and waits, and hears nothing, the employer not keeping his promise. The applicant is not to know one way or the other. I certainly think an applicant should be informed whether successful or not; I suppose I dare not suggest that he should be given a reason why not successful, although the fact that the employé is never given any satisfaction is responsible for a very serious suspicion which exists to-day amongst the employed that their present employers do not give satisfactory references, or adopt some means to prevent men from leaving their present jobs. If there are no grounds for this suspicion, why cannot some action be taken to remove it? There is no doubt that the suspicion exists. Again, in certain cases employers, after receiving applications, select certain ones and send an official form of application, with details of the vacant post. The employé, to suit the employer, makes a fresh application with further information, and returns it, to hear nothing further one way or the other. I consider these tactics totally wrong and unbusinesslike, and my suggestion is as follows: That these matters should be brought before the Joint Industrial Councils with a view to an agreement being come to, that all applications sent to Box Nos. should be acknowledged by the firm concerned, and the applicant informed whether successful or not, within a reasonable time. I believe very much in the D.J.I.C. idea, and if such matters as these were properly dealt with it would certainly promote the purpose of Industrial Councils, and in this particular case would soon do away with the Box No. principle. In conclusion, I give two extracts from the Whitley scheme:—

1. To make and consider suggestions for securing a permanent improvement in the relations between employers and workmen.

2. To recommend means for securing that industrial conditions affecting the relations between employers and workmen shall be systematically reviewed by those concerned, with a view to improving conditions in the future.

J. C.

[We refer to this matter in our leading columns.—EDS. ELEC. REV.]

The Efficiency of Domestic Electric Heating.

I was extremely pleased to see Mr. G. W. Stubbings's article under the above heading, because, far more important than that a truer aspect of the question should have been set forth than that placed before the public by the gas companies, is the understanding of the subject by all those who deal in the apparatus, and this can only be obtained by thorough discussion and an earnest attempt on the part of your readers to understand the meaning of the figures, and not just to skim them over and take them for granted.

I am sure that Mr. Stubbings will forgive me if I say that although he refers to a series of articles, he practically only deals with one (the first); for the second article corrected the efficiency of the gas oven from 13.6 per cent. to 7.4 per cent., while the third pointed out that the taking of 4 cwt. of coke as the net amount of coke available for sale after treating 1 ton of coal was due to the gas companies' error, and should be 8 cwt.

If Mr. Stubbings had devoted the same earnest attention to the second article that he did to the first he would have seen that this is a much fairer method of comparing the two systems, as it allows for gas and electricity for lighting purposes, and, of course, the use of percentages in this connection is impossible, as there is no standard from which to calculate the efficiency of either system.

If articles two and three are considered together it will be apparent that electricity produced at an efficiency of 20 per cent. will do, with coal of a thermal value of 16.4, what gas requires coal of a thermal value of 34.8 to do, and this figure allows the total potential value of the coke and tar to be deducted. The actual value of the coal used by the gas companies would be 58.24, and the gross value of the coke and tar products 22.624.

When I stated that I had a doubt of the possibility of the whole of the coke being utilised, I thought I made it clear that I was not questioning the 60 per cent. efficiency whether the coke was used for domestic or industrial heating. The point is that industry at present absorbs practically all the coke it can, while if gas engines are to be substituted for electric motors and gas lighting for electric lighting a correspondingly larger make of gas will be made with its con-

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sequent increased supply of coke, and it is this quantity of whose use I was dubious. If in addition the report of Lord Haldane's Committee and Sir Dugald Clerk's "James Forrest" lecture are studied side by side the matter stands out even more clearly. Lord Haldane's Committee contemplated the substitution of electricity for the stationary engines of this country, and arrived at certain figures for the amount of electricity required and the amount of coal necessary to give that amount. Sir Dugald Clerk takes the figure for the H.P. required, and says that a certain amount of gas would do the work, which could be produced from a certain amount of coal. Ignoring the fact that his figure for the efficiency of production is both wrong and misleading, it will be seen that the substitution of gas engines for stationary steam engines will immediately do away with the largest market for coke; so the comparison should really be made between 16.4 for electricity and 58.24 for gas.

In conclusion, I must say that the reason the 20 per cent. efficiency of production for electricity was taken was that both the B.C.G.A.'s advertisements and Sir Dugald Clerk's lectures selected this figure, and endeavoured to show that even then gas was more efficient, probably with the idea at the back of their minds that if gas is better than electricity when it can be produced at a 20 per cent. efficiency, how much more so must it be at the present time?

B. S. Klemens.

London, S.E.
May 31st, 1920.

BUSINESS NOTES.

Dr. Arnold's New Steel.—According to the *Times*, Dr. J. O. Arnold, who was formerly Professor of Metallurgy in the Univerity of Sheffield, has sold his production rights in the new high-speed steel invented by him to Mr. J. D. Moffat, one of the directors of Sir Thomas Salter Pyne & Co., and the new steel is to be made in Sheffield.

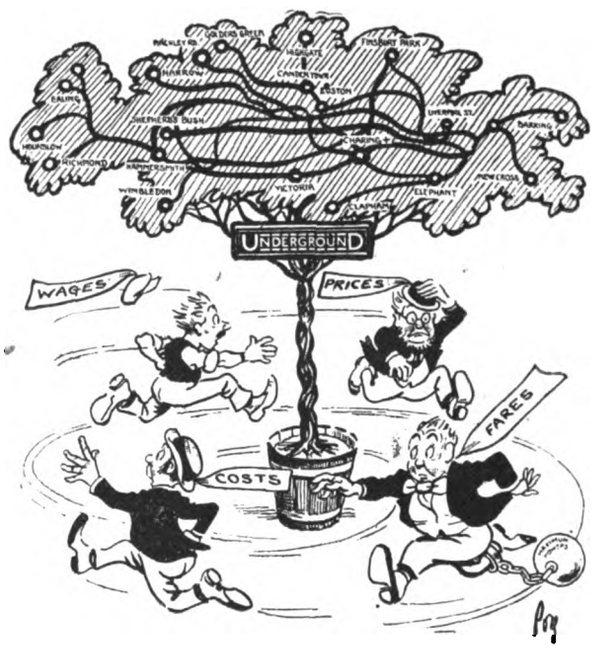
A T.E.T. Dinner.—On Thursday last week the first annual dinner of the TWISS ENGINEERING AND ELECTRIC TRANSMISSION, LTD., was held at the Criterion. The chairman, Mr. Oscar Andersen, presided, and was supported by Mr. G. V. Twiss, managing director, Mr. S. G. Leech, Mr. Rex Andersen, and other members of the firm. Proposing "The Company," Mr. J. Davie congratulated the directors on having laid a sound foundation for their business, and referred to the unfair incidence of the excess profits duty as between old firms and new ones. In responding, Mr. Twiss agreed that legislation which tended to retard the progress of young concerns was contrary to the interests of the country as a whole. Over a year ago he saw that the necessity of cheap power, involving the centralisation of generating plant, would lead to the erection of cross-country overhead mains, and the company, which would be known as the "T.E.T.," was formed for that purpose; it was now carrying out the biggest scheme of the kind in this country, in the North Wales district, as well as many other transmission schemes both at home and abroad, a very creditable result for one year's working, and that not a favourable year for industrial enterprise. They had started at the psychological instant, and their prospects were so good that Messrs. J. B. Saunders & Co. and Messrs. Laing, Wharton & Co. had joined hands with them. They had laid the foundations, and were now ready, with a well-organised staff, to erect upon them a worthy superstructure; they were doing work which would help to rehabilitate the country and improve social conditions. Mr. H. P. Allison, works manager, proposed "The Guests," for whom Mr. C. O'Malley responded, describing Mr. Twiss as himself a "live wire," who inspired those around him with his own enthusiasm for work. Proposing "The Personnel," Mr. Twiss said the success of the company was largely due to the co-operation and *esprit de corps* of the personnel, from the chairman downwards. The company was employing its full share of ex-service men, and Mr. R. C. Andersen had gained the Military Cross. Their duty was not first to make profits but rather to render service to the country, and in return for such service to receive profits whereby they would be able to continue that service in an ever-increasing manner: the motto of the company would be "Service First." They intended to raise abroad the standing of this country in the transmission of power. After Mr. Davie, at the request of Mr. Twiss, had described the profound impression of British predominance which he had gained during his recent travels on the Continent, Mr. S. G. Leech responded, expressing full confidence in the future of the company and in its founder—provided that the latter did not work himself to death. After the health of "The Chairman" had been duly honoured and acknowledged, the very successful and enjoyable function came to a close at a late hour.

Siemens Lamps and Supplies.—MESSRS. SIEMENS BROS. AND CO., LTD., inform us that they are taking over the lamp and supplies department of Messrs. Siemens Bros. Dynamo Works, Ltd. Contemporaneously with this change, the company is making provision for a largely increased output in metal filament lamps, and it is announced that henceforth these lamps will be sold by the company under the distinctive trade name of "Xoel." This trade name will apply to all types of metal filament lamps manufactured by the company, which include the following:—Standard vacuum lamps, half-watt lamps, automobile and battery lamps (vacuum and gas-filled), helical filament traction lamps. As from June 1st, 1920, Messrs. Siemens Bros. & Co., Ltd., will conduct the business in lamps and supplies from the same addresses in London and the provinces as hitherto, where, in addition to fittings and lighting supplies, attention will be given to inquiries regarding the whole of the material manufactured by the company at its Woolwich Works, such as wires, cables, Stannos wires, telephone and telegraph apparatus, fluid and dry cells, flashlight and torch batteries, &c. The company's showrooms at 38-39, Upper Thames Street, London, E.C., have been redecorated and refitted, and all *bonâ fide* trade buyers are invited to call. We are asked further to remind the trade that the advice of the Illuminating Engineering Department of the company is at the disposal of contractors to assist them in the development of any lighting schemes which they may have in hand.

Power Station Firemen.—Firemen employed in the Liverpool, Birkenhead and Wallasey power stations, are claiming advances through their Trade Union, the National Amalgamated Union of Enginemen and Firemen. Strike notices had been issued to the Birkenhead Corporation, but have been suspended, on a meeting being promised.

The Development of Derby.—The Derby Borough Development Committee, having come to the conclusion that there is nothing so effective as publicity, is arranging with Mr. E. J. Burrows, of Cheltenham, for the issue of a handbook advertising the town at a cost not exceeding £50. The Committee is also contributing £5 towards the cost of an advertisement of Derby and its electricity undertaking in the ELECTRICAL REVIEW.

Round and Round.—We reproduce herewith a very telling cartoon issued by the London Underground Electric Railways illustrating the dangerous and frantic chase that is taking place round and round the vicious circle. The educational effect of such posters upon the public mind should be considerable; the



principal object, of course, is to show the railway and tramway passenger how handicapped are the authorities by the chain and deadweight of "maximum powers" restricting fares and preventing them from catching up either costs, wages, or prices.

The following verses accompany the picture:—

ROUND AND ROUND THE UNDERGROUND TREE.

Here we go round the Underground Tree,
I chase you and you chase me,
Round and round—and so you see,
Nobody gets any further.

Round and round and round we tear,
Cost and Price and Wage and Fare,
With never a chance of "getting there"—
And other folks all cry "Murther!"

Round and round we race, in case
Someone behind should force the pace!
Oh, what an endless, senseless chase!
Oh, what a helter-skelter!

Round and round and roundabout,
Starting again where we first set out;
One of these days we'll stop, no doubt,
Under the Tree for shelter.

J. H. R.

Social.—The termination of a popular series of social evenings held by Pope's Social Club throughout the winter was marked by a successful Whist Drive and Fancy Dress Ball held on May 19th, at which Mr. Stanley Carman, works manager, Pope's Electric Lamp Co., Ltd., was present. There were many striking costumes to be seen among those worn by the 600 members and friends who attended, one of the prize winners being Miss Nunny, who represented an up-to-date "Pope" electric lamp. At the close of the proceedings Mr. E. A. Marx (sales manager) distributed the prizes.

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London Coal Prices.—In a written reply to Captain Bowyer. Mr. Bridgeman states that the present maximum retail price of best Derby coal in Central London is 57s. 2d. per ton, as compared with 27s. per ton in 1913. He gives the following analysis of these prices :—

	1913.	1920.
	s. d.	s. d.
Pit price	13 0	33 5
Railway rate	6 4	8 2
Wagon hire	1 0	1 6
Factorage	—	0 4
Distribution charges :—		
Wages, loaders, and carmen	1 10	4 9
Other cartage charges, including sacks	1 1¾	3 7
Loss on smalls	0 4	0 7
Establishment charges, including siding rent ...	2 5½	3 4
Management and interest	—	0 3
Profit...	0 10¼	1 3
	27 0	57 2

—*The Times.*

A Swedish Company.—The directors of the A. B. Luth and Rosen, of Stockholm, reporting on the year 1919, state that a considerable set-back took place in the electrical industry as compared with the favourable situation which prevailed in 1918. The reaction specially affected the company, as large stocks of raw materials were purchased on account of the great influx of orders in 1918. In the accounts for 1918 these stocks were entered at the prices of purchase, which also corresponded with the market prices which existed at the beginning of 1919. The great and rapid fall in prices during 1919, however, rendered it necessary for the stocks to be written down considerably. A circumstance which contributed towards this loss was that the company, as in the case of other Swedish electrical firms, could not help participating in the purchases of copper made through the Government's Industrial Commission. The sudden legislation concerning the prohibition of iron-zinc conductors for electrical purposes also brought about a loss of 500,000 kr. Moreover, the losses were contributed towards partly by export difficulties and partly by the decline in the home demand in the latter half of the year; the removal of mechanical manufactures to the Eskilstuna branch, so as to provide greater space for electrical production at the head works in Stockholm, also affected the results, as also did the lack of success with the heating element according to the Cardellska patents, and with a new type of motor-plough. In addition, the manufacture of electrical machinery at Stockholm proceeded with less favourable results, owing to labour conditions and the difficulties in the question of materials. The prospects at present (May), however, seemed to be brighter. All the shops were well supplied with orders, prices were steadily advancing, and the deliveries of materials were more certain, so that it was no longer necessary to keep large stocks. During the year the company were successful in forming some new export connections, and the directors hoped that this part of the business would be carried on satisfactorily, especially if exchange conditions became regular. The accounts show a loss of 5,390,000 kr. for 1919, as compared with net profits of 2,960,000 kr. in the previous year, on a share capital of 16,650,000 kr. It is now proposed to reconstruct the company by the formation of a new company, under which the loss will be written off, and one new share be offered for two old shares, and cumulative preference shares for 4,000,000 kr. are to be issued.

Dissolutions and Liquidations.—British Electrical Accessories, Ltd., Fawcett Row, Bradford. List of creditors in this voluntary liquidation :—

Albion Electric Stores	£234	Bankers	£2,215
Accumulators, Ltd.	19	Lund, Miss	355
Benjamin Electric, Ltd. ..	109	Lund, Percy, P. Lund, Humphries	234
Brearley, H.	37	Liverpool Electric Cable Co. ..	30
British Westinghouse Elec. Co.	33	Leach, S. G., & Co., Ltd. ..	24
Baxendale & Co., Ltd.	54	Pirelli, Ltd.	63
Brocklehurst, W. H.	15	Paterson & Service	12
British Insu. & Helsby Cables	11	Rushworth, J. W.	525
Crowther & Osborn, Ltd. ..	144	Rhodes, J. S.	296
Cable Accessories Co., Ltd. ..	127	Rylands Glass & Eng. Co., Ltd.	84
Cambridge & Paul Inst. Co., Ltd.	52	Reyrolle, A., & Co.	21
Crompton & Co., Ltd.	25	Stephenson, H. & J.	165
Connolly Bros., Ltd.	37	Sanders, W., & Co.	107
Driver, Drennan & Cooper, Ltd.	1,178	Sterling Tel. and Electric Co...	73
Battery D.P. Co., Ltd.	156	Star Electrical Co.	69
English Electric Supplies, Ltd.	13	Sperryn & Co.	36
Falk, Stadelmann & Co. ..	228	Sun Electrical Co.	14
Forward Electric Co., Ltd. ..	39	Taylor, F. W.	454
Gillespie, R. P.	33	Tividale Enamel Co.	28
Hodgson, Mrs.	113	Taylor, W., & Co.	16
Hurst Electrical Plant, Ltd. ..	75	Underwood, Ltd.	105
Judge, W. A.	150	Wilson, W. D.	1,048
Jarrett, Pyrah & Armitage ..	53		

Signal Electric Co., Ltd., Norfolk House, Laurence Pountney Hill, Cannon Street, London, E.C.—A meeting of the creditors of the above was held recently at the Cannon Street Hotel, when it was reported that the shareholders had passed the usual resolution in favour of voluntary liquidation, and had appointed Mr. G. L. Wynn to act as liquidator. A statement was presented showing the position as at May 5th last, and this disclosed unsecured liabilities of £3,152. The indebtedness to the trade was £2,380, while the directors were shown as creditors for fees amounting to £637, and the balance of £134 was due in respect of interest on the preference shares. The assets were estimated to realise £3,937, and as regarded the unsecured creditors a surplus was shown. The assets consisted of cash in hand, £4 18s. 8d.; deposits, £10; furniture, £32; plant at Walthamstow, £44 13s.; patents, trade marks, and secret processes, £2,388; preliminary expenses, £200; and stock at factory, at cost, £1,262. The issued share capital of the company was £5,160, and as regarded the contributories there was a deficiency of £4,375. The company was registered on May 31st, 1919, with a nominal capital of £12 500, divided into 10,000 preference shares of £1 each, bearing interest at the rate of 7 per cent. per annum, and 5,000 ordinary shares of 10s. each. The company had issued 3,402 preference shares for cash, but there were unpaid calls of £125, leaving the net amount received by the company at the sum of £3,277. The company had also issued 3,766 ordinary shares, and the total issued capital was, therefore, £5,160. The company had worked at a factory in Walthamstow, and there was some doubt whether the lease of the premises had been secured. The lease had about 14 years to run, at a rental of £470 per annum, and a portion of the premises was sublet at £300 yearly. The chief director of the company was Mr. C. St. John, who transferred the patents, &c., to the company. It was impossible to say what their present value was. A portion of the stock had not been made up, and might have to be completed by the liquidator. It was also stated that there were contracts still running, and it might be that the liabilities would be increased. The opinion was expressed that the creditors should be represented in the liquidation of the company, and it was decided that an application should be made to the Court for the appointment of Mr. E. H. Hawkins, of Messrs. Poppleton, Appleby & Hawkins, 4, Charterhouse Square, E.C., as liquidator of the company, while a committee of three of the principal creditors was also nominated. The following are creditors :—

Fish & Ludlow, Ltd.	£602	British Insulated and Helsby Cables, Ltd.	£63
Dangerfield, W. & J.	395	Brownrigg, H. K.	45
Abbey Industries, Ltd.	218	Gilson, D., & Co.	29
Cartland, James, & Sons, Ltd...	168	Baker, W. E.	24
Phillips, Ephraim	164	Norman, L...	24
Drycells, Ltd.	113	Druitt, H.	21
Lovelace, R. E. H.	112	Bailey, S. A.	20
Walthamstow Urban District Council (rates) ..	99	Flint, C. D.	17
Concordia Elec. Wire Co., Ltd.	81	Lea Bridge Gas Co.	14
Matthey, Johnson, & Co., Ltd.	79	St. John, C.	12

Little Wonder Battery Co., Ltd.—Winding up voluntarily. Liquidator, Mr. R. G. Pye, 26, Budge Row, E.C. Meeting of creditors, June 8th.

Siebe, Gorman & Co., Ltd.—Particulars of claims must be sent to the liquidator, Mr. R. B. Petre, 11, Ironmonger Lane, E.C., by June 30th.

Rotasphere Co., Ltd.—Claims must be sent to the liquidator, Mr. A. S. Jopp, 82, Belvedere Road, S.E., by June 22nd.

Ernest King & Co., electricians, engineers and contractors, 97, Bridge Street, Walsall.—Messrs. S. Birch, P. H. Tomkins and E. King have dissolved partnership. Messrs S. Birch and P. H. Tomkins will attend to debts.

Jenner, Chitham & Co., electrical engineers, 11, Red Lion Square, W.C. 1.—Mr. H. Jenner and Mr. R. M. Chitham have dissolved partnership. Debts will be attended to by Mr. H. Jenner, who will continue the business at the same address under the style of H. Jenner & Co.

British Trade-Mark Applications.—Appended is a summary of the recent applications for British trade-marks in respect of goods associated with the electrical trades and industries :—

Sollac. No. 400,442. Class 1. Electrolytes, being chemical substances.—Haslam & Stretton, Ltd., 11, Windsor Place, Cardiff. February 5th, 1920.

Quixpark, the Best of Fellows (lettering combined with name and address of firm and design). No. 396,037. Class 6. Magnetos. —Fellows Magneto Co., Ltd, Park Royal, Willesden, N.W. October 23rd, 1919.

E.A.C. (monogram design). No. 401,343. Class 6. Electrical machinery.—Electrical Apparatus Co., Ltd., Vauxhall Works, South Lambeth Road, London, S.W., 8. March 1st. 1920.

Elephant on Scooter (design). No. 394 361. Class 13. Electric cut-outs and terminals, electric switches, electric fittings, &c.—Leonard E. Hough, 246, High Street, Lewisham, S.E. August 19th, 1919.

Konled. No. 400,513. Class 13. Electric light and cable fittings.—Faulkner & Co., 5, Market Street, Manchester. February 7th, 1920.

A.E.G. (letters combined with design). No. 359,820. Class 13. Electrical goods of metal.—Allgemeine Elektricitäts Gesellschaft, 2-4, Friedrich Karl Ufer, Berlin, N.W., 10. March 23rd, 1914. (The registration of this trade-mark has apparently been held up during the war, having only just been passed.)

Rajah. No. 401,790. Class 15, also No. 401,791. Class 16. Fittings of glass and porcelain for use in electric lighting, &c.—Herbert & James Stevenson, Ltd., 16, Water Lane, Great Tower Street, London, E.C. March 12th, 1920.

Boreas. No. 398,548, Class 18. Electric and pneumatic bells (as systems in buildings, &c.).—Lacy-Hulbert & Co., Ltd., 91, Victoria Street, London, S.W. December 18th, 1919.

Electrical Exhibition in Holland.—The British Vice-Consul at Leeuwarden, Holland, reports that an exhibition of electrical products will be held by the municipality of that town from August 14th to September 15th, 1920. The Vice-Consul, who is chairman of the Executive Committee, suggests that United Kingdom firms should unite to make up a British Section for which it is possible to allocate a space in a favourable position. A translation of the official regulations has been prepared, and is available to callers at the D.O.T. in London, in Room 48 (Mr. Cresswell).

Catalogues Wanted.—The Electrical Engineering and Maintenance Co., 87, Main Street, Portrush, desire to receive catalogues and other publicity matter.

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Lead.—In their report, dated May 29th, MESSRS. G. CAWSON & Co. say :—

The general consumptive trade still remains rather stagnant. Electrical works, however, continue busy, and are taking good quantities of lead, and appear likely to do so for some considerable time. This demand keeps the market firmer than it otherwise would be.

Supplies continue to come in rather freely, so that there need be no alarm on the part of consumers as to any shortage. With general consumptive demand at about 50 per cent. below the pre-war normal, we cannot see how any shortage in supplies is likely to arise.

The outlook points to a steady market, and should speculators again begin operations, as other metals appear to be reviving, some fresh advance in price is not unlikely.

MESSRS. JAMES FORSTER & Co., reporting under the same date, say :—

The metal market continues under the depressing influence of outside markets and finance, supply and demand having very little to do with the course of values. Consumers generally have been buying with hesitation and only for near delivery, but towards the week-end there has been much more disposition shown to negotiate, and inquiries have been received from different parts of the country which have resulted in business at considerably above the market rates.

The difficulty in obtaining suitable brands is again in evidence, but this has been relieved somewhat by the discharge of steamers this week from Australia, after lying in the docks in one case for over two months and in others for weeks. The shipments from Australia for April are advised at 2,300 tons, against arrivals here in April from this source of 5,750 tons, so that June will be a short month for Australian brands.

Italian Company Notes.—There has been formed at Milan the Consorzio per l'Alienazione degli Impan e Materiali Elettrici e Telefonici Residuati della Guerra with a capital of 5,000,000 lire, of which 1,570,000 lire are paid up, for the liquidation of war plant.

With a capital of 6,000,000 lire the Società Anonima Elettrica Ghise e Acciai has been established at Genoa for the output of electric current for the production and trade in malleable iron and special steel and other industrial purposes.

The Società Anonima Elettricità Alta Italia, of Turin, has decided to increase its capital from 30,000,000 to 48,000,000 lire, a portion being allotted to the Società S.I.P. for its Biellese distribution network.

Other companies increasing their capitals are :—The Società Idroelettrica Monviso, at Verzuolo, from 5,000,000 to 20,000,000 lire ; the Società Italiana per l'Utilizzazione delle Forze Idrauliche delle Veneto, at Venezio, from 21,000,000 to 26,250,000 lire ; the Società Elettrica Bresciana, at Brescia, from 36,000,000 lire to a sum unnamed ; the Società Emiliana di Esercizizi Elettrici, of Parma, from 10,500,000 to 17,500,000 lire ; the Società Materiali Elettro-Trazione, of Florence, from 1,000,000 to 2,430,000 lire ; the Società Elettrica Radio di Sperone, of Avellano, up to 1,000,000 lire ; the Società Iesina di Elettricità, of Iesi, from 800,000 to 1,200,000 lire ; the Società Imprese Elettriche, of Macerata, from 1,200,000 to 1,500,000 lire ; the Società Industrie Elettriche Calabresi, of Radicena, increases from 2,000,000 to 3,000,000 lire, and amalgamates with the Società Elettrica Ionica, of Siderno ; and the Società Fabbrica Apparechi Riscaldamento Elettrico, of Milan, from 2,000,000 to 5,000,000 lire.

The Officina di Energia Elettrica, of Novara, has reduced its capital from 2,000,000 to 800,000 lire by assigning to its shareholders 8,000 12-lire shares of the Società Padana di Elettricità for one of the Officina.

Book Notices.—"The Problem of Dock Labour." By Arthur Shadwell, M.A., LL.D. Reprinted from *The Times*. London : Longmans, Green & Co. Price 1s.—This is a most thoughtful and valuable pamphlet. Every student of the pressing social and industrial problems of these critical times should secure a copy and read it carefully.

"Industrial Arts Index." Vol. VIII, No. 4. April, 1920. (62 pp.). New York : The H. W. Wilson Co.—A comprehensive index to articles which have recently appeared in engineering, trade and business periodicals, placed under subject-headings.

"Welfare Work." Vol. I, No. 5. (16 pp.).—The May number of the *Journal* of the Welfare Workers' Institute contains articles by E. D. Newcomb, "Foremen and Forewomen," and A. Rowland-Entwistle, "The Democratisation of Industry."

"Armature Winding and Motor Repair." By D. H. Bradymer. Pp. xxi + 515 ; figs. 298. London : Hill Publishing Co., Ltd. Price 18s. net.

"Engineers' Desk-Book and Diary." 1920. Leeds : Trades Publicity Co.—This handy publication contains a brief calendar, a diary giving ample space for notes and 96 pages of indexed information of a comprehensive character, including trade statistics and legal notes, as well as a small railway map of the British Isles.

"Ozone." By E. K. Rideal. Pp. ix + 198 ; 24 figs. London : Constable & Co., Ltd. Price 12s.

"Questions and Solutions in Telegraphy and Telephony." By H. P. Few. London : S. Rentell & Co., Ltd. Price 5s. 6d.—This useful handbook is now in its fifth edition—the last was published in 1914. It has been brought up to date by the addition of the papers and solutions of the City and Guilds of London Institute in Grade I of Telegraphy and Telephony for the last five years. Although the papers given in the first part of the volume no longer represent current practice, they are retained as illustrative of the various steps of progress.

"Induction Coil Design." By M. A. Codd. Pp. viii + 238 ; figs. 165. London : E. & F. N. Spon, Ltd. Price 21s. net.

"*Journal* of the Institution of Electrical Engineers." Vol. LVIII, No. 291. May, 1920. London : E. & F. N. Spon, Ltd. Price 10s. 6d.—The May issue contains the following papers :—"Scientific Management : A Solution of the Capital and Labour Problem," by Capt. J. M. Scott-Maxwell ; "Wireless Telephony on Aeroplanes," by Major C. E. Prince ; and "The Protection of Alternating-Current Systems without the use of Special Conductors," by Major K. Edgcumbe.

"Science Abstracts" (A and B). Vol. XXIII, Part 4. April 30th, 1920. London : E. & F. N. Spon, Ltd. Price 2s. 6d. each.

"The Peat Resources of Ireland." (25 pp.). A lecture given before the Royal Dublin Society on March 5th, 1919, by Prof. Pierce F. Purcell. London : H.M. Stationery Office. Price 9d. net.—This is described in a prefatory note by the Director of Fuel Research as "a clear and fair-minded exposition of the situation . . . written by an expert with a wide and intimate knowledge of the subject." The first part of the lecture is devoted to a description of the various forms and characteristics of peat deposits, and then the elimination of water, which forms the greater part of bog peat, is dealt with. Figures of the present-day consumption are given, as well as an estimate of the quantities available—a figure of 3,700 million tons of anhydrous peat. Tables comparing the peat and coal deposits of Ireland and the areas of the peat deposits of the world are included. The various methods of winning peat are described, and the production of power from this fuel is illustrated by an efficiency diagram.

"The Motor Ship." Vol. I., No. 3. (30 pp.). London : Temple Press, Ltd. Price 1s.—The June number of this well-produced and highly illustrated journal contains an interesting description of the 10,000-ton motor-tank ship *Narragansett*, built by Messrs. Vickers. The largest American motor-ship is also described among other informative articles.

"Vickers News." Vol. II, No. 17. June 1st. (20 pp.) London : Vickers, Ltd.—Presenting articles on "Trans-Continental Flying," "Transformers in Collieries," "A Simple Form of Refrigeration," &c., all well illustrated.

Bankruptcy Proceedings.—A. E. CHANNON, H. S. NADIN, and C. G. CHANNON (trading as A. E. Channon & Co.), electrical engineers, 8, Orrisdale Terrace, Cheltenham, and 425, High Street, Cheltenham.—The public examination of these debtors was held on May 27th, at the Court House, Cheltenham, before Mr. Registrar Williams. In reply to the Official Receiver, the debtor, H. S. Nadin, stated that he had acted as managing partner, and that the partnership commenced in January, 1919. He had had various occupations before commencing in partnership. They started business without any stock or capital. They had an offer of goods up to £250 on credit. The Official Receiver stated that the business had been carried on at a loss, owing to want of business knowledge, want of capital and negligence in book-keeping. Debtor admitted several losses on contracts which partly accounted for their deficiency. He also admitted that a statement prepared and sent to one of the creditors was misleading, though he suggested that he did not know it at the time. This creditor, who had removed debtors' goods just before the petition to the value of £200, had now written to the Official Receiver, that these goods were now held at the Official Receiver's disposal. The debtor, A. E. Channon, generally agreed with the answers given by the previous partner. He declared that by a deed made in September, 1918, he gave all his furniture to his wife, but the Official Receiver remarked that the wife had now withdrawn her claim. C. G. Channon was also examined as to the conduct of the business. On the application of the Official Receiver, the examination of the debtors was adjourned : meanwhile, Nadin was ordered to furnish a cash account of receipts and payments during the partnership.

W.P. O'REILLY, manufacturing electrician, 397, Edgware Road, and Old Broad Street, E.C.—Last day for proofs for dividend June 18th. Mr. D. Williams, Official Receiver, trustee, Carey Street, W.C.

Trade Announcements.—The offices of the PENINSULAR ENGINEERING CO., LTD., have been removed to Amberley House, Norfolk Street, Strand, W.C. 2. Telephone number unchanged. Telegrams "Pensuleco Estrand London."

THE HACKBRIDGE CABLE CO., LTD., have now closed down their London offices, and all communications should be addressed to the company at Hackbridge, Surrey.

THE METROPOLITAN-VICKERS ELECTRICAL CO., LTD., have removed their London office from Norfolk Street to No. 2, Central Buildings, Westminster, London, S.W. 1.

Mr. Farmer, electrical engineer, of Broadhurst, Skelmersdale Road, Clacton-on-Sea, has entered into partnership with Mr. C. R. Small & Wall Bros., and the firm will trade as THE CLACTON ELECTRICAL CO.

THE TWISS ENGINEERING & ELECTRIC TRANSMISSION, LTD., announce that they have now concluded arrangements whereby they acquire the Transmission Line Contracting Department of Messrs. J. B. Saunders & Co., Ltd., which will therefore become incorporated in the company's organisation, together with the services of Mr. S. G. Leech, M.I.E.E., as the director of contracts, with a staff of erecting engineers, linesmen, &c. The Twiss Engineering & Electric Transmission, Ltd., are also expanding their works at Mildmay Park, and laying down new plant to facilitate the manufacture of transmission line material. The directors have also decided to simplify and shorten the name of the company by the deletion of the words "engineering and," and the necessary formalities having been completed, the name of the company will in future be : Twiss Electric Transmission, Ltd. The head office remains at 62/63, Queen Street, E.C. 4. The capital of the company has been increased in order to deal with the increasing volume of business.

MR. THOMAS J. DIGBY, electrical engineer and contractor, has removed his offices and stores to 12, Gerrard Street, London, W. 1.

The address of MR. JAMES FERGUSON, electrical instrument maker and engineer, has been changed to Stepps Engineering Works, Stepps Road, Glasgow.

MESSRS. DOWNES & DAVIES, of Liverpool, have removed their Manchester offices and stores to 25/27, Faulkner Street, City.

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Catalogues and Lists.—MESSRS. F. J. SHENTON & CO., LTD., of 68 and 69, Shoe Lane, London, E.C. 4, have sent us a couple of calendar novelties on behalf of Messrs. Flather & Co., Ltd., dynamo and motor manufacturers, of Park Electrical Works, Leeds, for whom they are sole representatives. One takes the form of a glass paper-weight, with changing calendar affixed at base thereof. The other is a daily tear-off date pad for use on the wall; it has bold red figuring.

MESSRS. WARD & CRICHTON, 41, Chapel Walks, South Castle Street, Liverpool.—A booklet and two leaflets dealing with the "Tompkins" Boiler Steam Dryer (Patent No. 113,701), and illustrated by detailed drawings. The agent for Scotland is Mr. I. Ferguson, 27, Oswald Street, Glasgow.

THE COX-CAVENDISH ELECTRICAL CO. LTD., Twyford Abbey Works, 84, Acton Lane, Harlesden, N.W. 10.—"The X-Ray Examination of Materials" (20 pp.), a reprint from the *American Machinist* giving full details and illustrations of the apparatus required for this work. The paper is priced, and directions for treating films are given.

THE OVERSEAS ENGINEERING CO., LTD., 75, Curtain Road, E.C.—List 23, a folder illustrating and describing the "Overseas" electric lighting plant. Full details of working costs are given.

THE J.L. ELECTRIC CO., 30, Church Street, Birmingham.—Particulars and samples of a universal cable clip, to secure cables from 1/·044 single up to 7/20 twin, in C.T.S., lead-sheathed, or armoured types, which can be supplied from stock.

MESSRS. MICKELWRIGHT, LTD., Alperton, Wembley, Middlesex.—Pamphlet illustrating and describing arc and sliding resistances, dimmers, shunt regulators, switchboards, &c.

MESSRS. HIGGS BROS., Dynamo Works, Sand Pits, Birmingham.—"Monthly Magazine," Vol. 2, No. 4, June, 1920 (24 pp.). The present issue contains the usual features, including a stock list of motors and dynamos, and "Hints and Tips," giving notes on turning commutators.

MESSRS. BUCK & HICKMAN, LTD., 2 and 4, Whitechapel Road, E. 1.—An eight-page booklet dealing with machine tools, ganges, &c., and the "Buckman" training centre where prospective purchasers may not only see the desired machines running, but may, in addition, have work of their own operated upon.

THE STERLING TELEPHONE AND ELECTRIC CO., LTD, 210-12, Tottenham Court Road, W.—Publication No. 279, being a revised price list to the eleventh edition catalogue. Catalogue number and prices only are given.

AUTOMATIC AND ELECTRIC FURNACES, LTD., 281-283, Gray's Inn Road, W 1.—Heat Treatment *Bulletin* No. 22, "The Hardness of High-Speed Steel," illustrated by two curves of hardness tests.

Japanese Financial Crisis: Shipment of Goods.—The *Bulletin* of the F.B.I. this week contains the following notice:—"In view of the present financial crisis in Japan, members who are in doubt as to their position in connection with goods for shipment to that country are advised to communicate in the first instance with the Japan Section, Overseas Trade Organisation, F.B.I., 39, St. James's Street, S.W. 1.

Auction Sale.—By direction of the Disposal Board, Ministry of Munitions, MESSRS. OLIVER APPLETON & KITCHEN will sell by auction, on June 15th and following days, at the C.D.S. stores, Benbow, near Leeds, a quantity of electrical plant, fittings, engines, Lancashire boilers, machinery, and miscellaneous stores, &c. For particulars, see our advertisement pages to-day.

Manchester Turbo-Generators.—At the annual meeting of shareholders of MESSRS. RICHARDSONS, WESTGARTH & CO., LTD., held at Hartlepool on Monday, Mr. D. B. Morrison, who presided, said a notable contract in the "land" department of their engine works was a 25,000-KW. electric generating set for Manchester, of which they supplied the turbine and condensing plant and Metropolitan-Vickers the generator. This set was the largest in operation in the United Kingdom, and although the technical requirements were very severe, they had been successfully met, and the plant continued to give highly satisfactory results.

Derby Housing Scheme.—The Derby Town Council has received communications from the Derby Engineering Co. with respect to the wages and conditions of labour of men employed in connection with the electrical work on the municipal housing scheme. It has decided to inform the electrical contractors that they must observe the fair wages clause or the contracts will be cancelled.

Generating Plant for Sale.—Ipswich Corporation Electric Supply Department has for disposal two 80-I.H.P. Reavell high-speed tandem compound engines, direct-coupled to two 24-KW., 230/260-volt D.C. shunt-wound generators; also one 200-KW., 460/520-volt Electrical Co.'s D.C. generator. For particulars see our advertisement pages to-day.

Wigan Corporation Electricity Committee invites offers for one Willans high-speed compound engine (3 S. size), complete with Korting ejector condenser, direct coupled to 560-v. Dick, Kerr generator, &c. See our advertisement pages to-day.

Light-Weight Motors.—Referring to a note under this heading which appeared in our issue of December 13th, 1918, MESSRS. NEWTON BROTHERS (DERBY), LTD., inform us that the machine in question was probably one of their dynamos, as illustrated and described in their "Aircraft Dynamo Electric Machinery Supplement." This machine has an output of 500 watts at 12 to 14 volts, and weighs only 12 lb. Many other types of extreme lightness have been developed by the company for aircraft, vehicle motors, &c.

LIGHTING AND POWER NOTES.

Athlone.—ELECTRICITY SUPPLY.—The total cost of the new electric lighting scheme, promoted by the Urban Council, is now stated to be £20,000, but an estimate for a second scheme amounts to £17,653. The gross financial result is estimated as follows:—Revenue, £4,360; working expenses, £2,082; balance, £2,179; loan charges, £2,000; and net profit, £378. Mr. Kenny, representing Messrs. Tiesney, consulting engineers, said the cost of electricity would be 1s. per unit. For public lighting 120 lamps would be provided. A Committee of the Council is considering the whole matter.

Australia.—NEW UNDERTAKINGS.—A large number of townships in Victoria have schemes for electricity undertakings in hand or under consideration; among these are the towns of Stowell, Avoca, Beaufort, Colac, Mount Gambier, and Kyneton.

Birmingham.—CANAL STRIKE.—The electricity supply department was seriously affected by the recent strike of canal boatmen, as practically the whole of its fuel is water borne. While the strike was in progress, officials and members of the staff undertook the boatmen's work, and in this way a minimum supply of coal was got through to keep the service going. When a tentative settlement was reached, the Corporation boatmen, who had ceased work in sympathy with the other boatmen, resumed their duties.

Bolton.—PRICE INCREASE.—The electrical engineer reported, on May 27th, on the need for increasing the price of electricity. The Committee decided to advance the charge for both lighting and power by a tenth of a penny per unit. The request of the Chamber of Trade for a preferential rate was declined.

Bo'ness.—EXTENSION SCHEME.—Mr. Munro, consulting engineer, has reported to the Town Council on the proposed extension of the electricity works, and a decision regarding this will be made at a meeting of the Council at an early date. The cost of the scheme is given as £40,000.

Burnley.—EXTENSIONS.—On May 27th the chairman of the Electricity Committee reported that tenders had been obtained for the proposed extensions at the electricity supply station and for the installation of the required plant. The lowest tender at the present time was £120,000, and at least 16 months would be required in which to complete the work. The amount would be subject to variation in the event of increases occurring. The £120,000 was made up as follows:—Three water-tube boilers, with superheaters, economisers, valves, &c., £39,200; one 3,000-KW. turbo-alternator, with condenser, pumps, &c., £27,100; external pipe-work and valves, £6,270; water strainer, with motor pump, £577; cooling tower, £5,200; Venturi meters, £232; boiler feed-pump, £473; 1,000-KW. rotary set, £7,097; switchgear, booster, and cables. £6,600; ash-handling plant, £2,200; constructional work, cable and pipe trenches, £12,000; and contingencies, £13,051. It was anticipated that further rises in wages and materials would occur before the completion of the work, and the final cost would be greater than the £120,000.

The Council intends to apply for borrowing powers for the latter amount, and for an additional £20,000 for electricity mains.

China.—SHANGHAI.—Contracts for electrical generating plant for power and lighting are probable in connection with projects for supplying electricity outside the Settlement limits at Shanghai. In the ordinary course the proposed extensions of the electricity department of the Shanghai Municipal Council, as set out in March last, would have covered such requirements, but the extensions have been opposed on the ground that they are for the benefit of mills and factories outside the Settlement limits, which pay no taxes to the Municipal Council. It is probable, therefore, that independent power stations may be erected for such outlying establishments. Already works are being erected in Chinese territory in order to obtain power from the native city station. A way out of the difficulty has been provided by the proposal that outlying factories requiring current for power purposes should take up municipal debentures, but a very general response to this scheme is not anticipated.—*Eastern Engineering.*

Colne.—PRICE INCREASE.—The Town Council has decided to increase the charge for electricity for lighting from 4½d., plus 75 per cent., to 8d. per unit allowed under the provisional order; for power purposes, from 85 per cent. to 95 per cent.; and for heating, from 75 per cent. to 85 per cent. on the scale charge of 1½d.

Continental.—SWITZERLAND.—The Nordostschweizerische Kraftwerke A.-G. (N.E. Swiss Power Works), which increased its capital from 18 million to 36 million fr. in 1918, is now about to effect a further increase of 34 million fr. The following particulars concerning the future development of supply and demand and the construction of new power stations are extracted from the company's report of January 30th, 1920:—

In the financial year 1918-19 production amounted to 232·22 million KW.-hours, as against 185·66 million KW.-hours in 1917-18. It is estimated that requirements for the current year will increase by 13 per cent. As a return of pre-war coal prices cannot be looked for within a measurable time, electricity will be able to compete with coal for many years to come. Its use in the home, for hot water supply, and for metallurgical purposes has increased. The electrification of the railways is proceeding apace. Only for

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electrochemical purposes has the demand materially decreased and the present stagnation will, no doubt, continue until such time as the products of the industry are in a position to compete with foreign prices.

In view of the fact that the Swiss power stations are unable to cover home requirements, the N.O.K., which is responsible for the electricity supply of North-East Switzerland, is aiming at the construction of new power stations, so as to make the country independent of foreign supplies. It had been hoped that the concession for several small stations in the canton of Glarus would have been granted, but unexpected difficulties have arisen. The concession has, however, been obtained for a low-pressure station in the Canton of Aargau, viz., the Böttstein-Gippingen Power Station. In addition, subject to the sanction of the Administration of the Swiss Federal Railways, the project for the construction and working of the Etzel Power Station jointly by the S.F. Railways and the N.O.K. has been prepared and, finally, it is hoped that the construction of the Wäggital power station can be carried out in conjunction with the town of Zürich.—*Economic Review.*

GERMANY.—According to plans prepared by Mr. Hallinger, of Munich, it is proposed to divert water from the high level rivers in Southern Germany to the low level system of the Main. The fall of the River Lech, for instance, which now flows south and joins the Danube, would be increased from 300 ft. to 1,080 ft., resulting in a total of 500,000 H.P. if arranged with open canals and falls at three points. The first fall would be at Nurnberg, where 200,000 H.P. is obtainable, the second at Wurtzburg, delivering 150,000 H.P., and the balance of 150,000 H.P. at Frankfort, as against 60,000 H.P. if the river is to continue to flow south as at present. Coal-fired installations to produce the same power would require 3,000,000 tons of good quality coal annually, which at the present price in Germany is worth £15,000,000.—*Technical Review.*

AUSTRIA.—A report on the development of water-power and electricity works has been presented to Vienna Town Council.

In view of the present restrictions in the use of electricity and the high prices, the Council was compelled to ascertain the quickest and cheapest method of obtaining water power. In contrast to the length of time required for the Danube power works, the Ybbs and the falls of the Alpine water-system near Kienberg-Gaming, can be developed in three or four years. Also the technical preparation for the Ybbs works are so far advanced that in a few weeks the sanction for proceeding may be expected. The average yearly output of the Danube works would be 140,000 H.P., and of the Ybbs works 18,000 H.P. The cost of the former is estimated at the lowest at Kr. 211 mill. (peace value), of the latter at Kr. 30.8 mill. The production of the electrical works amounts at present to 250 mill. KW.-hours, and will be increased to at least 320 mill. The yearly increase of electrical output averages 18½ mill. KW.-hours, and will in future be still greater because the gas lighting from foreign gas coal is to cease and electricity alone to be used, especially in the largest industrial district of Austria between Vienna and Vienna-Neustadt. A yearly increase of 200 mill. KW.-hours can, therefore, be estimated. In 15 years' time, the earliest date for the completion of the Danube works, the municipal electricity works would be producing 620 mill. KW.-hours. But the Danube works will supply only 365 mill. and the Ybbs works 200 mill., leaving a balance to be supplied by steam. For this reason a large increase of coal production is essential.

It has been decided that Vienna shall establish a co-operative company in which the Province of Lower Austria, the State Railways and the Danube Control Commission will participate, that the commune of Vienna shall proceed with the immediate development of the Ybbs Valley Works, and approach the Government and Lower Austria for active support in this matter.—*Economic Review.*

NORWAY.—Plans are under consideration for the conveyance of electricity from Norwegian waterfalls to Denmark. This would necessitate the construction of a cable about 100 km. in length, extending across the Skager Rack to a point on the coast of Jutland between Hirtshals and Hanstholmen. The longest cable at present in existence connects Helsingborg with Elsinore, a distance of only 7 to 8 km. It is estimated that the total cost of carrying out these plans, including the erection of stations and the extension of the exploitation of the Norwegian waterfalls, would amount to Kr. 30 to 40 million.—*Economic Review.*

SPAIN.—A commission of the Portuguese Ministry of Public Works has arrived in Madrid with the object of drawing up an agreement in connection with the division of power to be obtained from the Douro. It is estimated that a total of 450,000 H.P. is available from this source.—*The Times.*

Derby.—PUMPING PLANT.—Owing to the initial expense, the Town Council has decided not to install electrical pumping plant at the Little Eaton Waterworks.

Dublin.—PROPOSED PRICE INCREASE.—The Corporation has given notice of application made to the Ministry of Transport for an order under the Statutory Undertakings (Temporary Increase of Charges) Act, 1918, to provide that the maximum rates of charge within the municipal area, shall be increased by 50 per cent., viz., from £2 to £3 for any amount up to 60 units, and from 7d. to 10½d. per unit over 60 units, so as to enable the electricity undertaking to be carried on without loss.

STRIKE.—The strike of the Irish railwaymen who object to the importation of arms and ammunition extended on May 27th to the L.N.W.R. power house employés. This station not only supplies the power for cranes, &c., but also for lighting the railway hotel.

Dungarvan (Co. Waterford). — ELECTRIC LIGHTING SCHEME.—A representative public meeting has approved a scheme for public electric lighting, the power to be derived from the Colligan river. Nearly half the required capital (£11,000) was promised at the meeting.

Halifax.—SLIDING SCALE.—The Tramways and Electricity Committee has decided that as from the last meter reading taken for the June quarter, the following clause in the power supply agreement shall apply to all power consumers of electricity, viz.:—"If in any quarter the average price of coal (pea slack) delivered at the Corporation's electricity works is above or below 8s. per ton, the price per unit to be paid by the consumer shall during such quarter, be increased or reduced by 2½ per cent. for every 6d. or portion of 6d., provided, however, that no such increase or reduction shall be made or allowed unless the average price of coal exceeds 9s. per ton, or is lower than 7s. per ton."

Heston and Isleworth. — YEAR'S WORKING. — The report upon the electricity undertaking for the past year shows that the sale of energy produced was £21,721, against £17,019 for the previous year; meter rents realised £284, against £255; and public lighting £2,140, against £1,368. Fuel cost £8,926, compared with £6,557; and wages rose to £2,009 from £1,559. A profit of £442 was made, this being £6 above the previous year's figure.

Japan.—HYDRO-ELECTRIC SCHEMES.—The organisation of the Hida-Gawa Electric Co. now under consideration is for the development of power from the Hida River, in the vicinity of Nagoya. An alternative scheme aims at the unification of the power supply of Nagoya and neighbouring districts under the control of the Nagoya Electric Light Co., which has bought half of the shares of the Bishu Electric Co., and is negotiating to secure control of the Ichinomiya Electric Light Co., the Inazawa Electric Co., the Gifu Electric Co., and the Yokkaichi Electric Co. As a result of the efforts of the governor, representatives of six big electrical companies in Miye Prefecture, the Hokusei, Iwakura, Tsu, Matsuzaka, Ise, and Toba, have been in consultation with regard to a possible combination of all the electrical companies within the Prefecture. With the double purpose of obtaining additional income and of controlling water rights, the authorities of Toyama Prefecture are contemplating the establishment of a large hydro-electric plant under Prefectural administration, to develop 37,000 KW. from the Joganji River. It is expected that this will be sufficient to supply all present demands for power within the Prefecture and leave a surplus to be sold to Kyoto and Osaka. Another power company recently organised in this district is known as the Etchu Electric Power Co., having been granted a licence to utilise the Wada River, from which it is expected to develop 10,000 KW.—*Eastern Engineering.*

Liverpool.—PRICE INCREASE.—An addition of 25 per cent. on the present charges is to be made after June 30th. This will not apply to charges based upon the cost of coal, and subject to adjustment according to increases or decreases. These will only be increased by 15 per cent.

London.—HAMMERSMITH.—The Electricity Committee strongly recommends the laying of mains for the supply of electricity to the new housing estate. The total cost is estimated at £27,000, including services. The system of charging favoured is the prepayment meter, the fixed price and limiter systems being considered a restriction upon the use of electricity for other than lighting purposes, while the Committee wishes to encourage the employment of the supply for all domestic purposes in order to cover the initial expenditure in a short time. If a tenant prefers an ordinary meter, this may be installed in lieu of a prepayment meter. Tenders are being invited for the erection of the first of the sub-stations required under this supply scheme.

Owing to increased costs, the estimated surplus of £3,582 at the end of March, 1921, will be changed to a deficit of £13,688 unless prices are increased immediately; and the Electricity Committee, therefore, proposes the following increases, to take effect from July 1st:—Lighting to be raised to 7d. per unit, and all supplies for power, heating, cooking, and industrial purposes to be increased by a further 50 per cent., bringing the prices up to double the pre-war rates.

The Works Committee recommends the purchase and conversion of 73 gas-lamp standards to electricity, at a total cost of £755. It is stated that the present yearly maintenance cost is £5 8s. 9d. per lamp, which will be reduced upon conversion to £3 18s. 1d.

SHOREDITCH.—The Electricity Committee deems its desirable to abolish the present system of charging for electricity which consists of adding percentages to the pre-war rate. A revised scale, to take effect from the June meter readings, is proposed as follows:—Lighting—maximum demand, 8d. for the first 1½ hours daily, and 3½d. per unit for all electricity consumed thereafter. Flat rate, 6½d. per unit; theatres and music halls, 6d.; and outside arc lighting and electric signs, 4d. per unit. Heating—1½d. per unit if taken in conjunction with a lighting supply. Power—30s. per quarter per E.H.P. of maximum demand, plus 1½d. per unit (maximum charge, 2¾d. per unit). A special rate of 4d. per unit for trade and testing purposes is also proposed. Discounts varying with the amount consumed from 2½ to 10 per cent., are to be allowed. A new scale of meter rents is being introduced at the same time.

Lurgan (Co. Armagh).—ELECTRICITY SUPPLY.—Just before the war, the firm of Messrs. Wanside & Co., Belfast, submitted an electric lighting and power scheme to the Urban

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Council, but the war intervening, the scheme was postponed. Mr. Pleasance, of the firm, recently waited on the Council and explained the great increase in the cost of production since 1914, and, as a result of the discussion, the firm was asked to bring the 1914 scheme up to date and re-submit it.

Mid-Lancashire.—Electricity District.—The Electricity Commissioners have provisionally determined that the undermentioned area shall be constituted a separate electricity district for the purposes of the Electricity (Supply) Act, 1919, that is to say:—The county boroughs of Blackburn, Blackpool, Burnley and Preston. The boroughs of Accrington, Bacup, Chorley, Clitheroe, Colne, Darwen, Haslingden, Nelson and Rawtenstall. The urban districts of Barrowford, Brierfield, Church, Clayton-le-Moors, Croston, Fleetwood, Fulwood, Great Harwood, Kirkham, Leyland, Longridge, Lytham, Oswaldtwistle, Padiham, Poulton-le-Fylde, Preesall, Rishton, St. Annes-on-Sea, Thornton, Trawden, Walton-le-Dale and Withnell. The rural districts of Blackburn, Burnley, Chorley, Clitheroe, The Fylde, Garstang and Preston. It being apparent to the Electricity Commissioners that the existing organisation for the supply of electricity in the district so provisionally determined should be improved, notice is further given that they intend to hold a local inquiry into the matter. Objections or representations may be made not later than September 30th, 1920.

Morley.—Year's Working.—The seventeenth annual report covering the year ended March 31st, 1920, shows that the total revenue for the year was £7,834, an increase of £2,907 on the previous year's figure. The total expenditure increased by £877 to £5,413, leaving a gross profit of £2,421. The net result, after payment of interest, &c., was a credit balance of £282, which, compared with a deficit of £1,759 for 1919-20, was very satisfactory. The report states that the plant is often subjected to overloads owing to its inability to meet the requirements of consumers. There is no reserve in case of a breakdown, and many applicants are waiting to be connected. Unless additional plant is installed before next winter it will probably be necessary to restrict the consumption of power during certain hours.

Plymouth.—Year's Working.—The recently-published accounts for the year ended March 31st last show a total income of £92,957, against an expenditure of £69,785, and a gross profit of £23,172. The net result, after the payment of loan interest, &c., was a credit balance of £274, comparing favourably with the loss of about £2,000 on the previous year's working.

Rotherham.—Price Increase.—The Town Council has increased the charges for electricity as under as from the June 1st quarter:—Power and heating, to 100 per cent., and lighting to 50 per cent. above the pre-war rates.

Swansea.—Strike.—A lightning strike of power-house workers, on Wednesday last week, caused the suspension of electricity supply to the docks.

Worcester.—Year's Working.—The accounts of the city electricity undertaking for the year ended March 31st show a total income of £33,116, compared with £32,235 for 1918-19. The cost of generation and distribution of electricity was £19,835, leaving a gross profit of £13,280. After payment of interest, redemption of capital and income-tax, there remained a profit of £1,224. Carried forward to the appropriation account, this makes, with last year's surplus, £4,406; £1,800 is being contributed to rate relief, and the electrical engineer (Mr. C. M. Shaw) suggests that the balance shall be placed to a reserve account. He points out that there is an urgent need for building up an adequate reserve. There is every probability that the demand upon the department will grow, and that a third turbo-alternator, of not less than 3,000-kw. capacity, may have to be provided within the next year or so. It would be of great benefit to the department if at least half the cost of the new equipment could be met out of a reserve fund. The number of units generated by water power was 563,020, compared with 615,703 in the previous year, and this had affected the cost of production. The total works costs were 1·52 per unit sold compared with 1·04 per unit last year. There was a likelihood that higher salaries and wages would have to be paid, and a possibility of a large increase in the cost of fuel. To meet the ½d. increase in the cost of production, and to provide a reasonable surplus each year to build up a reserve fund of at least £15,000, he recommends increases in the charges. These suggestions include:—Lighting to be increased to a flat rate of 7½d. per unit (with certain exceptions), charges for power supplies to be increased to 75 per cent. over pre-war rates; a labour clause to be added to special contract agreements; heating supply, by separate meter, from 1d., plus 20 per cent., to 1½d. per unit. The Electricity Committee recommends the adoption of these increased charges.

TRAMWAY AND RAILWAY NOTES.

Ashton-under-Lyne.—Fares.—Hurst District Council applied to the Corporation Tramways Committee for a revision of the rates on the Hurst section, with a view to bringing the minimum stage from 1½d. to 1d., but the Committee replied that the introduction of the three-halfpenny fare was due to increased wages, &c., and any alteration would more probably be in the direction of an increase.

Australia.—Adelaide Tramway Trust.—The statement of accounts of the municipal tramway trust, Adelaide, for the half-year ended January 31st, 1920, shows that the total receipts for the period amounted to £242,894, contrasted with £218,550 for the corresponding term in 1919. The revenue per car-mile on the Adelaide service was 22·259d.; expenses per car-mile, 14·770d.; percentage of operating expenses to revenue, 66·080. On the Port Adelaide line the figures for the items enumerated were—18·305d., 13·408d., and 73·253d. The total expenditure incurred in operating the whole services amounted to £239,339, leaving a balance of £3,555.—*Commonwealth Engineer.*

Strike Settled.—The threatened strike of tramway employés at Melbourne was averted early last week, a compromise having been effected.

Bath.—Proposed Fare Increase.—The case of the Bath Electric Tramways, Ltd., showing the necessity for an immediate increase of fares was placed before a special City Council sub-committee by the general manager on May 20th. The company proposes an addition of ½d. to all ordinary fares, irrespective of distance, and an increase of 50 per cent. on workmen's tickets. Even with these additions, the company states that it will not have sufficient funds to carry out the track renewals required by the Council. The sub-committee viewed the proposals favourably and recommends their acceptance by the City Council. The consent of the Ministry of Transport has also been applied for.

Batley.—Breakdown of Plant.—In consequence of a breakdown of a portion of the main generating plant at the electricity works, there was no supply during the whole of May 26th and 27th on the Thorncliffe Road and Healey car routes. The other sections were temporarily able to be supplied with power by neighbouring authorities till the plant was repaired. The lighting and power services were not affected.

Blackpool.—Wage Increase.—By a further bonus advance on June 1st, the tramway employés have now an increase of 173 per cent. on pre-war rates, whilst on the Fleetwood section the increase is much larger. The minimum wage for a motorman is now £3 16s. 6d. for a week of 48 hours. The total war advances are costing the Corporation £40,000 a year, the last 9s. increasing the wage bill by over £8,000 a year.

Bolton.—Employes' Wages.—By a recent award the tramway workers are to receive an advance in wages of 3s. per week retrospective to March 29th last.

Bradford.—Traffic Delay.—About a hundred yards of the overhead wire on the Manningham section of the Corporation tramways became detached on the night of May 24th, and caused much congestion of traffic on the road for upwards of half an hour.

Continental.—Spain.—According to statements by the financial Press of Brussels, confirmed by that of Bilbao, a Spanish syndicate, formed by the Banco Vizcaino and the Hidroelectrica Ibérica, is in treaty in Belgium for the purchase of all the shares in the Bilbao tramway company. The capital of this company consists of 7·5 mill. fr. in shares of 100 fr. each, and of as many founders' shares, the value of which is not stated. The purchase price is said to be 40 mill. fr. The chief Belgian shareholders of the company are the Société Financière de Transport; the Société Generale d'Entreprises Electriques; the Société Generale Belges des Chemins de Fer, and the Banque de Bruxelles, the latter holding founders' shares only.—*Economic Review.*

Portugal.—The Lisbon tramcars ceased running on May 23rd, owing to the rejection by the Socialist members of the city council of an arrangement negotiated by a special committee permitting modifications of the conditions of the contract, including an increase in fares on account of the high price of coal and increased working expenses. There were no disturbances. The municipality has appointed a fresh committee, mainly Socialist, to deal with the question.—*The Times.*

Greenock.—Proposed Municipalisation.—The Corporation has appointed a Committee for the purpose of negotiating with the local Tramways Co. regarding the proposed purchase of the system by the town.

Huddersfield.—Year's Working.—The report on the tramway undertaking for the year ended March 31st, 1920, shows that the capital outlay up to date was £477,607. The income was £261,147; wages, £70,726; power, £35,733; total working expenditure, £217,526, leaving a gross surplus of £43,620. The net surplus, after deducting redemption of debt, depreciation, &c., was £485. Reserve accounts show a net total of £64,835.

Twenty-four cars are to be ordered, in addition to the six in course of erection.

Tramway Services.—It is stated that if the Halifax Corporation extends its tramway system to Elland, *via* Woodside, the Huddersfield Tramway Committee will seriously consider the question of pulling up the tramway lines between Elland and West Vale. This service has proved a most profitable one, and the Greetland people, whom it serves primarily, are showing concern at the prospect of being neglected. If the Halifax project comes into being, there will not be sufficient passengers to warrant a service to West Vale only.

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Keighley. — Extensions. — The railless trolley-car system of the Corporation is about to be extended, it is stated, as far as Oxenhope (at the head of the Worth Valley). At present the service stops at Lees (Haworth). In 1916 the overhead equipment was erected as far as Oxhenhope, but the Local Government (Emergency Provisions) Act of that year barred further progress. Despite the difficulties with the present railless-trolley system on the other routes, by reason of the shortage of cars and the need for repairs, the Corporation is endeavouring to put the new service into operation at an early date.

London.—Floods.—A thunderstorm broke over south-west London on Wednesday evening last week, and the torrential rain caused considerable dislocation of traffic. At Ealing the tramway and District Railway services were interrupted owing to the flooding of the tracks. The Richmond railway service on the District line was suspended owing to the track being flooded to a depth of 12 in. at Chiswick Park, and a train on this line was derailed about 9 p.m. by damage to the track. At Kew Bridge the London and South-Western Railway was flooded to platform level, and the water entered the driver's compartment of an electric train.

An electrical defect at Holloway Road caused a suspension of traffic north of York Road on the Piccadilly Tube Railway on the same day.

Tramway and omnibus stopping places are being considered by the Ministry of Transport.

Fare Increase.—An arrangement has been come to between the London United Tramway Co. and the local authorities in Middlesex and Surrey that the company shall add 50 per cent. to its fares, as from June 1st, except in the case of workmen's fares, which are to remain unaltered. The company's lines run for more than 100 miles in the southern and western outer suburbs of London.

Whitsun Traffic.—During Whitsuntide the number of passengers carried on the trains, omnibuses and tramcars operated by the Underground Co. was as follows :—Saturday, 4,500.000 ; Sunday, 4,250,000 ; Monday, 5,250,000. The Whit Monday figure is considerably in excess of any previous record of passengers carried on any one day.—*The Times.*

Point failure on the City and South London Railway held up trains between Euston and the Angel for three-quarters of an hour early on Monday.

United States.—Railway Strike.—The employés of the Brooklyn Rapid Transport Co. struck for higher wages on May 28th, causing the closing down of the Brooklyn elevated railroads to the great inconvenience of the travelling public.

Rothwell.—Opposition to Extension.—The Urban District Council has affirmed its opposition to any extension of time being granted to the local tramway company for completing its schemes, powers for which have been obtained.

Swansea. — Strike Ended. — After five weeks of inactivity, the tramway services were resumed on May 30th, the employés returning to work, and unconditionally accepting the Joint Industrial Council's recent award.

Tramway Workers' Wages.—The meeting of the Joint Industrial Council of the Tramway Industry, held on May 28th, was concluded without a settlement being arrived at. The employers wished to introduce a scale of increases varying from 1s. to 3s., according to the district, but the employés' representatives held out for a uniform increase of 9s. (on the old rates) for all districts. The employés in Scotland have refused to submit their claims to arbitration.

TELEGRAPH AND TELEPHONE NOTES.

Cable Delays.—Canada.—Representatives of newspapers from all the provinces attended the annual meeting of the Canadian Press Association held at Toronto last month. *The Times* understands that proposals for the improvement of the cable services, which are entirely within the control of the Canadian Press, were approved. While expressing gratitude to the British Government for its offer of financial aid, the Association decided not to burden the British tax-payers, but it is prepared, from its own resources, and with such aid as the Canadian Government may grant, to improve the Imperial news services.

West Indies.—Cabling facilities from Trinidad are, according to the *Financial Times*, worse than ever. The repair ship of the West India and Panama Telegraph Co. has been for a considerable time laid up at Port of Spain for repairs, which are not expected to be completed for some months yet. Meanwhile the old cable is said to be breaking down in all directions, and the company is unable to obtain the services of a repair ship. Wireless telegraphy does not afford much relief as far as the West Indies are concerned. Messages from London reach Canada, but from thence it is quite uncertain how they are forwarded.

Finland. — Wireless Telegraphy. — A system of wireless telegraphy for Press messages will shortly be established between Helsingfors and Copenhagen. The Danish arrangements are complete, but the Finnish Military Authorities have not yet given their consent to the use of the Finnish wireless stations.—*Economic Review.*

France. — Telephone Subscribers' League.—The outcry against the telephone service has become so insistent that subscribers with grievances have formed themselves into a league, the object of which is to guard the interests of telephone users generally. The council of the league, says the *Daily Telegraph*, includes several hundred subscribers, and its duty will be to receive and examine all complaints of its members, and to suggest to the authorities improvements that might be effected.

Imperial Wireless Communication. — Committee's Report.—The Cabinet is now in possession, says *The Times*, of the report of the Imperial Wireless Telegraphy Committee appointed last November. The report, which has not yet been published, is unanimous.

Liverpool.—Wireless Demonstration.—The Applied Electricity Department of the University recently held a three days' demonstration of Marconi apparatus marvels, including a portable wireless telegraph and telephone set. The demonstration was of considerable interest to shipowners and those engaged in the electrical business. University students attended in large numbers.

London.—Storm Damage.—As a result of last week's thunderstorm, over 1,000 telephone subscribers were cut off—about 500 at Chiswick, 600 at Waltham Cross, and 60 at Hammersmith. The defect, which was soon put right, is said to have been due to the sudden rise of water in manholes where work was in progress, the water reaching the cables before they could be sealed.

Wireless Telephony.—For the first time in the history of British journalism, spoken news messages for publication were received by wireless telephony from Chelmsford, Essex, direct by means of the receiving apparatus recently installed at the *Daily Mail* offices, London. The news was transmitted from the Marconi station, and related to local affairs and to the demonstration before members of the London Chamber of Commerce and the Chartered Institute of Secretaries, which took place on May 26th, and listeners-in at different parts of the country, at distances varying from 100 to 450 miles, reported that the messages were heard distinctly.

Pacific Cable.—Proposed Duplication.—Mr. Milward, manager of the Pacific Cable Co, announces that a project is under consideration to duplicate the Vancouver to Norfolk Island cable. The cable cannot be completed until 1921. It will cost nearly £4,000,000. The Pacific "All-Red" cable, which was completed in October, 1902, was the outcome of the desire for an all-British telegraphic route between Great Britain and the Dominions. The distance from Vancouver to Norfolk Island, whence the cable proceeds to New Zealand and Australia, is 6,000 miles. There are two intermediate stations between Vancouver and Norfolk—namely, Fanning Island and Fiji. The cable between Vancouver and Fanning is the longest hitherto laid in one piece.—*The Times.*

Private Wireless Installations.—Fire Risk.—The range and capacity of many privately owned and operated wireless stations have been greatly increased, and many of these stations are located in private dwellings which are equipped with combination gas and electric lighting fixtures, the electric lighting equipment being connected to a 110-volt A.C. system which is grounded. Details are given in the *Electrical Review*, of Chicago, of a case in which trouble was experienced owing to fuses blowing and static discharges and even arcing in the fixtures, &c., when the wireless equipment was in use. Investigation showed that with the sending set in operation, the wiring of the house was subjected to an induced pressure of about 5,000 volts in addition to the line voltage. Further tests must be made before definite conclusions can be drawn, but it is suggested that :—(1) Insulating joints be not permitted on electric lighting fixtures in building containing wireless stations ; (2) the wiring of such fixtures should be with conductors having a rubber insulation at least $\frac{3}{64}$ in. in thickness ; (3) some provision be made for the draining of induced current from the ungrounded wire of the lighting system before the induced pressure reaches dangerous values ; (4) it may be necessary to insist upon wireless stations which take energy from a public service being connected to an independent transformer. It has still to be investigated to what extent parallelism between the antenna and the wiring affects the results.

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the* Electrical Review *in which the "Official Notice" appeared.)

OPEN.

Australia.—Sydney.—August 4th. N.S.W. Government Railways and Tramways. Two 1,000-kw. sub-station units. Chief Electrical Engineer, 61, Hunter Street, Sydney.

August 3rd. Department of Public Works. Turbines and generators for the Barren Jack hydro-electric development scheme. Department of Public Works, Sydney.

July 18th. City Council. Maximum demand indicators. Electric Lighting Department, Town Hall, Sydney.

Perth. — July 14th. P.M.G.'s Department. Telegraph and telephone instruments (various parts). Schedule 674.

June 16th. P.M.G.'s Department. Telegraph and telephone instruments (various parts). Schedule 680. (May 14th.)

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ADELAIDE.—June 23rd. P.M.G.'s Department. Telephone parts (schedule 541). (May 21st.)

Barnes.—June 7th. Urban District Council Electricity Department. Coal-handling plant and overhead steel or ferro-concrete bunkers. (May 14th.)

Bedford. — June 21st. Electricity Department. One 2-ton locomotive jib crane, with grab and track rails, steam and other pipework. (See this issue.)

Belgium.—June 8th. Tenders are being invited by the municipal authorities of Horlon-Hozemont (Province of Liége) for the concession for the supply of electricity for lighting and power purposes.

The Belgian State Railway authorities at La Salle Madeleine, Brussels, are shortly inviting tenders for the supply of a quantity of material, in connection with the Stone train electric lighting system, including 636 dynamo suspensions, 1,075 battery cases and 636 driving pulleys, with safety guards.

June 19th. The Belgian Post and Telegraph authorities at La Salle Madeleine, Brussels, are inviting tenders for the supply of 1,710 kilometres of covered copper wire, comprising several varieties.

Carlisle.—June 25th. Electricity Department. One 3,000-KW. turbo-alternator and condensing plant. (May 28th.)

Crewe.—June 5th. Electricity Department. 12 months' supply of slack (about 4,000 tons). Borough Electrical Engineer.

Dublin. — June 7th. Electricity Supply Committee. 12 months' supply of single-phase and three-phase meters. (May 21st.)

June 10th. Electricity Supply Committee. Feed pump, tanks, pipework, &c., for Pigeon House generating station. (May 28th.)

Dundalk.—June 15th. Urban District Council. Electricity Department. 750 yd., L.T., 3-core, paper-insulated, lead-covered and armoured cable; disconnecting boxes (pavement type) and joint boxes. (May 28th.)

Edinburgh.—June 19th. Electricity Supply Department. E.H.T. and L.T. switchgear, &c., for Portobello station. (May 21st.)

France.—The French Post & Telegraph authorities in Paris have just invited tenders for the supply of 170 tons of bronze and copper wire, to be made from old wire supplied by the department.

Grimsby.—June 7th. Electricity Department. E.H.T. cables and pilot cables (specification No. 146). (May 28th.)

Ince-in-Makerfield.—June 15th. Urban District Council. Waterworks Department. Motor-driven pumping sets; cables; alterations to winding engine from steam to electric drive; switchgear. (May 28th.)

Leeds.—June 14th. Electricity Department. 12,000-KW. steam turbine, alternator and condensing plant. (May 14th.)

London.—HACKNEY.—June 9th. Electricity Department. Four water-tube boilers, each 33,000 lb. per hour capacity, with superheaters, mechanical stokers, &c.; four induced-draught plants; four fuel economisers; one 10,000-KW. turbo-alternator and exciter, with ventilating fan and air filter or cooler; one surface condensing plant; two circulating water motor-driven pumps; E.H.T. switchgear; two 20,000-KW. coupler panels; one 10,000-KW. generator panel; six 2,000-KW. and one 4,000-KW. feeder panels. (May 7th.)

BETHNAL GREEN.—June 7th. Electricity Supply Department. Two 500-K.V.A. transformers; one E.H.T. and one L.T. panel; L.T. feeder cables; section pillars and road work. (May 21st.)

WIMBLEDON.—June 12th. Electric Lighting Committee. Two boilers, with mechanical stokers, induced-draught fan and motor, pipework, steel chimney, &c. (May 28th.)

Manchester.—June 7th. Electricity Department. Main and auxiliary switchgear; Section A, 33,000-volt and 6,000-volt main switchgear; Section B, pressure-testing switchgear; Section C, 420-volt A.C. auxiliary switchgear; Section D, 240-volt D.C. auxiliary switchgear. (April 30th.)

New Zealand.—AUCKLAND.—September 1st. Harbour Board. For the supply of electric capstans and spares. Messrs. W. & A. McArthur, Ltd., 18-19, Silk Street, Cripplegate, London, E.C. 2.

Newport.—June 26th. Electricity Department. Turbo-alternating plant, surface-condensing plant, boilers, economisers, draught plant, steel flue and stack, &c. (See this issue.)

Nuneaton. — June 30th. Electricity Department. 1,000-KW., D.C., geared turbo alternator, surface-condensing plant and pipework. (See this issue.)

Rochdale.—June 5th. Corporation. Electric lighting installation in 52 houses on Spotland site. Particulars from Architects' Office, Town Hall.

Salford.—June 5th. Electricity Department. 12 months' supply of D.C. and A.C. meters. (May 21st.)

Seychelles Islands.—An electric light system is being introduced in the Seychelles, and tenders for the lighting-up of Port Victoria, in Mahé, are invited in the latest issue of the *Government Gazette* to reach this country.—*Times Trade Supplement.*

Southampton. — July 3rd. Electricity Department. E.H.T. and H.T. switchgear and D.C. control panel. (See this issue.)

Spain.—The Spanish Government has just invited tenders for the supply of the material necessary for the equipment of 12 wireless telegraph and telephone stations in the Madrid military area.

Warrington.—June 15th. Electricity and Tramways Committee. Motors and transformers. (May 28th.)

CLOSED.

Belgium. — Four Belgian and one British concern (B.I. & Helsby Cables, Ltd.) submitted tenders recently to the municipal authorities of Antwerp, for the supply of the 10,690 metres of armoured electric mains required for the electrical equipment of the Nos. 2 and 3 docks at the port. The result of the tendering has not yet been made known.

Chesterfield.—Electricity Committee. Accepted:—
Feeder cables and the extension of cables, £8,775.—B. I. & Helsby Cables, Ltd.

Glasgow.—Town Council. Accepted:—
Gear wheels.—A. Wiseman, Ltd.
V.I.R. cable.—Liverpool Electric Cable Co., Ltd.; Western Electric Co., Ltd.
Car wheels.—J. Baker & Co.
Rotary converter and switchgear.—Met.-Vickers Electrical Co., Ltd.

The Health Committee has accepted the offer of Messrs. W. C. Martin & Co., for the installation of electric lighting, &c., at the Knightswood Hospital, the tender being £7,579.

Town Council. Accepted. Supplies for 12 months:—
Copper bonds.—B. I. & Helsby Cables, Ltd.
Armature coils.—Manchester Armature Repair Co., Ltd.
7/20 V.I.R. cable.—Liverpool Electric Cable Co., Ltd.
Trolley wire.—F. Smith & Co., Ltd.

Halifax—Tramways and Electricity Committee. Accepted:
Babcock & Wilcox, Ltd.—One patent cross-type marine boiler for the electricity works, £10,710.
E. Green & Son, Ltd.—One economiser of 240 tubes, £2,063.
Crompton & Co.—Three new motors, £777; starting gear for same, £170.

Manchester.—Tramways Committee. Accepted:—
Trolley wire.—F. Smith & Co. (incorporated in the London Electric Wire Co. & Smiths, Ltd.)
Fishplates for tramway rails.—United States Steel Products Co.

Electricity Committee. Accepted:—
Laying cable.—Callender's Cable & Construction Co., Ltd.
Knife switches.—Ferguson, Pailin & Co., Ltd.; Park Royal Engineering Works, Ltd.; Whipp & Bourne, Ltd.
Extension to balancer board, Dickinson Street Station.—Whipp and Bourne, Ltd.
One 8,000/10,000-KW. turbo-alternator and condensing plant for Stuart Street Station.—Richardsons, Westgarth & Co., Ltd. Contract and licence to sublet the alternator to C. A. Parsons & Co., Ltd., to be prepared and sealed.
Steel work on workshop, Barton Station.—F. Morton & Co., Ltd.

Salford.—Tramways Committee. Accepted:—
Metal-filament lamps during the year, 1s. 8d. each (approx. £750).—British Union Lamp Works, Ltd.

Electricity Committee. Accepted:—
Additions to buildings and construction of foundations for the 5,000-KW. turbo-alternator set, £3,220.—Smith & Briggs, Ltd.
Switchgear for the sub-station of the C.W.S. at Weastle, £1,234. Switchgear for controlling the supply to second feeder cable to Eccles, £264; one E.H.T. switch-cubicle, £874; two 600-K.V.A. transformers, in connection with the supply of electricity to the sewage works, £2,048.—Met.-Vickers Electrical Co., Ltd.

FORTHCOMING EVENTS.

Royal Institution of Great Britain.—Saturday, June 5th. At Albemarle Street, W. At 3 p.m. Tyndall lecture on "The Theory of Quanta," by Dr. J. H. Jeans, F.R.S.

North of England Institute of Mining and Mechanical Engineers.—Saturday, June 5th. At the Wood Memorial Hall, Newcastle-on-Tyne. At 2.15 p.m. General meeting.

Royal Society.—Monday, June 7th. At John Street, Adelphi. At 7 p.m. Cantor lecture (postponed from April 26th) on "Aluminium and its Alloys," by Dr. W. Rosenhain.

Electrical Trades Benevolent Institution.—Monday, June 7th. At 36/38, Kingsway, W.C. At 2.30 p.m. General meeting.

British Science Guild.—Tuesday, June 8th. At Goldsmiths' Hall, Foster Lane, E.C. At 3 p.m. Annual meeting.

Institution of Electrical Engineers (Scottish Centre).—June 9th to 12th. Summer outing. June 11th. Visit to Kinlochleven.

(Wireless Sectional Meeting). — Wednesday, June 9th. At the Institution of Mechanical Engineers, Storey's Gate, S.W. At 6 p.m. Paper on "High-frequency Machines," by Mr. M. Latour.

Institution of Mining Engineers.—Thursday, June 10th. At 11 a.m. At Burlington House, Piccadilly. Annual meeting. At 7 p.m. At the Connaught Rooms, Gt. Queen Street, W.C. Annual dinner.

Friday, June 11th. At 10 a.m. Visit to the Royal School of Mines and the Science Museum, South Kensington, S.W.

Institute of Metals.—Thursday, June 10th. At the Institution of Mechanical Engineers, Storey's Gate, S.W. 1. At 8 p.m. Annual May lecture on "The Recent Progress in Thermo-Electricity," by Prof. C. A. F. Benedicks.

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NOTES.

National Joint Board of Employers and Staff Members for the Electricity Supply Industry.—Following on the announcement regarding power-station engineers in our last issue, we are now able to give the recommendations as to commercial and clerical staffs, which have been settled by the National Joint Board. The following schedule of salaries is applicable to all electricity supply undertakings, statutory or non-statutory, for public or private supply in Great Britain and Ireland :—

Basic rates of wages or Salary per annum.	Amount to be paid as from April 1st, 1920.
£75 and under.	An additional £135 per annum to the basic rates.
100	£240 per annum.
150	300
200	360
250	420
300	480
350	540
400	600
450	660
500	720
550	780
600	840
650	900
700	960
750	1,020

The basic rates are based upon the net amounts paid on April 1st, 1919, after deduction of all awards, grants, and bonuses paid in respect of increased cost of living, and include all merit, scale, or grade increases granted up to that date. Any increases granted since that date are to be deemed to be increases in the basic rates as from the same dates that such increases were paid.

Where total salaries and bonus paid since April 1st, 1919, amount to more than the amounts shown in the table, no reduction is to be made. The increases shown are to apply to all male employés over 21 years of age only, except temporary ones. The rates to the extent of 75 per cent. are to apply generally to women employés over the age of 21 years who were in receipt of the basic rates set out in the table, but exceptional cases may be considered on their merits. The remuneration of juniors is not fixed.

The increases are to apply until January 1st, 1901, by which date it is anticipated a graded schedule will be agreed, or until a revised scale is adopted on account of a material variation in the cost of living.

British Oil.—It was officially stated on May 27th that so far as the research work in Derbyshire is concerned, which has received Government support, it will take another six months to establish whether oil can be obtained in sufficient quantities to make oilfields in Britain a commercial possibility.

Fatalities.—The *Daily Telegraph* reports that on Sunday night, while, at the entrance to the Forth Goods Station, Newcastle-on-Tyne, a gang of a dozen linesmen employed by the Newcastle and District Electric Lighting Co. was repairing a faulty main in Neville Street, the current was switched on unexpectedly. Two of the men, Thomas Farrar and Murray Kennedy, were immediately killed, while another, Thomas Lawrence, was injured.

At an inquiry held into the death of a foreman electrician named Henry Spurr, aged 37, who was killed while making alterations to the electrical installation at the Cerebos Salt Works, Greatham, near West Hartlepool, Mr. S. R. Bennett, H.M. Factory Inspector, mentioned that this case was the third in a fortnight in which death had been caused by the 220-volt current in the Tees-side district. The evidence showed that while Spurr was behind the switchboard at the works on Saturday, May 22nd, there was a flash, and he was found unconscious. Artificial respiration was used for 40 minutes without effect. Mr. Neve, works manager, said that immediately after an accident a year ago, when a boy touched a live wire and was killed, they had instructions to do certain work to bring the installation up to Home Office standard, and Spurr and others had been engaged on the work pretty continuously for six months. Mr. Edgar Phillips, the contractor, thought that Spurr had been using a screwdriver, and that his hand had slipped and caught a bare conductor. The jury returned a verdict of "Accidental death," no blame being attached to anyone. Mr. Bennett mentioned that in the view of the Home Office, artificial respiration in those cases should be kept up for two hours, and a notice to this effect was being issued.

Inquiries.—A correspondent desires information regarding the details of the treatment of wood separators with soda ash, for accumulators. Makers of small insulators, known as "fish-backbone" insulators, and French makers of Steatite for insulation, are asked for. Suppliers of "Micarta," "Bakelite," or substitutes, and Swedish iron rod and sheet are wanted.

The Association of Consulting Engineers (Inc.).—The annual dinner of the Association was held at the Connaught Rooms, London, on May 28th. Mr. H. J. Rofe, chairman of the committee of the Association, presided, and a thoroughly enjoyable evening was spent; some 70 members and guests were present and partook of an excellent menu, after which the usual toasts were honoured.

Following the toast of "The King," Mr. W. B. CLODE, K.C., proposed the "Association of Consulting Engineers," and referred to the engineer as a romantic person who harnessed the powers of nature in the service of mankind. The CHAIRMAN, who responded, also proposed "Engineering Institutions," mentioning the good work done by the Institutions of Civil, Electrical, and Mechanical Engineers. He then outlined some of the aims and objects of their own Association. Capt. H. RIALL SANKEY, C.B., C.B.E., president I.Mech.E., and member of Council, Inst.C.E., replied, and pointed out that besides the Institutions mentioned by the chairman there were a number of others which fulfilled important functions in their respective spheres. He also referred to the desirability from all points of view of the registration of qualified engineers.

Mr. ROGER T. SMITH, President I.E.E., who also replied, said that the Institution of Electrical Engineers had long ago ceased to represent solely the professional section of the industry; its aim now was to represent the electrical industry as a whole, which accounted for its policy of decentralisation. The various territorial centres scattered over the country were doing very valuable work. The desirability of registering all qualified engineers was admitted, but he was told that it took the medical profession 20 years to carry its registration through. The present difficulty was to settle upon an adequate definition of a civil or any other engineer.

The "Future of British Industries" was proposed by Mr. G. MIDGLEY TAYLOR, who gave it as his opinion that the future prosperity of industries in this country depended on cheap power, and in this connection he hoped that the schemes proposed by Sir John Snell, who was present, and his Commission would be brought to early fruition. Further, the water powers of this country should not be neglected; although they were not so abundant as those to be found in other countries, still they were of sufficient importance to render useful aid. He had no fear for the future of British industries. One thing did trouble him, however, and that was labour. He did wish that they could by some means or other rouse the working man's sense of responsibility, to make him endeavour to do an honest day's work.

The toast was responded to by Viscount COWDRAY, P.C., President of the Federation of Civil Engineering Contractors, who dealt with the financial side of the matter, and said in part that the present state of affairs with regard to labour was due to the lack of decisive action on the part of the Government in dealing with wages and claims put forward. Labour could not be dealt with in sections, it could only be considered as a whole. When they sought information or advice on technical engineering questions they need go no further than this country, but when it came to business matters they had to go, he was sorry to say, to the U.S.A. It was very wasteful to burn oil under boilers; it should be reserved for internal-combustion engines. The oil existing within the British Empire, in his opinion, should be kept for use within the Empire.

Mr. LL. B. ATKINSON, secretary of the Cable Makers' Association, and president-elect I.E.E., did not think the prospect before them was so rosy as was thought by some; it was time they paused to consider to what they were heading. He need not emphasise the dangers that attended constantly increasing wages and their attendant evils. They were suffering from lack of production, the reason for which was the fear of unemployment on the part of the workers. That was the first problem they must solve, and in his opinion the only way of doing so was by each particular industry guaranteeing the employment of a full complement of operatives in lean as well as in prosperous times. To do that co-operation was essential between factories so that work could be distributed evenly over the whole, and also co-operation in selling the finished products abroad. The next problem they had to solve was that of standardisation, and what they were in need of was co-operative effort. He asked consulting engineers to give their assistance in solving those problems; there was just as much skill required to select the necessary plant for a particular job from standardised as from unstandardised material, and they would need their help to break the economic front, which must be broken if the future of British industries was to be assured.

Mr. SIDNEY R. LOWCOCK proposed "Our Guests." Sir F. J. WILLIS, assistant secretary, Ministry of Health, and Mr. ARTHUR J. LEES, secretary, Urban District Councils' Association, responded, and the final toast of the evening, that of "Our Hon. Officers," was proposed by Mr. H. W. COUZENS, and responded to by Messrs. A. H. DYKES, hon. secretary, and F. E. WRIGHT, hon. solicitor to the Association.

Service Notes.—On return from Constantinople, Mr. T. S. Harvey, acting assistant electrical engineer, has been posted to Devonport Dockyard. Lieut. H. C. Crossley, Cinque Ports Fortress Engineers (Electric Lights Company), has resigned his commission after four years' service, and has been granted the rank of captain. Lieut. H. F. Hecking, Lancashire Fortress Engineers (Electric Lights Company), has resigned his commission. He served in the corps from 1916. Lieut. G. V. Waterhouse has resigned his commission in the Electric Lights Company of the Fortress Engineers (Territorial Force). A large number of wireless operators, some 150, are wanted for the army, as well as a lot of electricians (wireless) fitters, and instrument makers for the Army Signal Service. The service is competing against private firms by offering a bounty of £100 to wireless operators and £50 to the others.

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Kinema Operators' Strike.—A number of kinema operators are on strike in Manchester and Salford for a wage of from £3 10s. to £4 10s. a week according to the size of the hall, locality, and charge for admission. The Electrical Trades Union has declared the strike, and the men's officials state that over 80 per cent. of the proprietors have met the demands in full. To these permits to perform have been granted. The remaining kinemas are being picketed.

The Women's Engineering Society.—At the first annual general meeting of the Society, which was incorporated this year, the Hon. Lady Parsons presided, and said, in the course of an address, that in order to gain their objects they must exercise patience and continue their struggle. Miss Rachel M. Parsons was elected president, Miss Selby hon. secretary, and Lady Parsons treasurer, with a strong Council. The annual report stated that the work of the Society was meeting with success. A small quarterly, entitled "The Woman Engineer," had been established, and a club-room opened at 46, Dover Street, W. A resolution deprecating the continued exclusion of women from training and employment in many industries, and calling upon all leaders of industry and Trade Unions to unite with them in overcoming all artificial barriers to progress, was carried, and a discussion took place on "The Present Position of Women in the Various Branches of Engineering."

Appointments Vacant.—Mains engineer (£6), for the Greenock Corporation Electricity Department; switchboard attendant (92s. 3d.), for Rawtenstall Corporation Electricity Works; lecturer in mathematics (£315), assistant lecturers in mechanical or electrical engineering (£275 or £315), for the Woolwich Polytechnic; mains assistant, for the Colombo Electric Tramways and Lighting Co., Ltd.; second assistant superintendent, for Central Canal Works, Amritsar, Punjab (Rs. 725 to 1,025 per month); charge engineer (£270), for the Bootle Corporation Electricity Works; meter superintendent (£5 5s.), for the Paisley Corporation Electricity Department; E.H.T. plumber-jointer (£5), for the Swansea B.C. Electricity Department; junior for the mains department (84s.), for the Bradford Corporation Electricity and Tramways Department; engineering draughtsman (£200 + 20% + £120), for the Hammersmith B.C. Electricity Department. See our advertisement pages to-day.

INSTITUTION NOTES.

Institution of Electrical Engineers.—The Secretary of the Institution announces that applications for the following scholarships may be sent to the Secretary, R.E. War Benefits Committee, R.E. Institute, Chatham:—"A" Scholarships of £40 per annum for children of officers and other ranks of the Royal Engineers of all branches who, prior to the war, were in a position to give their children a public school education. Ten of these scholarships, tenable between the ages of 10 and 18, are available. "B" Scholarships of £15 per annum for children of warrant officers, N.C.O.'s and men, to assist in educating them at a technical or secondary school. Tenable between the ages of 13 and 16 years—40 available. "C" Kitchener Scholarships, at present limited to one of £40 and two of £15, under the same conditions as "A" and "B" respectively. Owing to the large number of casualties, these scholarships will be confined, for the present, to children or dependents of members of the Corps killed in action, &c., or permanently disabled, and in all cases primary consideration will be given to cases of necessity. The applications to be considered in the first adjudication were to be sent in by June 1st, and the necessary forms are obtainable from the Secretary of the R.E. War Benefits Committee.

WIRELESS SECTIONAL MEETING.—On Wednesday, June 23rd, at 6 p.m., at the Institution of Mechanical Engineers, Storey's Gate, Westminster, S.W., a paper will be read by Mr. B. S. Gossling on "The Development of Thermionic Valves for Naval Uses."

Liverpool Wireless Association.—The usual semi-monthly meeting was held at 56, Whitechapel, Liverpool, on May 26th, when the subject under review was the "Winding of Inductances" and 'Loose Couplers." Numerous methods of construction were discussed, and varying experiences under numerous conditions related. A member also exhibited a piece of apparatus for winding honeycomb coils.

Incorporated Municipal Electrical Association.—Engineers or others who are specially interested in the subjects of papers to be read at the forthcoming I.M.E.A. Bradford Convention, and who wish to be present to speak thereon, should communicate with the Secretary, I.M.E.A., Electricity Works, Factory Lane, Croydon.

Association of Consulting Engineers.—The annual general meeting was held on May 28th, Mr. H. J. Rofe presiding. Moving the adoption of the report of the committee for the past year, the chairman said a sub-committee had been engaged in drawing up a model general set of conditions for use in work carried out on a prime cost and profit basis, a method of carrying out work which had become more and more general. Another matter that had called for attention was the formation of the Federation of Civil Engineering Contractors by the leading firms in the country; they were asking for an over-riding clause to be inserted in all engineering contracts, which in its present form the Association could not accept. As far back as 1914, the Committee had had under consideration a model set of general conditions of contract for electrical work, drawn up by the Institution of Electrical Engineers, to several clauses of which the Committee took exception. The matter had been in abeyance since the beginning of 1915, but the whole question had now been re-opened. The Institution was revising the model general conditions, and had invited the Association to send a representative to sit on a committee formed of all the various interests connected with electrical work. The manufacturers had agreed to modify practically every clause to which the Association raised objections, and he thought that eventually the Electrical Conditions of Contract would come into line with the general conditions that were inserted in their civil engineering contracts. The Council of the Institution of Civil Engineers suggested that the rise in the cost of work automatically increased the engineer's remuneration to the extent necessary to meet his increased expenses, but that in certain cases he was justified in charging an extra fee; in respect of reports, inquiries, Parliamentary work, and general advice on engineering matters, the Council was of opinion that civil engineers were justified in making an advance of 50 per cent. on pre-war rates. These views supported the action recently taken by the Committee of the Association.

During the year the British Engineering Standards Association had asked the Association to appoint representatives on various Sub-Committees.

The Foreign Office and the Board of Trade had recently written to the Association suggesting that members who were going abroad should give notice to the Department of Overseas Trade of their intention, so that the Department could notify H.M. Diplomatic Consular and other officers concerned, and give them the opportunity of rendering assistance and of discussing matters connected with British trade of very great interest to them. This, he thought, was a very valuable suggestion. The report was carried unanimously.

The accounts for the year showed a balance of income over expenditure of £24.

The ballot for new members of the Committee resulted as follows:—

London Members.—Messrs. Kenneth P. Hawkaley, W. Vaux Graham, A. M. Sillar, H. R. J. Burstall, and John H. Rider.

Country Members.—Messrs. James Caldwell and F. W. Hodson.

Votes of thanks were accorded to the honorary solicitor, Mr. F. E. Wright; to Messrs. Cash, Stone & Co., the honorary auditors; to Mr. H. J. Rofe for acting as chairman; and to the honorary secretary (Mr. A. H. Dykes) and the honorary treasurer (Mr. S. R. Lowcock) for their valuable services during the past year.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

MR. STEVENSON, telegraph and electrical engineer to the Caledonian Railway Co., Glasgow, on the occasion of his retirement on reaching the age limit, was waited upon on Friday by his office staff and a few friends and presented with a gold watch for himself, and a diamond ring for Mrs. Stevenson. The presentation was made by Mr. A. S. Humpton, his successor in office.

The King has granted permission for MR. C. D. LEYS, electrical engineer, Malta Dockyard, to wear the Japanese Order of the Rising Sun (Fourth Class), conferred upon him in recognition of valuable services.

MR. E. H. W. COOKE, who was chief accountant with the Birmingham Corporation Gas Department for many years, and has been appointed chief accountant with the Metropolitan-Vickers Electrical Co., Manchester, bade farewell to the Gas Committee on Monday.

Leek (Staffordshire) Urban District Council has decided to increase the salary of the electrical engineer to £400 per annum.

Horsham Urban District Council has increased the salary of the assistant engineer at the electric lighting works from £220 to £250 a year.

MR. F. HARMAN LEWIS, chief electrical engineer to the Leyton Urban District Council, on completing 21 years' service, has been presented by the staff and employés with a clock with Westminster tubular chimes.

MR. A. W. J. BEDBROOK has resigned his position as managing director of the C.E.A., Ltd. His address is 140, Delaware Mansions, Maida Vale, W.

Messrs. Robinson & Hands Electrical Co., Ltd., of Birmingham, have just engaged MR. S. GRAY, late of Messrs. J. H. Tucker & Co., Ltd., to take complete charge of their case-making department for the manufacture of fuseboard cases and general electrical woodwork.

The honour of O.B.E. has been conferred upon CAPTAIN JOHN WILSON, chief electrical engineer, Buenos Aires Western Railway, superintending engineer of the Shandon Experimental Station. CAPTAIN THEODORE WILLIAM SMYTHE, Master of the Eastern Telegraph Co.'s cable ship *Electra*, has received a similar distinction. MR. P. F. JOHNSON, late Chief Officer of Messrs. Siemens's cable ship *Faraday*, is made M.B.E.

Obituary.—MR. J. FINDLAY.—The death is announced of Mr. James Findlay, for many years managing director of the Rugby Lamp Co., Ltd., whose premises were taken over by the B.T.H. Co., Ltd.

MAJOR S. C. A. WACE.—The death is announced to have taken place at Hampstead of Major S. C. A. Wace, C.B.E., Royal Marine Artillery, head of the Wireless Telegraphy Board. He was in charge of the wireless station at Malat during the war, and was the author of a hand-book on "Wireless Telegraphy."

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NEW COMPANIES REGISTERED.

Anglo-Russian Engineering Co. (Birmingham), Ltd. (167,458).—Private company. Registered May 14th. Capital, £1,000 in 5s. shares. To carry on the business of electricians, mechanical engineers, suppliers of electricity, manufacturers of and dealers in electrical apparatus, &c. The subscribers (each with one share) are: J. B. Webb, 1, Telford Avenue, Streatham, S.W. (managing director, Anglo-Russian Engineering Co., Ltd.); J. Hastings, Lee Mount, Yardley Wood Road, Moseley, Birmingham, accountant; V. E. Whalley, Alyon, Dora Road, Small Heath, Birmingham, engineer. The subscribers are to appoint the first directors. Secretary: J. Hastings. Registered office: 26, Guildhall Buildings, Stephenson Street, Birmingham.

Wilkins Wire and Wire Ropes, Ltd. (167,584).—Private company. Registered May 18th. Capital, £125,000 in £1 shares. To take over the undertaking, assets and liabilities of the Wilkins Wire Rope Co., Ltd. (incorporated in 1904), and to carry on the business of wire and wire rope manufacturers, manufacturers of and dealers in mining, colliery and electrical machinery, electrical, mechanical, hydraulic, heating and ventilating engineers, &c. The subscribers (each with one share) are: Elsie L. Trollope, 28, Crossways, Stoke Newington, N.16; A. J. Taylor, 28, Duncombe Road, Hornsey Rise, N.19, clerk. The first directors are: S. H. Hudson (chairman and permanent director), T. H. Hudson, General W. Wright Bemrose and A. S. Watson. Secretary: W. E. Bowley. Solicitor: H. Clifton, 4, New Court, Lincoln's Inn, W.C.

Catchpole & Maurice, Ltd. (167,513).—Private company. Registered May 17th. Capital, £5,000 in £1 shares. To take over the business of wholesale and export electrical and mechanical engineers and merchants formerly carried on by A. E. Catchpole and E. Maurice at Albion House, New Oxford Street, W.C. The first directors are: A. E. Catchpole, 17, Broxholm Road, S.E.27; C. B. Maurice, Russell Square Mansions, W.C.; F. W. Dennis, 15, Ventnor Villas, Hove; W. N. Scovell, 41, Lee Park, Blackheath. Solicitor: A. G. Hardy, 27, Chancery Lane, W.C. Registered office: Albion House, 59-61, New Oxford Street, W.

McReynolds Trolley Wheel Co., Ltd. (167,495).—Private company. Registered May 15th. Capital, £5,000 in 5s. shares. To carry on the business indicated by the title, and that of electric, railway, tramway, naval, marine and general engineers, &c. The subscribers (each with one share) are: E. M. Lloyd, 143, Mount View Road, Stroud Green, N.4, secretary; A. E. Hutton, 55, Kimberley Road, Stockwell, S.W.9, secretary. The subscribers are to appoint the first directors. Solicitors: Roney & Co., 42, New Broad Street, E.C. Registered office: 11, Angel Court, E.C.

Dux Electric Quilt & Fibril, Ltd. (167,727).—Private company. Registered May 28th. Capital, £10,000 in £1 shares. To take over the business of mattress manufacturers, engineers and agents carried on by W. Fairclough, H. Speakman, T. R. Greenough and R. E. Beddoe as "Hall and Co." and "Fibril and Co.," together with certain British and Colonial patents for improvements in the manufacture of horsehair, devices for fastening or securing ropes, rope handles, cords and the like, and improvements in electric heating quilts, blankets and the like. The first directors are: H. Speakman, The Walmsleys, Leigh Road, Leigh, Lancs.; T. R. Greenough, Beachwood, Leigh Road, Leigh, Lancs.; E. C. Beddoe, Tower Buildings, Wallgate, Wigan; E. R. Davies, 3, King Street, Wigan; G. A. Kirk, Electrical Works, Wilcock Street, Wigan; P. Gaskell, jun., 112, Park Road, Hindley. Registered office: Dobb's Fold, Wallgate, Wigan.

Telephone Manufacturing Co. (1920), Ltd. (167,634).—Registered May 20th. Capital, £600,000 in £1 shares. To take over the business of the Telephone Manufacturing Co., Ltd., and to carry on so far as is lawful the business of makers, sellers, hirers out, maintainers and workers of and dealers in telephones and telegraphs, &c. The first directors are: F. T. Jackson, 20, Herne Hill, S.E.; C. Cochran, 58, Newark Drive, Pollokshields, Glasgow; J. MacMahon, Sheriff Park House, Rutherglen, N.B. (all directors of London Telephone (N.S.) Co., Ltd., and other companies); T. H. Walker, 7, Linden Gardens, W.; C. E. Walker, 43, Clifton Hill, Maida Vale, W.; C. Clare, 32, Eaton Terrace, S.W. (managing director, George Clare & Co., Ltd., &c.). Minimum cash subscription, 7 shares. Solicitors: Durrant, Cooper and Hambling, 70-71, Gracechurch Street, E.C. Registered office: Hollingsworth Works, Martell Road, West Dulwich, S.E.

H. & F. Moore, Ltd. (167,649).—Private company. Registered May 21st. Capital, £2,000 in £1 shares. To carry on the business of machine builders, electricians, electrical, mechanical, motor, telephone and general engineers, &c., and to adopt an agreement with H. Moore. The subscribers (each with one share) are: Mrs. C. Stanton, Albert Road, Hinckley; B. Gill, 49, Winchester Avenue, Leicester. Mrs. C. Stanton is first director. Secretary: F. E. Fordham, 19, Cank Street, Leicester. Registered office: Albert Mill, Hinckley, Leicestershire.

National Electric Welding Co., Ltd. (167,631).—Private company. Registered May 20th. Capital, £10,000 in £1 shares (4,000 preference). To carry on the business indicated by the title. The first directors are: F. E. Saunders, 63, Leigham Court Road, Streatham, S.W.; P. Buckley, New Oxford and Cambridge Club, 68, Pall Mall, S.W.; N. D. R. Bruce, Blythswood, 63, Leigham Court Road, Streatham, S.W.; H. C. Wright, Wychwood, Arlington Drive, Mapperley Park, Nottingham. Solicitor: W. H. Bellamy, Walter House, 418-422, Strand, W.C. Registered office: 6, Old Queen Street, Westminster.

Taggart & Wilson, Ltd. (11,252).—Private company. Registered in Edinburgh May 20th. Capital, £6,000 in £1 shares. To carry on the business of general merchants, electricians, mechanical, electrical, gas, structural, water and general engineers, ironmongers, builders, &c. The subscribers (each with one share) are: R. Taggart, Arcadia, Cathcart Street, Motherwell, builder; J. Wilson, Anwoth, Douglas Street, Motherwell, electrical engineer; J. Taggart, Coradinn, Catherine Street, Motherwell, motor engineer; T. Taggart, Kilnkoln, Catherine Street, Motherwell, motor engineer. The first directors are not named. Secretary: R. T. Ballantyne, 2, Windmillhill Street, Motherwell.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

International Electric Co., Ltd.—Mortgage debenture charged on freehold land, factory and premises at Tottenham and company's general assets, including uncalled capital, dated May 6th, 1920, to secure all moneys due or to become due from company to Williams Deacons Banks, Ltd. Also satisfaction in full on May 5th, 1920 (*a*) of charge dated January 21st, 1919, securing £25,500; (*b*) of mortgage dated February 8th, 1917, securing the sum then due or to become due.

Edmundson's Electricity Corporation, Ltd.—Particulars of £100,000 prior lien debenture stock authorised January 15th, and covered by trust deed of January 13th, 1920; whole amount issued, charged on mortgage debentures in various companies and company's general assets. Trustees: British Trust Association, Ltd.

Lamplough Radiator and Engineering Co., Ltd.—Satisfaction in full on April 30th, 1920 (*a*) of mortgage or charge as collateral security dated September 8th, 1916, securing £12,000, and (*b*) mortgage or charge, dated May 16th, 1917, securing overdraft and general indebtedness.

Siemens Brothers Dynamo Works, Ltd.—Satisfaction in full on May 6th, 1920, of trust deed dated June 10th, 1907, securing £200,000 debentures.

James Keith & Blackman Co., Ltd.—Satisfaction in full of debentures dated October 29th, 1901, July 21st, 1913, and May 11th, 1915, securing £1,300.

National Telewriter Co., Ltd.—Issue on May 12th, 1920, of £130 debentures, part of a series.

Smale & Collins, Ltd.—Particulars of £2,473 debentures authorised April 26th, 1920, whole amount issued; charged on the company's undertaking and property, present and future, including uncalled capital subject to prior charges. No trustees.

Edmundson's Electricity Corporation, Ltd.—Particulars of £75,000 three-year notes authorised January 15th, and covered by trust deed dated April 13th, 1920, whole amount issued; charged on £100,000 prior lien debenture stock. Trustees: British Trusts Association, Ltd.

Herne Bay Gas and Electricity Co., Ltd.—Issue on May 6th, 1920, of £2,600 debentures, part of a series.

Surrey Electrical Co., Ltd.—Satisfaction in full on May 7th, 1920, of debentures dated June 12th, 1919, securing £1,000.

CITY NOTES.

Richardsons, Westgarth and Co., Ltd.

In the course of his speech at the annual meeting, held at West Hartlepool, on Monday, Mr. D. B. Morison said that a dividend of 18 per cent. had already been paid, and a further dividend of 12 per cent. was now due for payment, making 30 per cent. for the year. During the whole of last year only three months were unaffected by labour troubles either in their own works or in the shipyards to which they supplied machinery. Referring to the heavy demands of the Inland Revenue, the speaker said that as provision for efficient production was imperative, there was good reason why sufficient money should be left to them by the Inland Revenue to make good the destructive effects on their plant due to the highly abnormal conditions of working which prevailed throughout the war period. It was not a question of the relative money values of this or that machine before and after the war. The present inflation was simply a passing phase; what they as manufacturers had a right to expect was that the productive efficiency of their plant should be adequately restored. Efficient production was vital to manufacturing success, and, if that efficiency had to remain seriously impaired because of the ravages of taxation, then their manufacturing position would be prejudiced to an extent that could only be revealed, all too late, when they were brought face to face with competition that they might be unable to withstand. With regard to the outlook, they had a very full order book, but, on the other hand, the rate of production was deplorably low. Before the war the standard week was 53 hours, and after making allowance for overtime on the one hand and sickness on the other, the average hours actually worked per man per week were approximately 53. Now, when the standard week was 47 hours, after making allowance for overtime and sickness, the average hours actually worked per man per week was 44. There was thus a net decrease in time worked of nine hours per week per man—or about 17 per cent. Furthermore, and what was worse, the actual time now taken to complete a given amount of work was, on an average, nearly half as long again as before the war. In a business in which a vast amount of highly expensive machinery was employed the effect of such a decrease in its productive capacity as these facts and figures indicated, combined with the corresponding increase in working expenses per unit of work, must obviously be serious. Fortunately there was indications of an appreciation of the undoubted fact that the costs of production were now so extravagantly high that, if the continuous demands for still higher wages were persisted in, commercial success would ultimately become impossible. Demand would then cease, and a slump—and unemployment—must inevitably follow. The desideratum at the moment was the restoration of at least the pre-war output per man per hour.

Calcutta Electric Supply Corporation, Ltd.

At the annual meeting, held on May 27th, the chairman said that the coal position in India was now easier, and they had been able to place new contracts, but the cost per ton had considerably increased. The increased cost of generation and distribution was referred to. Excess profits duty at £61,794 showed an increase of £29,794. The assessments for excess profits duty in respect of the years 1917 and 1918 which had now been received, showed £27,724 over and above the amount reserved for this purpose in the 1918 accounts, and this sum added to the £34,070 reserved in respect of 1919 made the total £61,794. He now placed before the meeting the scheme for a retiring gratuity fund for the staff, which was sanctioned in 1917. They had reverted to the pre-war system of a bonus to employés based on net profits. This bonus had been fixed at 2 per cent. on the 1919 net profits, and amounted to £4,834. The further reduction to a general 3 annas flat rate was put into force from March 1st, 1920. Considering that so many electric supply undertakings had raised their rates, their customers had every reason to be

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satisfied with the reduction as regards the cost of their lighting and fans. To the company it was a costly reduction, but they looked for increased demands for current at the very low rates now charged. After referring to the proposed bonus share distribution, for which they were capitalising £55,000 of the reserve fund, the speaker discussed the excess profits duty and the new corporation tax. He said it was to be hoped that before long some means would be found to obtain the necessary State revenue by a method which would bear less hardly on those companies whose datum level was a low one. In the case of this company, the increase of profits since 1914 had in no way been due to the war, but to the large increase in business due to capital expenditure shortly before 1914. Apart from the onus of taxation, the prospects were decidedly bright. After five years of stagnation during the war, there were signs of great activity in business in Calcutta, and a corresponding demand for electric power. Mr. Donkin, consulting engineer, visited Calcutta last winter, and he had reported as to the best way of arranging a programme to meet the situation. He recommended a very large and costly extension. Notwithstanding that electric plant now cost just about double what it did before the war, they had decided to order two 15,000-KW. turbo-alternator sets with all accessories, for delivery towards the end of next year. That order, large as it was, was justified, nay, necessitated, by the actual applications for current which had been so far received. In addition, very large extensions of the general system were in hand, including new sub-stations and new cables. The total cost incurred, or about to be incurred, was well over one million sterling. Application had been made for an extension of the already large area of the company's supply, and arrangements were being made for spanning the Hooghley at Cossipore, to enable the new demands of districts on the opposite side of the river to be met. The new expenditure would involve more capital, and they wanted to increase the capital from 1½ to 3 millions, part of which would be required at an early date. They expected to be able to arrange easy terms of payment. In the extensions alluded to no mention was made of such projects as the electrification of suburban railways, and the introduction of tube railways, because although the subject was under discussion, there was, so far, nothing definite to go upon. There were immense possibilities in Calcutta as regarded the demands for electric power, and at no very distant date they might have to come again for still further increase of capital. The chairman briefly referred to the Indian exchange, and spoke highly of the work of the staff in Calcutta contributing to a very successful year in 1919. Mr. Winkfield, the agent and engineer in Calcutta, had retired after 15 years' service, and Mr. J. T. Mertens, for many years deputy agent, had been appointed in his place.

An extraordinary general meeting followed, at which the resolution was passed altering the articles so as to raise the preference dividend rate on the old shares from 5 per cent. to 6½ per cent., raising new capital, &c.

Brisbane Electric Tramways Investment Co., Ltd.

Mr. H. R. Beeton, presiding at the annual meeting, on May 27th, said that the present position as compared with the previous year was that whilst the operating expenses in Brisbane had increased by £30,830, the receipts in Brisbane had increased by £34,220, but British and Colonial income tax had increased by £17,689, and in 1918 a refund was received of £11,414 on account of excess profits duty, whereas last year only £3,486 was received on the same account. There had been increases of wages since October, 1918, of between 12 and 16 per cent., and 10 and 16 per cent. of the total receipts in Brisbane of £468,892, the amount paid in wages on operation account was £209,000. The speaker gave figures showing the growth of the undertaking, and said he believed that they were the only company in the Commonwealth which had not raised its fares. Mr. Badger had felt it necessary, owing to failing health, to tender his resignation, and had left Brisbane. They were keeping his resignation in abeyance, and were constantly getting the benefit of his advice by correspondence. In the extraordinary circumstances prevailing they had appointed a local board. The speaker proceeded to outline the main features of the Purchase Act passed by the State of Queensland for the purchase of the company's undertaking. Most of the electric light business had already been sold. A special resolution was passed recording deep gratitude to Mr. Badger for his long and conspicuous services to the company, and expressing hope for his speedy recovery.

Madras Electric Supply Corporation, Ltd.

Mr. James Gray, presiding at the annual meeting, on May 28th, said that almost every branch of the business had developed during 1919. The chief trouble was to procure plant and materials to connect new consumers. Additional distributing plant was now necessary, and until this was obtainable early next year the engineering staff would be considerably taxed to meet demands. The revenue from lighting and fans increased by £11,262, due, principally, to the ordinary expansion of business, but to some extent also to an increase of An. 1 in the flat rate, which came into force on August 1st, and would operate for a period of three years. The revenue from power increased by the comparatively small sum of £542, but this was entirely accounted for by a reduction in demand for the tramways in consequence of a strike in the spring of last year, which lasted over three weeks. The total revenue showed an improvement of £22,452 on that of 1918. On the debit side of the revenue account there was an increase under every heading, in consequence of the larger volume of business and of the upward trend in wages and cost of materials. The aggregate was £4,469 more than last year. The net revenue account was enhanced by £4,581, the dividend from their holding in the tramway company. The provision for depreciation and renewals had been increased from £9,000 to £14,000, which some might consider excessive. Having regard however, to the greatly enhanced cost of renewals, which might continue for some years, and to the ordinary depreciation of electrical apparatus which prevailed in Madras in consequence of the atmospheric conditions, it was in the best interests of the company to make liberal contributions until a substantial fund had been built up. After referring to the exchange adjustment account, the chairman mentioned the proposed further extensions of mains. They had on order four 250-KW. rotary converters and one water-tube boiler of a similar capacity to those now installed, and it was hoped shipment would be made about the end of the year. Additional mains would be available about the same time. They also contemplated ordering one 3,000-KW. turbo alternator. In consequence of the steady growth of the demand, they had practically no spares when one unit of the plant was shut down for overhauling, and to remedy this and to provide for new business an additional turbo alternator was necessary, but shipment could not be expected in less than 12 months. The cost of carrying out this programme would be approximately £60,000 to £70,000. In view of the improved prospects the directors decided to postpone the issue of new shares until the results for 1919 had been ascertained. Advantage would be taken of a favourable opportunity of placing new capital, and, meantime, temporary arrangements had been made for their requirements. The tramways company again yielded a dividend of 8 per cent., free of income tax. The traffic receipts increased 9 per cent., but expenditure in Madras rose 19.6 per cent., due to higher wages and increased cost of materials. However, the net revenue was sufficient to pay the usual dividend, to make proper provision for depreciation and renewals, and to provide £1,000 for an employés' gratuity fund, also £3,000 for general reserve. Further labour troubles have been experienced in Madras from which the tramways had not been exempt, another strike having occurred on January 26th last, and continued until February 4th. It having been demonstrated that the cost of living had risen in greater ratio than wages, further increases and allowances were made in addition to the voluntary increases which had been granted by both of their companies. Application had been made to Government, however, for sanction to increase the statutory fares, which were framed 28 years ago, when the spending value of the rupee was much greater than at present.

Dutch Companies.

The N.V. Electrotechnische Artikelen (late John Wolff & Co.), of Gouda, has resolved to pay a dividend of 12 per cent. for 1919 out of net profits amounting to 60,000 florins.

The N.V. Nederlandsche Kabel Fabriek, of the Hague, has declared a dividend at the rate of 34 per cent. out of net profits of 707,000 florins in 1919, as compared with 28 per cent. and 582,000 florins respectively in the preceding year.

The N.V. Metaaldraad Lampenfabriek Volt, of Tilburg, has decided to pay a dividend at the rate of 6 per cent. on the cumulative preference shares for 1919. As the company is entering on a community of interests with another undertaking the balance of the net profits for last year, instead of being applied to the payment of a dividend on the ordinary shares, is being devoted to the redemption of the profit participating certificates.

The report for 1919 of *L. Zelander's Electrotechnische en Technische Handels Vennootschap, of Amsterdam*, states that the home demand for materials and motors was not so great as in the previous years, and prices declined, whilst falling exchange rendered it difficult to export at remunerative prices. The net profits permit of the payment of a dividend of 7 per cent. on the ordinary shares, this rate contrasting with 11 per cent. in 1918.

Italian Companies.

The report of the *Società Generale italiana di Elettricita Edison (of Milan)*—the largest Italian electrical company—with a capital of 96,000,000 lire, of which 74,400,000 lire are paid up, gives an exhaustive exposition of the difficulties with which the Italian industry has at present to contend. Reference is made to the scarcity and incredible dearness of materials, daily increasing delay in the execution of work by contractors, disorganisation of transport, continuous increase in the cost, and the demands of workmen. These causes, the report says, constitute a powerful brake on the construction of new plant, with, in consequence, grave shortage in the amount of electrical energy available, to the pitch of sapping the industrial energies of the country. Allusion is then made to the efforts put forth by the Government to help the electrical industry, and the 40 lire per H.P. subvention is characterised as absolutely laughable; with the present cost of materials, it amounts to no more than 5 per cent. of the prime cost. The tariff rises authorised are also regarded as absolutely inadequate in view of the greater cost of working. The report calls for a revision of all these decrees, which should

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be made more in harmony with existing economic conditions. An acute examination is also given of questions of capital and labour, the evils of workmen's organisations and their fallacious pretensions being thrown into relief. The balance sheet showed a net profit of 9,746,299 lire, allowing of dividends of 34 lire to the old shares to bearer, 34,568 lire among other shares, and 12,766 lire to shares issued during the present year, 107,345 lire being carried to the reserve.

Of similar gloomy tenor are the reports of other companies, and noteworthily those of the Società Industrie telefoniche italiane Diglio (Milan), which, on its 6,000,000 lire capital, was unable to declare a dividend, its net profits being only 80,447 lire. Workmen's agitations and the low output of the labourer are the reasons given. The Officine Elettroferroviarie (Milan), with 8,000,000 lire capital, was only able to distribute 9 lire on its 100 lire shares, the cause alleged being the plight in which the whole manufacturing industry lay, in consequence of reduced production and the agitations of workmen. The Società Anonima Ing. V. Tedeschi (Turin), while distributing 12 lire on its 100 lire shares, also lays strong emphasis on the difficulties of all kinds besetting the working, especially those of labour, which, it says, is becoming daily dearer, and more undisciplined, new taxes, rising exchange, &c.

Electric Construction Co., Ltd.—The net profit for the year ended March 31st, 1920, after providing £6,304 for debenture interest and £10,000 for depreciation is £66,169, plus £38,669 brought forward, less £20,000 paid on account of excess profits duty for the year ended March, 1919, making £84,839. After paying 7 per cent. on the preference shares and 7½ per cent. for the year on the ordinary, both less tax, a bonus of 2½ per cent. is to be paid on the ordinary, leaving £10,663 carried to general reserve (making it £100,000), and £39,781 to be carried forward, subject to liability for excess profits duty. The extensions of the works were only completed in time to permit of their contributing in a small degree to the profits of the past year. The moulders' strike, which lasted for 18 weeks, caused great disorganisation, which will continue to be felt during the new financial year. The enlarged premises, however, will permit of an increased turnover, and the volume of unexecuted orders exceeds that of any previous period.

Peel-Conner Telephone Works, Ltd.—The profit and loss account shows a net profit for the year ended March 31st, 1920, of £31,595. Of this, £10,000 has been put to general reserve and £5,000 to depreciation reserve. £16,595 remains, plus £8,560 brought forward. After paying the preference dividend, a dividend of 2s. per share, free of tax, and a bonus of 1s. per share, free of tax, are to be paid on the ordinary shares, leaving £8,155 to be carried forward. The works have been fully employed during the year. The great amount of orders in hand, as well as the growing demand for telephone equipment throughout the world, necessitates a considerable extension of the works. A site has been acquired near Coventry; factory buildings are in course of erection, and a quantity of plant has already been secured. The necessary funds for these extensions are being provided by the General Electric Co., Ltd.

Austin Motor Co., Ltd.—After paying preference dividends for 1919, a bonus of one ordinary share is given for every two ordinary shares held, and there is carried to general reserve £425,000 to provide for liabilities to the Inland Revenue and to leave a substantial proportion available for other contingencies. With the same object it is proposed that the ordinary shareholders should not take any dividend in cash. Sir Reginald H. Brade (late Secretary to the War Office) has joined the board. The accounts for 1916, 1917, and 1918 are also now presented.

Oldham, Ashton & Hyde Electric Tramways Co., Ltd.—Net profit for 1919 £16,529, plus £4,957 brought forward. To reserve £10,000; 6 per cent. dividend on the ordinary shares; carried forward £5,987. The local authorities have given notice of intention to purchase the undertaking, and arbitration proceedings relating to price will begin shortly.

Bordeaux Electric Tramways Co.—The directors of the Compagnie Francaise des Tramways Electriques et Omnibus de Bordeaux announce payment of dividend as follows: 11,875 frs. on registered shares by endorsement on certificate; 10,756 frs. on bearer shares against coupon No. 33; 297.50 frs. for drawn shares, plus an "action de jouissance."—*Financial Times.*

Brisbane Electric Tramways Investment Co., Ltd.—Dividend of 8 per cent. per annum, free of tax, on the ordinary shares for the half-year, making 8 per cent. for the year. £20,000 to reserve, carrying £38,876 forward.

Cork Electric Tramways & Lighting Co., Ltd.—After putting £6,500 to reserve for depreciation and renewals and £4,000 to maintenance reserve, 5 per cent. is paid on the preference shares and £2,512 is carried forward.

Anglo-Argentine Tramways Co., Ltd.—Dividend of 5s. 6d. per share, less tax, on the 5½ per cent. cumulative first preference shares, being 12 months' arrears to June, 1918.

Anderston Foundry Co., Ltd.—Final dividend 15s. per share, making 18s. per share for year ended March, 1920. £10,000 to reserve.

Cork Electric Tramways & Lighting Co., Ltd.—Dividend of 5 per cent. on the cumulative preference shares for 1919.

Canadian General Electric Co., Ltd.—Dividend of 2 per cent. on the common stock for the June quarter.

Brazilian Traction, Light & Power Co., Ltd.—Quarterly dividend of 1¼ per cent. on cumulative preference shares.

STOCKS AND SHARES.

Tuesday Evening.

Interest this week has been taken up a good deal more by sport than by finance. Nevertheless, the latter absorbs a good deal of attention, and the tone in the Stock Exchange markets is a little firmer than it was. This is due to the expectation that the War Profits Levy will be entirely dropped. On the other hand, cautious people aver that the Chancellor will have to get the money somehow, and that as the Treasury 5¾ per cent. 5-15 year bonds have so far proved a fiasco, more drastic taxation will be introduced later. Accordingly, it cannot be said that the clouds of uncertainty are lightened to any great extent. This being so, it is natural enough that investment demand should run mostly upon the gilt-edged stocks which have been in such favour for the past three or four weeks. Once more it is preference shares which command more support than ordinary, while as for good debentures in well-known industrial concerns, such stocks are so scarce as to make their acquisition a matter of speculation as well as investment.

The dulness of electric lighting shares continues to be a matter for some surprise. This does not materialise into buying orders, and consequently the pressure to sell a hundred or two shares in any particular company has a pronounced effect. County of London ordinary can be bought about 8 or a shade over, and at the level price they show a return of 10 per cent. on the money, while the yield on Westminsters, as already indicated here, comes also to the round double figures. Kensingtons are lower at 4¼, Chelseas at 50s. Why this should be so is a matter difficult to explain, but the fact remains, and investors decline to be tempted with the opportunities offered them in this department.

General Electric 6½ per cent. first preference can be bought at 18s. 6d., giving 7 per cent. on the money, and the 7½ per cent. "B" preference at 19s. 6d. return 7¾ per cent. Vickers 5 per cent. preference, tax free up to 6s., are on offer at 19s., returning 5¼ per cent. net, equal to 7½ per cent., less tax. The company's issued capital is six million sterling, and there are reserves of rather over 2½ millions sterling. Armstrong 6½ per cent. new third preference stand at 18s., affording 7¼ per cent. on the money. Another tax-free investment is the "A" preference of Adelaide Electric Supply. The shares can be bought at 19s. 6d., giving 5½ per cent. on the money net, equal to 7¼ per cent., less tax, and the Lancashire Power Construction 6 per cent. tax free first preference at 19s. 6d. yield 6⅛ net, the shares being convertible into ordinary up to June, 1923.

The remarkable traffics published by the London General Omnibus Company of the number of passengers carried in the Whitsun week, together with the forthcoming developments in the way of extending motor-'buses into the country, and on pneumatic tires, strengthens the impression that the Underground Electric 6 per cent. income bonds are by no means over-valued at their present price of 61½. It is possible enough there may be further reduction in the dividend this half-year, and those who buy the bonds will do so with the intention of putting them away and waiting for better times. Until the company is given power to raise its fares, there is not likely to be much attention paid to the bonds, but as soon as the Undergrounds do get upon a business basis, there will come sharp improvements in the various issues. It is, of course, as a lock-up that the bonds are pointed out as unduly depressed. For income purposes, they hold out little attraction as present.

One of the features of the week is a smart rise in Brazilian Traction Common shares, the price spurting to 54 before any number of shares were dislodged. The price at 53 is 3½ higher on balance. Talk is reviving of the company being able to resume its one per cent. quarterly dividends in the near future. The last distribution made was in January, 1917, so shareholders have been wandering in the wilderness for 3¼ years without any reward for their patience. The shares having been held largely in Paris and Brussels, recent Continental selling included these amongst other securities which the foreign holders endeavoured to melt into cash for what the shares could fetch. It may be argued that even a resumption of 4 per cent. annual dividends would not make the shares particularly attractive at 53, but here again it must be recognised that in the enormous field open for profitable working in Brazil, as soon as the unfavourable conditions become dissolved, prospects will brighten materially. Meanwhile, dollar securities of Brazil and the United States have been hardening up a little after their fall of a week ago, but prices

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are put up and down, more in accordance, of course, with the movements in rates of exchange than with any particular business in the stocks.

Mexican securities are a little better, although the actual alterations are small. Anglo-Argentine Trams keep their improvement. British Columbian deferred is harder at 45½, and the 4½ per cent. debenture gained ½ at 52½.

Amongst telegraphs and cable shares, a fall of 5 has lowered Indo-European to 35. The price has dropped sharply since the announcement of the reduction in dividend. West India and Panama have recovered a trifle after their heavy fall. The first and second preferences, however, remain about £5 per share nominally, the first having last changed hands at 80s. ten days ago. Marconis developed a fair amount of strength, and at 3 5/16 show a gain of 3/16 on the week. Marconi Marines have risen to 2½.

Callenders are now quoted in their £1 shape, instead of £5 as heretofore. The price at 1½ is nominally 10s. lower than it stood at £8 before the splitting. The preference shares at 18s. 9d. are practically the same as they were before the alteration occurred in them also. General Electric ordinary at 32s. are ninepence better. British Insulated have eased off a trifle, and other movements are of little moment. Rubber shares keep tolerably steady, and with the price of the commodity once more over a florin per lb., there is a slight disposition on the part of the public to pick up shares when the latter come in cheaply. The armament group is fairly hard, but in all the sections devoted to industrial shares, the fear of what effect may be produced upon profits by the 60 per cent. E.P.D. is a predominant factor. Rumour still sports with the idea that the increase of 20 per cent. may be dropped, but no particular importance attaches to this improbability.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1918.	Dividend 1919.	Price June 1, 1920.	Rise or fall.	Yield p.c.
HOME ELECTRICITY COMPANIES.					
Brompton Ordinary	8	12	6¾	—	£9 8 2
Charing Cross Ordinary	4	7	8½	—	9 6 8
do. do. do 4½ Pref.	4½	4½	2¾	—	8 8 8
Chelsea	8	4	2½	— ½	8 0 0
City of London	8	10	14	—	8 17 10
do. do. 6 per cent. Pref.	6	6	17/-	—	7 1 2
County of London	7	8	8½	— ¼	9 17 0
do. do. 6 per cent. Pref.	6	6	8½	— ½	7 5 5
Kensington Ordinary	6	7	4⅝	— ⅛	7 15 6
London Electric	Nil	2½	1½	—	6 0 0
do. do. 6 per cent. Pref.	6	6	8½	—	9 4 8
Metropolitan	5	6	2¼	—	10 8 8
do. 4½ per cent. Pref.	4½	4½	2¼	—	8 0 0
St. James' and Pall Mall	10	12	6¾	—	8 16 10
South London	5	6	2¾	—	9 12 0
South Metropolitan Pref.	7	7	18/9	—	7 0 0
Westminster Ordinary	8	10	5	—	10 0 0
TELEGRAPHS AND TELEPHONES.					
Anglo-Am. Tel. Pref.	6	6	77½	—	7 14 10
do. Def.	33/6	1½	18½	—	8 2 2
Chile Telephone	8	6	6½	—	*4 18 2
Cuba Sub. Ord.	7	7	9½	—	*7 7 4
Eastern Extension	8	10	15	—	*6 13 4
Eastern Tel. Ord.	8	10	153½	—	*6 11 4
Globe Tel. and T. Ord.	8	10	15½	—	*5 7 0
do. do. Pref.	6	6	8½	—	7 1 2
Great Northern Tel.	22	—	21½	—	9 15 6
Indo-European	13	10	35	— 5	7 2 10
Marconi	25		8 3/16	+ 3/16	7 11 6
Oriental Telephone Ord.	10	12	2½	—	*4 16 0
United R. Plate Tel.	8	—	7½	—	*5 6 8
West India and Panama	1/8	—	5/8	— 1/16	—
Western Telegraph	8	10	15½	—	*6 7 0
HOME RAILS.					
Central London Ord. Assented	4	4	44½	—	8 19 9
Metropolitan	1	1½	19½	— ½	6 8 2
do. District	Nil	Nil	15½	—	Nil
Underground Electric Ordinary	Nil	Nil	1⅞	— ¼	Nil
do. do. "A"	Nil	Nil	4/-	—	Nil
do. do. Income	5	4	60½	—	6 12 8
FOREIGN TRAMS, &c.					
Anglo-Arg. Trams. First Pref.	Nil	Nil	8½	—	—
do. do. 2nd Pref.	—	—	8	—	—
do. do. 5 Deb.	5	5	56 xd	—	8 18 6
Brazil Tractions	—	—	53	+ 3½	—
Bombay Electric Pref.	6	6	18½	—	4 11 8
British Columbia Elec. Rly. Pfce.	5	5	55½	—	9 2 0
do. do. Preferrred	2½	5	48½	—	10 6 2
do. do. Deferred	Nil	8	45½	+ 1	6 11 10
do. do. Deb.	4½	4½	52½	+ ½	8 2 0
Mexico Trams 5 per cent. Bonds	Nil	Nil	28½	—	Nil
do. 6 per cent. Bonds	Nil	Nil	20	—	Nil
Mexican Light Common	Nil	Nil	13½	—	Nil
do. Pref.	Nil	Nil	21½	—	Nil
do. 1st Bonds	Nil	Nil	42½	+ 1½	—
MANUFACTURING COMPANIES.					
Babcock & Wilcox	15	—	27⅛	—	*5 4 4
British Aluminium Ord.	10	10	1⅛	—	9 8 2
British Insulated Ord.	12½	15	1⅝	+ 1/32	8 2 8
Callenders	25	—	1½	— ½	8 6 8
,, 6½ Pref.	6½	6½	18.9	—	6 18 6
Castner Kellner	20	—	4	—	5 0 0
Crompton Ord.	10	—	22/-	+ 6d.	9 1 10
Edison-Swan, "A"	10	—	1⅛	—	8 8 0
do. do. 5 per cent. Deb.	5	5	79½	—	6 5 9
Electric Construction	10	—	21/-	—	9 10 6
Gen. Elec. Pref.	6½	6½	18/6	+ 6d.	7 0 5
do. Ord.	10	—	32/-	+ 9d.	*5 5 0
Henley	25	15	2	—	7 10 0
do. 4½ Pref.	4½	4½	8½	—	6 18 6
India-Rubber	10	—	13½	—	*7 11 0
Met.-Vickers Pref.	—	8	9⅞	—	6 18 6
Siemens Ord.	10	10	26/-	—	*7 13 10
Telegraph Con.	20	20	22½	—	*5 6 8

* Dividends paid free of Income Tax.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Tuesday, June 1st.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Oxalic	per lb.	2/10	...
a Ammoniac Sal	per ton	£100	...
a Ammonia, Muriate (large crystal)	,,	£92	...
a Bisulphide of Carbon	,,	...	...
a Borax	,,	£42	...
a Copper Sulphate	,,	£48	£1 dec.
a Potash, Chlorate	per lb.	1/-	...
a ,, Perchlorate	,,	1/3	...
a Shellac	per cwt.	£29 10s.	£0/- inc.
a Sulphate of Magnesia	per ton	£18	..
a Sulphur, Sublimed Flowers	,,	£28	...
a ,, Lump	,,	£25	...
a Soda, Chlorate	per lb.	6d.	...
a ,, Crystals	per ton	£12	...
a Sodium Bichromate, casks	per lb.	...	...
METALS, &c.			
g Babbitt's Metal Ingots	per ton	£118 to £345	
c Brass (rolled metal 2" to 12" basis)	per lb.	1/8	½d. dec.
c ,, Tubes (solid drawn)	,,	1/5½ to 1/6	½d. dec.
c ,, Wire, basis	,,	1/3½	½d. dec.
c Copper Tubes (solid drawn)	,,	1/8½	½d. dec.
g ,, Bars (best selected)	per ton	£151	£4 dec.
g ,, Sheet	,,	£161	£4 dec.
g ,, Rod	,,	£161	£4 dec.
d ,, (Electrolytic) Bars	,,	£109	£5 dec.
d ,, ,, Sheets	,,	£156	...
d ,, ,, Wire Rods	,,	£124	£5 dec.
d ,, ,, H.C. Wire	per lb.	1/4	½d. dec.
f Ebonite Rod	,,	8/-	...
f ,, Sheet	,,	2/6	...
n German Silver Wire	,,	3/-	...
h Gutta-percha, fine	,,	18/-	...
h India-rubber, Para fine	,,	2/1½	1½d. dec.
i Iron Pig (Cleveland Warrants)	per ton	Nom.	...
l ,, Wire, galv. No. 8, P.O. qual.	,,	£57	...
g Lead, English Pig	,,	£10 10s.	...
g Mercury	per bot.	£17 10s. to £18	£3 10s. to £7 dec.
e Mica (in original cases) small	per lb.	6d. to 4/6	...
e ,, ,, ,, medium	,,	5/- to 10/-	...
e ,, ,, ,, large	,,	12/6 to 25/- & up	...
g Phosphor Bronze, plain castings	,,	1/6 to 1/1	...
g ,, ,, rolled bars and rods	,,	2/2 to 2/6	1d. d.c.
g ,, ,, rolled strip & sheet	,,	2/3 to 2/9	...
d Silicium Bronze Wire	per lb.	1/11½	...
r Steel, Magnet, in bars	,,	1/8	½d. inc.
g Tin, Block (English)	per ton	£278 to £274	£10 to £11 dec.
n ,, Wire, Nos. 1 to 16	per lb.	4/9	6d. dec.
White Anti-friction Metals	per ton	£90 to £345	...

Quotations supplied by—

a G. Boor & Co.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
r W. F. Dennis & Co.

Licensing Wiremen.—Most of the principal cities in New Zealand have licensed wiremen for some ten years, and have found that the application of the system was necessary in the interests of satisfactory workmanship. When the Victorian scheme was put before the Australian Electricity Commissioners, who had been empowered by Parliament to make the necessary regulations, they eliminated the clause providing for the licensing of the electrical contractor—the employer, as well as the employé. The regulations were passed by the State Executive Council in March, and the rules came into operation on April 1st last, but already efforts are being made to amend them so as to include the rejected clause, which is considered to be vital to the issue, for it is contended that an employer may place the licensed employé in an invidious position by supplying him with material about which he has scruples. The scope of the examinations for licences may include tests in calculation, practical work, sketching, and knowledge of such rules as may be prescribed, and the Commissioners may determine that oral, written, or practical tests shall be employed. No fees will be charged for examinations or for the licence. The Commissioners may grant licences to wiremen holding licences in another State, providing that the Commissioners are satisfied with the system of licensing in that State. Applicants may be exempt who have passed an equivalent examination held by an approved body.

Static Charges on Motor Lorries.—According to *La Feuille*, motor lorries running between Gabès and Tatouine often become charged with electricity during sirocco storms, and when the drivers grasp the starting handle for re-starting after a stop they are liable to receive severe shocks. The phenomenon is ascribed to the discharge of electrically charged particles of sand on to the chassis, the charge being maintained owing to the good insulation of the vehicle from the ground by its rubber tires. The drivers attach trailing wires to the vehicles in order to allow the charge to flow to earth.—*Technical Review.*

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WHAT IS THE CONTRACTOR DOING?

[COMMUNICATED.]

Domestic electrification is in a state of arrested development: not technically, for lack of enterprise and inventiveness cannot be charged against the engineer. He has done *his* part, and has designed a wonderful range of highly-efficient appliances for heating, cooking, cleaning—in fact, for every household purpose involving the use of heat or mechanical energy. Supply stations are partly to blame, because many of them have not encouraged, and some have quite definitely discouraged by the imposition of high rates, the non-lighting applications of electricity.

This, of course, is a serious handicap; but undoubtedly the chief responsibility for the suspended animation of the electrical industry rests on the shoulders of the contractor. After all, it is his business to create a demand for electrical appliances, and once the demand is created, everything else must inevitably follow. The attitude of the average contractor seems to be one of hopeless resignation to an unkind and gas-engineered fate. He does not seem to realise his responsibility in the matter; he cannot see that he is the master of his own fate. And yet there is no doubt but that if the retail side of the business would only bestir itself, we might soon look for that happy day when electric boilers shall be as common and unregarded as the gas ring.

What is the contractor doing to advance electrical interests? In ninety-nine cases out of a hundred, the answer is "Nothing." He opens a small shop, fills the window with a miscellaneous collection of uninteresting articles, such as tumbler switches, ceiling roses, &c., with, perhaps, a single flat-iron and a kettle to give an air of modernity to the display. And then he waits for business to come to him. Occasionally he carries out a small wiring job, and, perhaps, supplies the fittings therefor, although frequently the householder has already bought them from a West-End showroom. But he does not, and apparently will not, regard his business premises primarily as a shop where goods are stocked in sufficient quantities and sold over the counter. Ten to one, if you call on any suburban electrical contractor, and ask for any ordinary heating or cooking device, you will be told that it can only be obtained by placing an order in advance. There may be a single piece of apparatus for demonstration purposes, but even that is doubtful. Sometimes bread and butter articles, like lamps and shades and simple fittings, cannot be obtained.

Bad deliveries, small production, and other manufacturing shortcomings may be urged as an excuse, but the excuse is not adequate. Things were just as bad before the war. The trouble is that the ordinary contractor will not place a stock order for anything beyond a few wiring accessories. It is obviously impossible to conduct a successful retail business without a stock; people simply will not buy without seeing. Naturally enough, when a householder does want any piece of electrical apparatus, he goes to one of the big electrical showrooms in the West End or City, or to a department stores, where he can almost be certain of finding the things he desires to purchase. That this procedure should be necessary is a damning indictment against the contractor, and constitutes a serious hindrance to the extension of electrical service.

It would probably improve matters if the manufacturers of cookers, irons, fans, &c., were to advertise their products to the general public. This would create a demand; but, after all, the contractor has no business to rely on the advertising of his suppliers. He should be able to create and supply his own demand.

The first essential of a successful electrical retail business is, therefore, an adequate stock of every sort of domestic appliance. This would naturally involve capital expenditure, but nothing can be done nowadays without capital; and, in any case, an enterprising man should experience no difficulty in raising the necessary money.

Having acquired a stock the question of disposal arises; and it may be taken for granted that, without some form of publicity, electrical appliances cannot be sold. On the other hand, we know from American experience that properly advertised (and any piece of electrical appliance simply bristles with talking points), these things can be sold with the greatest ease, and with a good margin of profit. Electric cookers, cleaners, &c., are necessarily more expensive than their prototypes, and, therefore, although they may tempt, they do not compel the casual customer. When demonstrated, or otherwise advertised, their advantages are so obvious and convincing, that most people will pay any reasonable price to secure such valuable domestic help. They can be made to consider the transaction, not as an unrelated acquisition, but as a productive investment, with regard to which it would be absurd to grudge ha'pennies in first cost.

How is the contractor to advertise his wares? As a rule, Press advertising will not be suitable because the contractor's field is necessarily local, and local papers are not generally read by the kind of people who are most likely to buy. One very effective and cheap method of advertising is by means of window displays. Not the sort of display indulged in by the ordinary contractor, who appears to imagine that passers-by will be cajoled by a dusty and variegated collection of wiring accessories which remains essentially unchanged from season to season and from year to year. The window must be made arresting, attractive, and convincing, and in order to secure these characteristics there must always be a central point of interest, such as a vacuum sweeper, a washer, or a show of fans or irons, which should be fully described by means of legibly-written cards. It is not enough to mark an article, "Washing machine, 100 volts"—that will never sell a thing costing upwards of £40. The window-card should enumerate the chief advantages of the appliance in such a way that he who runs may read, and he who stays will be, if not induced to purchase, at least convinced that by not doing so he is neglecting a duty to his household.

A lot may also be done with the form (or, preferably, the personal) letter. A carefully-written letter, describing a particular piece of apparatus and mentioning others, and asking for an appointment, will almost certainly bring a considerable number of inquiries, of which a good proportion might, by skilful demonstration, be turned into sales. It is the writer's personal opinion that a great deal of business could be done by simply calling on consumers with small appliances and trying to sell them on the spot. This work, of course, would require a man (or woman) of good address and appearance, who knows the talking points from A to Z. There is little doubt but that hundreds of irons, hot-plates, kettles, fans, &c., could be sold in this way to people who might never enter the contractor's shop.

There is a block of moderately expensive flats in a western suburb of London, in which 90 per cent. of the tenants use electric light, but not more than 1 or 2 per cent. use electricity for any other purpose. These people could well afford to buy and use any of the small appliances suitable for lighting circuits, and a pleasant and persuasive salesman who succeeded in interviewing the tenants (and why should he not?) would do excellent business. A demonstration on site is so much more convincing than in a shop, although, of course, every contractor should possess a well-equipped demonstration room.

The fringe of the electrical appliance business has hardly been touched as yet. It is evident that the contractor is the most potent factor in the problem, and that without his intelligent co-operation the most valuable public utility in the world will stay where it is—playing second fiddle to the enterprising mediocrity of coal gas. The contractor must stock and advertise the things he hopes to sell. To expect to sell them in any other way betokens the foolish optimism of the proverb-maker who said that good wine needs no bush. As a matter of fact, it needs the best and most elaborate bush available.

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THE FOREMAN IN THE ENGINEERING INDUSTRIES.

By HARTLAND SEYMOUR.

The exact status and responsibilities of the foreman are, just now, receiving a good deal of attention in the engineering industries. Having held the position of a foreman in a machine shop, the writer is naturally exceedingly interested in the various discussions to which he has listened during the past few weeks.

Apparently the foreman in the engineering industries is the "guide, philosopher, and friend" of the shop operative. His business is to represent the management. Among his duties he is primarily responsible for the discipline of his men, finding jobs to suit these men, and seeing to it that they keep to schedule on the work.

The foremost quality of any foreman always has been, is, and always will be, in spite of scientifically-planned schedules, the knack of handling men. Not that this is the only essential quality of a good foreman—he must know his trade thoroughly, besides which, he should possess teaching qualities, in order that he may impart his knowledge to his subordinates.

He should, moreover, be a keen observer of men and methods, so that on one hand he may be able to size a man up and pigeonhole him for a job, and, on the other hand, that he may be able to suggest improvements in methods of production.

Now that manufacturing processes are becoming more specialised and standardised, technical knowledge is more essential in a foreman. That is to say, in the "line," or military type of works organisation, the foreman was more of an organiser than a technical expert.

In this type of management the foreman was usually trained in the shop over which he was subsequently placed in authority. The fact that he was a better workman than his colleagues, and that he possessed tact and loyalty, usually secured for him the position of authority. Now, however, in the "staff," or functional organisation, the foreman must be a technical expert, so that he can convey the orders of the chemist or the engineer to operatives engaged on that particular line, irrespective of departmental or shop authority.

To fulfil his duties and responsibilities in the latter type of organisation, the foreman must not possess technical knowledge only, he must have executive ability, and be able to impart knowledge and convey instructions in a simple and straightforward manner.

In the "line" management organisations, superintendents, as a rule, preferred to make a foreman of one of their own men—that is, a man who had been trained in their own shops. It is quite obvious that this system possesses many advantages. The foreman will be acquainted with the *personnel* of the works, will understand the various trades in the shops, and will be conversant with the firm's methods. Further, if a man is selected from among his fellow-workmen and placed in authority, it will encourage the others, which is not the case if positions of authority are given to "imported" men. Moreover, each man is then given an objective, so to speak.

The writer very well remembers a typical case of a man in the shops who showed he was suited to authoritative control. This man was a first-class mechanic. But, more than this, he was a born leader. Middle-aged, his sane counsels and foresight were constantly being appealed to by younger and less-experienced men. He was generally called upon to arbitrate in quarrels between the men, he was invariably their spokesman at interviews with the management, and was often consulted by the existing foreman on such matters as discipline and manufacturing methods.

When the existing foreman left, this man was promoted, but the authorities were in doubt about placing him over his fellow men. They considered that jealousy and consequent friction would be avoided if he were placed in authority over another department. However, he was tried in his old shop, and proved a complete success. He is now works manager of the same factory.

Various authorities have declared that the position foreman is one of the most difficult to undertake. When one considers what the majority of managers expect from their foreman, this statement is not surprising. He is considered a very convenient executive to "come down on" if things did not go properly, and some managers did not worry very much if the foreman was provided with the necessary accessories to perform his task in an efficient manner or not.

It is not always necessary for a foreman to be a manipulator, but this quality is always desirable, as a man without it lacks the demonstrative quality when directing operations, which quality is, of course, of more practical utility than any other. Further, the workmen will always respect a man who is better at their jobs than they themselves are far more than they will a man who is an expert organiser and capable of co-ordinating their efforts to obtain the best results, but, at the same time, who lacks the ability to show exactly "how."

Opinion apparently varies from factory to factory on the subject of education as a necessary quality in a foreman. Some managers hold that education is unnecessary as long as the foreman has a thorough knowledge of his trade and possesses executive ability. Others maintain that education is highly important—in fact, is essential in a foreman.

However, most progressive managers, to the writer's knowledge, hold to the former view. That is to say, these managers do not believe that education of a high order is essential to an organiser. Theory alone would not, of course, make a good foreman. Some of the best of this class are men who have been right through the shops from apprenticeship, who have attended evening classes at technical schools, and who are wide readers and students of manufacturing processes and industrial economics.

Foremen, along with works managers, are rapidly becoming more clearly defined—in fact, industrial administration is going to be a definite profession. Some day this will be attained, with degrees and diplomas from an institute formed for the purpose of training organisers on scientific lines, and combining, in their proper proportions, theory and practice.

POWER FACTOR FROM THE BUSINESS MAN'S POINT OF VIEW.

By C. TURNBULL.

Introduction:—The importance of power factor to the commercial welfare of electricity undertakings can hardly be over-estimated. Engineers are now coming to the conclusion that low-power-factor energy must be charged for at a higher rate than the energy taken at unity power factor. The difficulty in doing this is that, so far, it has been found very difficult to explain the meaning of the phrase "power factor" to consumers whose training is of a commercial nature. If one cannot explain it to the consumer, it becomes almost impossible to charge him for it. Engineers have frequently tried to explain it from a technical point of view, but they usually leave the consumer in a hopeless fog, with his mind firmly made up that he will not pay for anything so elusive as wattless current.

In the following article an attempt is made to explain power factor from the business man's point of view. If this method makes it possible to charge consumers for the waste of energy and money involved by low power factor, its inclusion in the columns of the Electrical Review will be justified.

Power Factor Explained Commercially.

If a man were to draw £130 from the bank, and then immediately afterwards return £30, he would be debited with £100. In that respect he would stand in the books just as if he had drawn £100 in the first case, but he would have caused much unnecessary work, and would be a nuisance.

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Now certain electric motors act like the undesirable bank customer. Instead of drawing their current from the mains, to convert it right away into useful work, during part of a revolution they draw more current than they need, and return the surplus to the mains during the other part of the revolution.

Thus certain 100-H.P. motors will take 130 H.P. for part of the time, but instead of using the extra 30 H.P., like the undesirable bank customer, they keep putting it back into the mains immediately afterwards.

The effect, therefore, is that the mains must have sufficient capacity to deal with the additional 30 H.P. which oscillates to and fro between them and the motor, in addition to the 100 H.P. actually required, making a mains capacity of 130 H.P. altogether.

An ordinary measuring instrument, in fact, shows a consumption of 130 H.P., but a specially-designed instrument discloses the fact that 30 H.P. is what may be called an oscillating power; that is, instead of being used, it passes into the motor for a short time, and immediately afterwards passes from the motor back again into the mains.

It is, in fact, like the £30 which the man drew from the bank in excess of his requirements, but which he immediately returned.

The banks have recognised that such transactions should not pass without charge. The man who pays, say, £10,000 into the bank, and draws out £11,000 by numerous cheques, leaving an overdraft of £1,000, pays more bank charges than the man who gets a clean overdraft of £1,000. In short, a bank customer pays on his turnover, and not merely on the balance.

Suppliers of electricity have found out that they must follow the precedent set by the bankers. If two consumers have 100-H.P. motors, and if the motor of one takes a clean 100 H.P. from the mains, while that of the other takes an additional 30 H.P., which it immediately returns to the mains, then the first one must have a lower rate than the second.

For the imperfect type of motor the electricity works must lay down, in some cases, hundreds of thousands of pounds'worth of plant which produces no useful effect, but which is merely occupied in dealing with the useless power which oscillates to and fro from the mains to the motors, and back again from the motors to the mains.

To this explanation we may add some technical terms, which consumers will find useful.

The power factor of a motor is the correction which must be applied to give its real power. Thus in the case of the motor which takes 100 H.P. from the mains without any oscillating power at all, the power factor is 100 per cent. All the power is used.

Where the motor takes 130 H.P. from the mains, while it returns 30 H.P. back again as an oscillating power, the power factor is 77 per cent. The reason for this is that if we take 77 per cent. of the apparent power, namely, 130 H.P., we get 100 H.P., which is the real power which the motor absorbs from the mains.

Turning to our analogy, if a bank customer continually presented cheques for sums of £130 at a time, and immediately returned £30 before leaving the bank counter, he might be called a 77 per cent. man, because he only took out 77 per cent. of the money indicated on his cheque.

Users of electric motors may naturally ask if they cannot get motors which will use the energy directly without developing an oscillating current. The answer to this is not only that such motors can be got, but that the imperfect type of motor can be corrected so that it will work without oscillating currents. While these improvements cost money, they bring about a great saving in the cost of supply, which is naturally beneficial to users of electric motors.

These facts have been set out to enlist the sympathies of consumers in the problem, and to get their help to reduce the cost of energy. If the supply authorities have to deal with motors which, as many do, return to the mains as much as half the current which they take, then the plant which supplies the current must cost something like double the money that it would cost if the motors were efficient. Efficient motors mean economy in supply, and that means, what everyone wants—CHEAP ENERGY.

GAS TURBINE DEVELOPMENT.

THE development of an efficient commercial gas turbine is a problem of much interest. In his contribution to a recent discussion at the Institution of Electrical Engineers on the use of producer and blast furnace gases for power production, Mr. Lymn mentioned experiments that had been carried out in Germany on the Holzwarth gas turbine since 1914. We are now able in what follows to give further details of these investigations.

Shortly before the outbreak of war tests were commenced on a 1,000-H.P. vertical gas turbine built by Messrs. Thyssen and Co., at Mülheim, Ruhr. The tests were discontinued during the war, but recommenced in 1918. The Thyssen turbine does not differ in external appearance from the machine previously built at Mannheim, but differs from it in several particulars of design. The tests aimed at the evolution of a simple and effective gas turbine capable of being manufactured in large units, but with a lower cost of production than the steam turbine, including its steam-raising plant.

According to the *Journal* of the American Society of Mechanical Engineers, in which is abstracted Hans Holzwarth's article on the subject published in the *Zeitschrift des Vereines deutscher Ingenieure*, higher charge and explosion pressures were adopted to increase the output per cubic unit of chamber capacity and the thermal efficiency. The average explosion pressure for continuous operation was raised from 12 to 14 atmos. abs., compared with 5 to 6 in the Mannheim machine. Holzwarth thinks it possible to raise this figure still higher by increasing the charge pressure above 2.3 atmos. abs. Curve 1 shows the thermal efficiency (producer gas of 500 kg.-cal. per cu. m.; temp. of mixture, 77 deg. C.), and curve 2 the specific output of the Holzwarth gas turbine (assumed to be free from losses) as a function of the charge pressure previous to the explosion.

The combustion period of the gas turbine is now 0.1 sec., compared with 0.33 sec. for large 90 R.P.M. gas engines and 0.02 sec. for 1,500 R.P.M. aero engines. Fundamentally there is nothing to prevent reducing the expansion period still more, but it would involve an increase of the nozzle cross section, which in turn would lead to an increase in blade length and in flow resistance.

Decreasing the period of expansion increases the pressure on the blades, and the jet in explosion turbines, unlike a steam jet, acts intermittently for short periods, and is of the character of a blow. Because of this new blade shapes and fastenings had to be developed to withstand the added stresses. The blade caps, blades, and blade roots were designed in one piece, as in the De Laval steam turbine, which design has given satisfactory results.

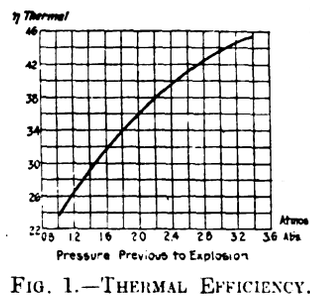

FIG. 1.—THERMAL EFFICIENCY.

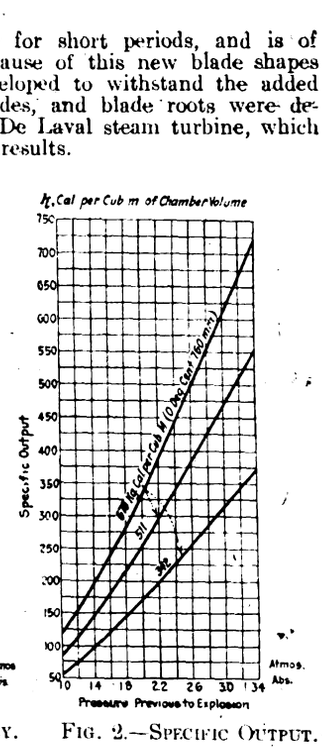

FIG. 2.—SPECIFIC OUTPUT.

Long and expensive tests to determine the most suitable material for the blading led to the adoption of mild electric steel; with proper heat treatment blades of this material proved very satisfactory. Table I shows the physical properties of this steel from tests made at the Technical High School, Stuttgart. While blades made of harder or alloy steels rapidly show changes in structure of the metal, cracks

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and fissures, electric steel appears to be capable of withstanding wear and is also resistant against surface corrosion and erosion, provided, however, no substantial amounts of wet steam or water are present in the gases of combustion. The chief difficulty in gas turbines is caused by deterioration of the blades and wheels owing to the high temperature necessary, 600 deg. C. and over, and metals used must be reasonably indifferent to changes of temperature and the action of the gas. Figures relating to other tests made in Germany on alloys for the same purpose are given in the *Mining Journal*, and it is shown that the material which is considered to have the best prospects for use on a large scale in the construction of gas turbines is a nickel-chrome steel (74 per cent. Fe, 20 per cent. Cr, 6 per cent. Ni, 0.3 per cent. carbon). At 600 deg. C. its strength was 47 kilos., with 19 per cent. ductility, and an elastic limit of 16 kilos.; at 700 deg. C. the strength was 24 kilos. and the ductility 7 per cent.; and in an air bath at 700 deg. C. the surface remained free from scale.

With regard to nozzle shapes, on the whole it was found that steam turbine experience applied within reason to the design of gas turbines. Thorough tests on nozzles showed the De Laval type to be satisfactory, provided the angle of

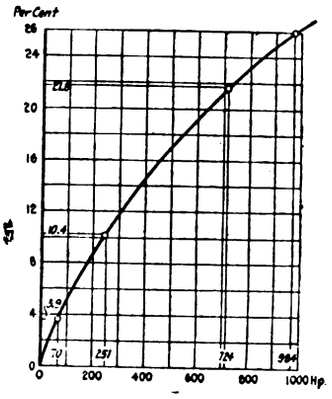

Fig. 3.—Total Efficiency.

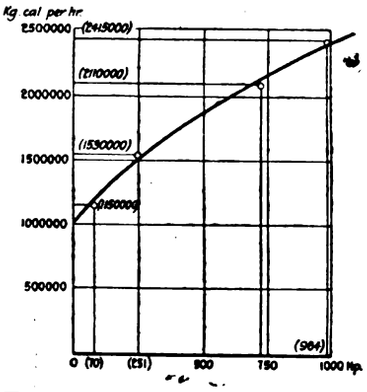

Fig. 4.—Total Heat Supplied.

outlet is kept as small as possible. The rate of combustion and scavenging were improved by the use of an oil pressure loaded nozzle valve.

If the instantaneous maximum jet velocity at the beginning of expansion is in the neighbourhood of 1,500 m. per sec., more than 95 per cent. of the mechanical energy of the gases of combustion is available at the wheel up to the time when the jet velocity decreases to about 1,000 m. per sec. This means that more than 95 per cent. of the energy is available at jet velocities varying 19 per cent. either way from the average jet velocity for which the nozzle and blading have been designed. Practical experience confirms these theoretical considerations. Efficiencies of about 55 per cent. (*i.e.*, about 55 per cent. of the output attainable in a gas turbine free

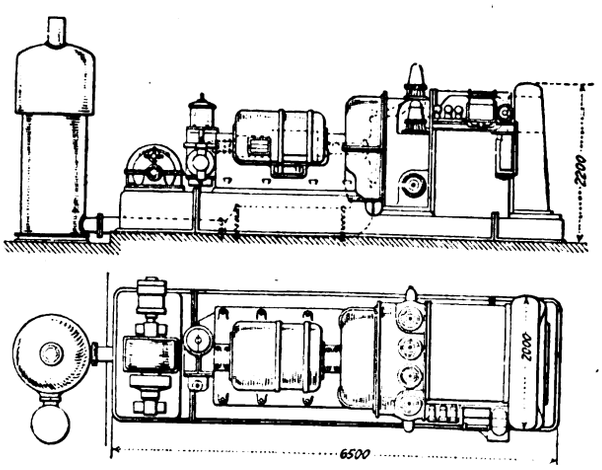

Fig. 5.—A 500-h.p. Holzwarth Gas Turbine.

from all losses) have been indicated on the periphery of the wheel. In gas turbine practice the lower limit of the heat drop is predetermined and for practical purposes so are the peripheral velocity and number of stages. On the other hand, the designer is free to vary the upper limit of the heat drop, and through this the important ratio (jet velocity) : (peripheral velocity) without materially affecting thereby the thermal efficiency of the turbine.

A 4-hour test was carried out in December, 1919, with a gas turbine coupled to a D.C. generator connected to a water rheostat. Coke-oven gas having a calorific value of 3,860 kg. cal. per cu. m. (432 B.TH.U.) was the fuel used. The results are shown in Table II. In the present tests all the combustion chambers were in operation, but in future the governor gear is to be arranged to cut out certain combustion chambers, thus increasing the efficiency on partial loads. Fig. 3 shows the efficiency as measured at the wheel periphery, and fig. 4 the heat supplied, as a function of the power output at the wheel to the turbine per hour. The work consumed in compressing the blast air and gas amounted to 5.7 per cent. of the exhaust heat, so that the power consumption for the blowers can be well taken care of by exhaust heat.

Gas turbines of the horizontal type appear to be preferable in several ways; working parts are more accessible, and the generator can be kept separate, and it is intended in the future to build only this type.

TABLE I.

	Tested at	
	Room temperature	450 deg. Cent.
Yield point, kg. per sq. cm.	{ 4,204 / 3,185 }	1,975
Breaking load, kg. per sq. cm. ...	4,510	2,675
Elongation, per cent.	27·2	50·2
Contraction, per cent.	73	88·4

TABLE II.

	1	2	3	4
Gas consumption, reduced to 0 deg. Cent., and 760 mm. mercury pressure, cb.m. per hour	300	400	550	630
Heat supplied, cal. per hour	1,150,000	1,530,000	2,110,000	2,415,000
Power output at wheel periphery, H.P.	70	251	724	984
Heat consumption, kg-cal. per H.P.-hour	16,430	6,090	2,915	2,450
Efficiency (periph.) per cent.	3·9	10·4	21·8	26

Fig. 5 shows the outlines of a 500-H.P., 3,000 R.P.M., oil-fuel gas turbine now under construction to drive a D.C. generator. The blower and exciter are built on the same base as the main machine, and directly-connected thereto is the exhaust-heated boiler delivering steam for the blowers. The installation is for the Prussian railway administration.

The original article gives drawings of a 12,000-KW. gas turbo-generator set, and of a 3,300-KW. gas turbine together with blower and waste heat accumulator. It may be added that during the war it was rumoured that a high-efficiency gas turbine had been developed by the Augsburg-Nuremberg Machine Co., but so far the rumour has not been confirmed.

THE ELECTRICAL EQUIPMENT OF ARTISAN DWELLINGS.

At a meeting of the North Midland Centre of the Institution of Electrical Engineers at Leeds, on May 11th, Mr. Leonard Milne read his paper on the above subject. This paper was abstracted in our issue of April 9th.

In opening the discussion, Mr. T. B. Johnson (Leeds) said that up to the present he had been under the impression that whereas electricity was obviously the best means of lighting a house and providing such small domestic comforts as electric heaters, ironers, and vacuum cleaners, yet when it came to heating, gas was more economical. The Fuel Research Board recently published a table showing that the cost of 100,000 B.TH.U. with gas at 4s. 2d. per thousand feet was 10d. per thousand; and with electricity at 2d. a unit was 58d. That was six times as much for electricity as for gas. They did not want to go too far in recommending electricity if there was a better way. When they wanted a fire for a short time only, they could get the gas fire at a suitable heat much more quickly than they could get an electric radiator of similar size. If they could get the open fireplace completely abolished, the gain from a health point of view would be enormous. If they must have the coal fire kitchen range, he thought that was the means whereby they should get the supply of hot water. He thought the author in some instances had gone too far in the way of saving first cost, and would lose money in subsequent maintenance. The author proposed to dispense with switch drops, and to place a combined switch and ceiling rose on the wall near the ceiling level, and to operate the switch by a cord or rod

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attachment. If that was done, the maintenance costs would soon wipe out the saving on the twin flexible, which was only 40 per cent. on a small sum. The author proposed that the supply from house to house of a group should be made by means of bare overhead wires. There, too, the initial saving would be wiped out by subsequent troubles in maintenance. Where telephone wires were wanted, bare telephone wires and bare electric wires did not go together. The author's suggestion that a group of houses should be taken, and a common charge made on the occupiers, would be quite unworkable. When a number of people shared one meter, even in one firm, there was everlasting trouble in finding out where there had been excessive use of current.

Mr. W. Wraith (Leeds) remarked that the idea of having these groups of houses was a very economical one, and ought to be applied. He did not agree that an extra charge should be made for small domestic apparatus. The electric iron and anything of that sort usually took only a very small current. Electric heating was not as cheap as fiers were now. In his office he had an electric radiator which in the winter took two kilowatts to keep the room fairly comfortable the whole day. The cost at the old price, ½d., was 8d. for the day, whereas a bucket-full of coal at 8d. lasted them two days.

Mr. W. H. Brown (Shipley) was dubious as to the desirability of the lightly insulated neutral wire, particularly if one came across damp cellars or anything of that sort. It was liable to lead to all sorts of trouble. The voltage of the neutral was not usually much above earth potential, but he had found that in the case of a fault coming on, under certain circumstances, there might be a very considerable increase of potential between earth and the neutral wire. Having one meter for a number of houses might be found quite suitable in the majority of cases. He gave a copy of the paper to one of his workmen, and asked him to talk the matter over with his wife; she thought this electrically-equipped house would be a fine thing if it could only be done; but she said that the gentleman who wrote the paper had entirely forgotten about the washing day. They wanted as much hot water then as they did for the rest of the week. The woman was also up against the idea of having "this chemical business," as she called it—the nitrate of soda and that sort of thing—when the kiddies were about. The question of cost came in. Who was to provide this electrical tackle?

Mr. Davidson (Leeds) said the cost of wiring with twin wires for a heating plug was given as about 18s.; the cost of a moderately good combined switch plug to-day, without any wiring or anything else, was in the region of 18s. Only a few days before, he had to cost up 500 houses on one estate. Those houses were to be wired in screwed tube, with C.M.A. cable, complete with opal shades and lamps, and the prices as they worked out were: For a seven-light house, lighting only, £22 5s.; 8 lights, £25 10s.; 8 lights in blocks of four, £29 10s. per house. The variation in those prices was due to the cost of interconnecting mains. The supply authority proposed to put in one service for each pair of houses, and one service for blocks of four, and it was suggested to interconnect inside by 7/16 mains. Those were the lowest prices at which the work could be carried out. Cleat wiring he did not agree with at all; after the houses had been occupied a week, the wires in the kitchen would be used for hanging up the clothes, and the cost in repairs would be very heavy. The lamps should be fairly high, and probably in the living room should be suspended by a tube rather than a flexible cord. It was desirable that there should be a separate meter for each house; it would encourage people to use special apparatus such as washing machines, irons, and so on, if they could afford them. It was also very desirable to put in a very good type of switch, and that switch should be earthed. The average cost of a house was in the region of £1,000, and if £20 to £25 of that was spent on electric lighting it was a very low figure. The cost of an oven with hot plates suitable for the Yorkshire wife was considerably higher than the cost of the chimneys in the house, which the author gave as £25.

Mr. Innes (Leeds) asked what the author took as the cost—the net cost to the contractor, or the cost to the builder?—Mr. Milne replied that the cost was the price that the contractor would charge, and provided for his establishment charges and profit, for which a provision of 20 per cent. was made. Mr. Innes observed that dealing with it from that point of view, in close-joint conduit with continuity fittings, he did not think the author would to-day be able to do it at anything approaching the cost he had given. His firm was carrying out work at some of those houses, for which the cost was given at 29s., including lamps and fittings. It worked out at that without lamps and shades, and only the cost to themselves. His firm had carried out a good deal of cleat wiring for the Office of Works, but were not satisfied with it; the Corporation would not allow it except as a temporary expedient. After it had been done for a short time they found the wires sagging in all directions. They could considerably cheapen the wiring by the use of a combined switch and ceiling rosé; it would practically do away with inspection fittings and tees, which were to-day costing more than 50 per cent. of the cost of the tubing. As regarded the special flexible, the total saving was not a very serious item to put against the danger which would come about through careless workmen putting thinly insulated flexibles on the live side, or by the owners themselves tinkering with the wiring. As regarded working in conjunction with the architects and builders, it certainly should be done in every case, but it was not, because they often came on to the job very much too late. With regard to service, in a block one service was quite sufficient as a general rule, in a central position. He did not think the running of overhead mains between the blocks could be recommended. In many cases they could dispense with meters where lighting only was required. Two meters ought not to be necessary, if some system of charging like the rateable value system was adopted, he thought it was certainly the best system. There was a big future for electric cooking, once they could educate the public to know that they could save actually on the food alone in cooking; but the people they had to educate in the first instance were those who had the money to pay for the apparatus. The people who were building the artisans' dwellings would not be justified in going to the expense of putting electric cooking apparatus in. Electric washers were very expensive, but no one who had used one would be without one. With regard to heating by electricity, the present type of radiator got hot within a minute, and he did not think they could expect anything quicker than that. For continuous heating it might be more expensive than gas, but for rooms only used for short periods, he did not think there was any question about its being economical, provided they could educate the people into using it in the proper way. He agreed that the best way of getting a hot water supply would be by a separately fired boiler, with anthracite or coke, which was the most economical method they could find, and would probably solve the problem of getting plenty of hot water on washing day, as well. The experience he had had of the thermal storage system so far was unsatisfactory. For linen cupboards a small, low-temperature heater taking about 100 watts was fairly economical. The people they had to educate to the use of electricity first were those who had the money to spend on the apparatus, and they were educating them in that direction with very little trouble, for those electric helps did away with the dependence on servants, and people were becoming more and more converted to their use.

Mr. H. Moss (Bradford) could not see how a house could be wired at £14 in close-joint tubes with continuity fittings. Overhead mains were highly satisfactory for distribution from house to house when blocks of buildings were being put up together; and it was far cheaper than running supply mains through basements in a row of houses. He had been connected with installations where they had adopted overhead mains, cheapening the cost considerably. The wires could be put out of the way by running on the backs of the houses, and would be far more out of sight than if run along the chimneys. In a case he had in mind there were telephone wires; there had been an electric supply for the last ten years, and he had never heard yet of any difficulty arising through the telephone wires coming in contact with the lighting wires. Every customer should pay for what he used, and must have a meter. There were numbers of consumers who would buy these meters outright rather than pay the rental year after year. In the paper the use of all kinds of electric apparatus was advocated; they would have to have separate meters and let those people who used electric radiators and irons pay for what they used. When the author came to suggest that a 9-light installation could be put in for £7, an average cost of 16s. 9d. per light, and that radiator plugs should be put in for 18s. per point, he thought it was impossible to put in wiring that would pass any regulations for that figure. £5 per plug was a common price to-day for radiator plugs in houses, and he did not see how they were going to reduce that price. The smallest radiator it was safe to wire for was a two-unit. They must have cables to suit, a switch of ample capacity, a suitable plug, and separate fuses. It would be a long time before they got electricity adopted universally for heating and cooking in artisans' dwellings.

Mr. Adams observed that gas or electricity had to be put in; the electric installation would be more expensive, but the cost of the gas installation should be taken off that. With regard to co-operation with the architects in building, if they would put wood plugs in and make the runs properly they would considerably reduce the cost in tubing, and tubing would quite easily be put in if all the runs were made out. As regarded the leading-in wires, the overhead proposal had great weaknesses in the way of faults and leakage. Would not it be better to have some system of block wiring, similar to that which the Post Office used at the present time in a large building? The supply was brought up to a pot head outside and branched off to the various offices. A flat rate would undoubtedly lead to extravagance. If £25 would be saved by not making chimneys, an electric installation could be put in for that, therefore why economise on the installation? If they put electric installations in which appeared to be cheap but were not cheap, and did not last, they would do harm to the electrical trade.

Mr. Pickersgill (Cleckheaton) said the Council at Cleckheaton expected to put up 300 houses on the garden city plan. The question of wiring the houses and how the service was to be run was rather a moot point. Going in from the chimney points did not seem to him to be feasible so far as their area was concerned, owing to the sulphur and acids in the air which came up from the dyeworks. The wires would soon be corroded. One man quoted him £5 a light to do about 40 lights in a motor garage. He got it done for

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32s. per light, twin lead-covered wire, and a good job too. Five years ago they could wire for £1 a light. They were coming now and wanting £3 a light. They all knew the cost of material had gone up, but it had not gone up as much as the wages and the drop in the amount of work done for the money. Until they could get the workman to do more work in the time, now that he had got his hours lowered, they could not reduce the cost.

Mr. REID (Morley) said he was connected with the housing scheme at Morley, and he would like to point out that the most important question had not been touched upon at all in that discussion. The Housing Commissioner was the most extraordinary barrier to progress. He found that they had got gas in for £12 for a seven-point installation. Unless an electric installation was going to compete with that, he thought it would be almost hopeless to induce the Housing Commissioner to accept it at all. He would propose to bring the wires to the eaves of the buildings, which were mostly about 15 ft. 6 in. from the floor level, and then lead them down to the first-floor level, and take them below the ceiling level through the wall, put the replacement fuses there and the meter, and from there take the wires through the underdrawing, and for the ground floor drop ceiling roses at the various points required. The other points on the first floor, for the bedrooms, might be on the wall sides like gas brackets, and the only switches in the building would be the replacement fuses and a switch at each lampholder or the ordinary key switch. Some years ago he installed lamps with cord attachments to operate them from the ceiling rose, and they proved a complete failure, even with rod attachments. For the bedroom lights there might be, in place of the key switch, ordinary light dimmers or resistances with the combined switch arrangement mounted on the wall-bracket base or on a common plug, which would reduce the cost considerably. Regarding the cost of doing away with chimneys, he did not agree with the author. The average artisan was educated to use the ordinary grate and get plenty of hot water from the ordinary fire and set pot. Regarding gas-heated geysers, three of them were installed at a hospital in Morley, and they were never satisfactory. With regard to cooking apparatus, he did not think those would come in, although he had installed quite a number some twelve years ago at Calcutta, amongst a community educated to the use of electricity. They were not of the artisan type, and they proved quite a success. Open cleat wiring was also a success, and if they could install that in a place like Calcutta where the climate was very damp and the walls got damp, it should suit any other climate. There were practically no fires from cleat wiring; they used to use cleat wiring and tapeless cable manufactured by the General Electric Co., and they all proved quite successful.

Mr. JESSOP (Bradford) said with regard to the author's suggestion to use switches and ceiling roses combined, or fixed together, he had fixed thousands of them in factories, and had some thousands under maintenance at the present time; he found that those switches would last four or five years without any maintenance. That was the usual Wadsworth Tucker fish-tail type with a couple of chains attached. In addition, he liked to put an additional chain on to hold the weight of the lamp, and he did not see any objection to using that in an artisan's dwelling. The artisan had been accustomed to going to the gas and turning on a tap. Relieve him of the match, but give him the tap, and he thought they would make a good job there. With regard to collaborating with the architect, he thought if they did that, contractors would find that it would cost them more, because the architect would put a condition in the contract that as the building was going along they would have to send a man to put in the plugs for the switches. If he put it on to the builder, the builder was going to charge an exorbitant price, because in turn he had to turn it over to his bricklayer and leave him to measure out the exact position and put it in. They had had to do it for some architects, and had to have a man on the job watching the bricklayer. With regard to metering, there was one system that had not been dealt with—the lighting of these artisans' dwellings from A.C. supply, using a condenser for limiting the current. He had had opportunities of inspecting some houses which had been done on that system, and with a charge of 6d. per week the company supplying electricity made a profit. The house had five or six lights, with 50-C.P. lamps in the living rooms and 30-C.P. in the bedrooms, which he thought was equal to what they got with the ordinary incandescent gas. In those houses they had a considerable saving in the charges for meters. He had asked one of the ladies resident in the houses, an ordinary workingman's house, if she was satisfied with the light, because he thought a 50-C.P. lamp would not be sufficient. She said that she was quite satisfied, and preferred the light far above gas. The wiring for that could be done almost entirely with single wiring, simply running a single wire in series round the whole of the house. Instead of being switched out the lights were short-circuited. They could put in a good quality wire, and certainly the cost of seven lights including a condenser, reasonable shades, and lamps, would not come to over £10 10s. for a seven-light installation. For D.C. supply he did not see why a reasonable current limiter should not be used instead of a meter, that would limit the supply, say, to two 50-C.P. or one 50-C.P. and two 25-C.P. lamps.

Mr. FIRTH (Dewsbury) supported the two speakers who had mentioned the question of comparison of costs with gas and the question of the Health Commissioner or Building Commissioner. In Dewsbury there were probably two hundred houses to be built, and they had come on the scene after the prices had been fixed. They had to compete against 12s. 6d. per point for gas. The lowest figure came out at about 25s. per light.

Replying to the discussion, Mr. MILNE agreed that gas was more economical than electricity for heating, but he did not think the question of economy in running cost was of any importance whatever as regarded the heating of such rooms as bedrooms, where the heating would possibly be used for one night in the year. He did not think that they could advocate the electrical heating of rooms that were in constant use. The important point was that if they used gas they must have flues, and practically did not save anything at all on their building, and they had to provide gas stoves for the bedrooms. An electric stove could be carted in when it was wanted, hired from the landlord, and fixed without any noise or fuss at all. They could not do that with a gas stove, it must be permanently fixed and bought and paid for by the landlord. He did not think the maintenance would be at all heavy if the scheme was carried out in its complete form, for the reason that none of the wiring was within hand-reach, and if a cleat wire was run along a ceiling it was not going to be touched except maliciously. Of all the small economies that he had suggested, the one that effected the largest saving was the doing-away with the switch drops. That saved an enormous amount of labour. They should spend money in the factory; and not on the job. One or two speakers had suggested that the thing was not safe. Experience was against that. He could not find that any speaker had ever brought forward at any of the meetings they had had a suggestion that a fire had been coincident with the development of a fault on a system, and surely that must have happened if the want of insulation on the neutral side was a danger. In nine installations out of ten the insulation on the neutral side of a three-wire distribution was practically nil, and when they had to put a neutral side on to an outer, they blew fuses time after time. Artisan dwellings had no cellars at all. Those who had had experience of overhead systems in villages did not find that their bare services were a heavy cost for maintenance. In some cases it might be advisable to run under the eaves and not on the chimneys, and, indeed, in some cases to run through the false roofs of the houses. Each case would have to be dealt with on its own merits. If they looked at the figures which he had suggested for hot water they would find that very fair provision was made for ordinary washing. When he started his paper he thought that the electrical heating of water was not a commercial proposition at all. He was astonished to find that the electrical heating of hot water was cheaper than a separately-run anthracite stove for a small house, and also cheaper than a gas geyser if they provided a pilot burner. If they cut out the pilot burner it was not, but then they had not got anything like the facilities. If one made a comparison between the two, they must make it with a gas geyser fitted with a pilot burner, and he had found to his astonishment that the gas-heated geyser was dearer than an electrical heater. This subject of heating water merited very much greater consideration than had been given to it at present. The figure of 18s. per point for wiring plug points was perfectly sound for the time at which it was given—last autumn. It had to go up because wages had risen, and material had risen a little. It was based on the twin wire that he was suggesting. It would cost a bit more if it was run in a tube or casing or even lead-covered wire. He had allowed for a bed-room, which was a very small room, 1 KW.; and in the scullery, where cooking might go on, 2 KW., and taking the average price all round, it worked out at 18s. per point, providing 20 per cent. for contractors' establishment charges and profit. He did not include in that price the control apparatus of the stove. The prices given for the cost of screwed tube were considerably above his figures. They pointed to the importance of introducing some cheaper form of wiring if they were going to get this work at all. If they had to charge anything like £22 to £29 for wiring an artisan dwelling to-day for lighting only, they would not get it. The landlord, it seemed to him, should bear the cost of cooking apparatus, just as he bore the cost of a coal range, if a range was put into the house. He had found in village supplies for which he was responsible that in some cases where a fixed charge was being made there had been gross extravagance. That sort of thing would have to be stopped. The system he proposed was not going to be unsightly; the wire was about half the diameter of a pencil, run on small cleats close up to the ceiling. It would be very inconspicuous indeed, and distempering would not do any harm. The figure given by Mr. Reid of the cost of the gas installation of seven lights at 12s. per light showed that if they adopted one of those cheap forms they could cut under that price easily. Of that he was convinced. The proposition they wanted to put forward was this: that they could provide the whole advantages of an electrically-equipped house, and save money on the job. They could cover the whole cost of their electrical installation by the saving which they effected in the buildings. When they came to 1,000 or 500 houses of the same pattern, it was worth their while to go carefully into the plan with the architect and fix the positions in which they wanted their fixing blocks.

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NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

The "Ibsco" Battery Steamer and Still.

A simple combined pure water condensing still and generator for steaming the interior of pitch-sealed accumulators preliminary to opening them out for inspection has recently been introduced by the BAILEY-DRAKE CO., of 1,120, South Michigan Avenue, Chicago, U.S.A. The now large and almost universal use of electrically-started and lighted motor vehicles indicates that there is a corresponding scope for apparatus of this kind, at least in garages where motor vehicles are stored and maintained in running order.

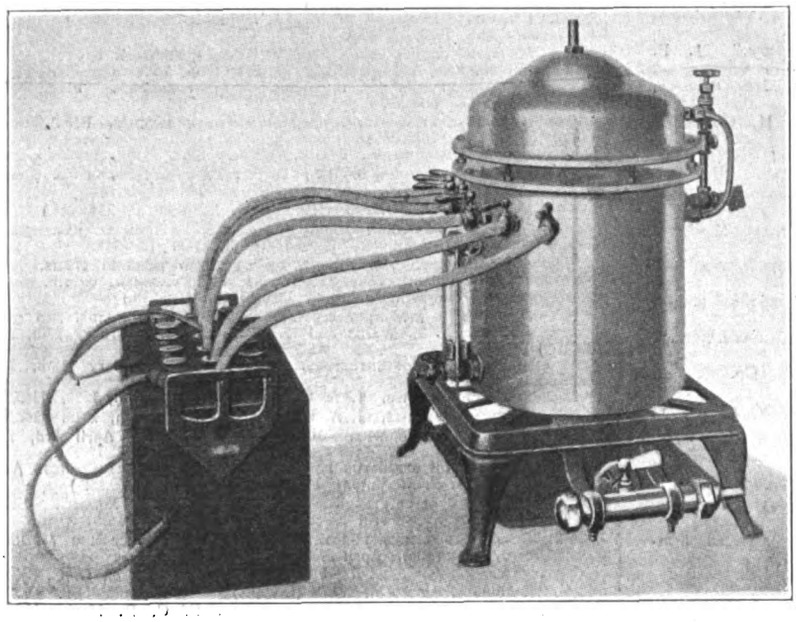

FIG. 1.—THE "IBSCO" BATTERY STEAMER AND STILL.

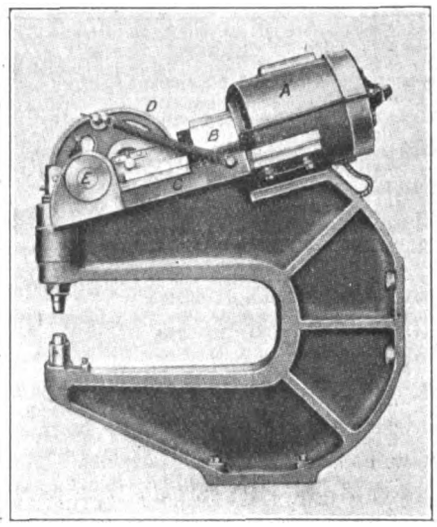

FIG. 2.—"REMCA" PATENT ELECTRIC RIVETER.

As will be seen from the accompanying illustration (fig. 1) the apparatus consists of a cast-metal base for a Bunsen gas or other burner, a generator, 18 in. by 10 in., with taps and pipes for leading into the vent plug holes of the respective cells for softening the pitch preparatory to exposing the plates, and superimposed under a cover a coil-still made up of 5 ft. of ⅜ in. soft copper tube, the combined generator and still being 21 in. high. The details are of 14 gauge seamless spun aluminium and brass. A low-pressure safety valve and level gauge glass are fitted, and provision made for hand-feeding the generator by connecting it up to a service supply. There is also a load from the still as an outlet for the distilled steam-water into a glass vessel. The weight of the apparatus ranges from 8 to 12 lb. Four varieties are made, viz., with combined steamer and still as illustrated, (2) automatic steamer without still, (3) steamer and still not automatic, and (4) the steamer only.

A Patent Electric Riveter.

The advantages possessed by the electric riveter over the pneumatic and hydraulic types are many and varied. Among them may be mentioned the absence of auxiliary apparatus, and the small power consumption leading to reduced costs. The MADA ENGINEERING CO., LTD., 12, Bevington Hill, Liverpool, are the makers of the "Remca," a very compact and efficient riveting machine shown in fig. 2. Referring to the illustration, A is a magnet with a plunger B attached to the end of which are side plates bearing three rollers. When the circuit switch is closed the plunger is attracted into the magnet, and the rollers are drawn back along a slide C, and the top roller forces a cast steel lever upwards, causing it to rotate about a pin E. The opposite end of the lever pushes down the riveting ram F, to which is attached the top die for forming the rivet head. When the power is switched off the moving parts are returned to their original position by means of springs. Tests have shown that a ⅝-in. iron rivet can be snapped up with a current of 16 amps. at 230 volts D.C. in 3 seconds. This means that one B.O.T. unit is sufficient for 300 of such rivets.

A G.E.C. Turbine-driven Alternator.

Among the plant installed at the Berthlwyd Colliery, Gowerton, by the GENERAL ELECTRIC CO., LTD., was the new turbine-driven alternator shown in fig. 3. The turbine runs at a speed of 3,000 R.P.M., and is directly connected with a 1,000-KW., 3,000-volt, three-phase, 50-cycle alternator. The power factor is .8, and the alternator will maintain a 25 per cent. overload for two hours without excessive heating. The conductor insulating tubes are of micanite moulded on to the coil. The complete coil is pushed through the slots from one end, and for this purpose one end of the coil is left straight. To prevent any movement of the conductors or coils heavy metal clamps with spacing blocks are placed round the windings. The rotor is one solid forging which gives it great mechanical strength. The rotor winding is made up of coils which are completely shaped before they are embedded in slots milled out of the solid drum. The turbine, of compact design, is of the impulse type, and the exhaust steam is dealt with by a Cole, Marchent & Morley condenser. The circulating and air pumps are driven by a 3,000-volt, 50-cycle, 3-phase "Witton" motor of 55 B.H.P.

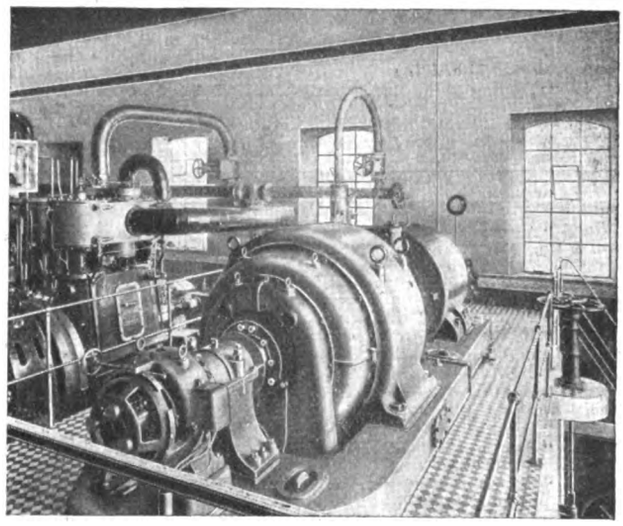

FIG. 3.—G.E.C. TURBINE-DRIVEN ALTERNATOR.

A New Squirrel-cage Rotor.

Referring to the description of their new rotor in our issue of May 14th, Messrs. Higgs Brothers write pointing out that they left the address there given some years ago; the correct address is Sand Pits and Summer Hill Street, Birmingham.

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NEW PATENTS APPLIED FOR, 1920.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by MESSRS. SEFTON-JONES, O'DELL AND STEPHENS, Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

13,487. "Electric distributing systems." F. A. ROSS. May 17th.

13,490. "Variable electrical resistance." W. MANN. May 17th.

13,491. "Electric motor controlling switchgear." C. C. GARRARD, M. SOLOMON, and W. WILSON. May 17th.

13,516. "Protective fuses for electric circuits." F. W. UREN. May 17th.

13,517. "Means for detecting and indicating defective sparking plugs." S. L. VARVEL. May 17th.

13,518. "Electric switches, &c." B. H. LEESON and A. REYROLLE & Co. May 17th.

13,538. "Thermionic devices." WESTERN ELECTRIC Co. May 17th. (United States, November 1st, 1916.)

13,552. "Spark plugs." J. BARTHA and A. E. GLASSMAN. May 17th.

13,572. "Electrodes." CHILE EXPLORATION Co. May 17th. (United States, January 21st.)

13,587. "Means for amplifying sounds of receivers or transmitters of telephones." F. H. GORDELIER. May 17th.

13,602. "Storage and supply of electrical energy." F. P. HABICHT. May 17th. (Switzerland, May 17th, 1919.)

13,622. "Operating-handles of electrical resistance boards, switchboards, &c." F. V. BREEDEN and HOCKLEY CHEMICAL Co. May 18th.

13,645. "Selecting devices for automatic telephone systems." J. E. COLLYER, E. A. PETITHORY and SIEMENS BROS. & Co. May 18th.

13,670. "Manufacture of micanite." H. HERRMANN. May 18th. (France, September 29th, 1919.)

13,671. "Manufacture of electric insulating material." H. HERRMANN. May 18th. (France, November 7th, 1919.)

13,672. "Electric insulating material and manufacture of same." H. HERRMANN. May 18th. (France, November 8th, 1919.)

13,673. "Electrical collectors, commutators, &c." H. HERRMANN. May 18th. (France, October 29th, 1919.)

13,674. "Electrical collectors, commutators, &c., and manufacture of same." H. HERRMANN. May 18th. (France, February 27th.)

13,675. "Electric lighting installations." BRITISH THOMSON-HOUSTON Co. (General Electric Co.). May 18th.

13,692. "Apparatus for regulating voltage of dynamo-electric machines." A. J. JULLIN. May 18th. (France, April 30th, 1918.)

13,694. "High-tension electric depositing-plants." SIEMENS-SCHUCKERTWERKE. May 18th. (Germany, March 31st, 1916.)

13,700. "Electro-magnetic switches." IGRANIC ELECTRIC Co. (Cutler-Hammer Manufacturing Co.). May 18th.

13,714. "Method of generation of electricity from water turbines." C. Y. LAUTH. May 18th.

13,721. "Electric faucets." H. K. CLOVER. May 18th.

13,738. "Electrical plugs." J. A. ROMER. May 19th.

13,741. "Electrical measuring instruments." A. MONKHOUSE. May 19th.

13,753. "Means for applying electricity to the soil for agricultural purposes." W. BEAN. May 19th.

13,766. "Sound indicator for protecting users of non-luminous electric heating appliances." G. H. LOFTS. May 19th.

13,767. "Electrically-heated articles." G. H. LOFTS. May 19th.

13,775. "Electrolytic separation of metals." C. LANGER. May 19th.

13,780. "Electrically-heated perforator." A. B. CAMPBELL. May 19th.

13,784. "Starting devices for internal-combustion engines." C. SETTERBERG. May 19th. (Sweden, February 10th.)

13,793. "Magnetos." D. V. L. FELLOWS. May 19th.

13,813. "Telephone exchange system." WESTERN ELECTRIC Co. May 19th. (United States, July 22nd, 1918.)

13,821. "Thermionic apparatus." F. A. GRAHAM and W. J. RICKETS. May 19th.

13,824. "Control of electric motors." BRITISH THOMSON-HOUSTON Co. and J. MARTIN. May 19th.

13,836. "Maximum demand controller and load indicator for electric power installations." D. F. CAMPBELL and C. C. GOW. May 19th.

13,839. "Contrivances for applying metal filament to carrier in electric incandescence lamps." Dr. H. NAHNSEN SPRENGESTOFFEWERKE & Co. May 19th. (Germany, August 11th, 1919.)

13,841. "Trunk circuits for automatic, &c., telephone systems." AUTOMATIC TELEPHONE MANUFACTURING Co. May 19th. (United States, September 18th, 1919.)

13,861. "Incandescent gas burners, electric glow lamp holders, &c." A. C. JONES, MESSENGER & SON, and S. P. STUBBS. May 20th.

13,867. "Accumulator cases." H. R. RICHARDSON. May 20th.

13,873. "Electric contacts." J. B. TUCKER and J. H. TUCKER & Co. May 20th.

13,895. "Automatic telephone systems." D. A. CHRISTIAN and SIEMENS BROS. & Co. May 20th.

13,905/6. "Duplex electric welding machines." J. LEDWINKA. May 20th.

13,909. "Jigs for electrically welding automobile bodies, &c." J. LEDWINKA. May 20th.

13,912. "Transformers." J. LEDWINKA. May 20th.

13,913. "Method of electrically welding galvanised metal sheets, plates, &c." J. LEDWINKA. May 20th.

13,928. "Polarised electric bell." A. FISK. May 20th.

13,931. "Systems of electric control." BRITISH THOMSON-HOUSTON Co. (General Electric Co.). May 20th.

13,934. "Telegraph and telephone systems." I. HORTIX. May 20th.

13,947. "Electric switches." W. A. COATES and METROPOLITAN-VICKERS ELECTRICAL Co. May 20th.

13,955. "Electric accumulators, &c." GREENWOOD & BATLEY, H. LEITNER and G. E. WOOD. May 20th.

13,968. "Apparatus for detecting or translating electric impulses." RADIO COMMUNICATION Co. and J. SCOTT-TAGGART. May 20th.

13,969. "Dynamo-electric machines." P. H. H. JANTZEN and SIEMENS BROS. DYNAMO WORKS. May 20th.

14,015. "Electric motor car lamps, &c." E. G. SANGUINETTI. May 21st.

14,031. "Holder for sparking plugs." BURNS & Co., J. BYRNE and O. DEUTSCH. May 21st.

14,038. "Electric signalling means." W. P. THOMPSON (Soc. Francaise Radio-Electrique). May 21st.

14,043. "Wireless directional systems." J. ROBINSON and R. T. SMITH. May 21st.

14,067. "Non-conducting supports for electrical accumulator plates." H. LEITNER. May 21st.

14,093. "Electric heater for liquids." E. C. R. MARKS (Langguth & Heur). May 21st.

14,097. "Receiving electrical undamped continuous oscillations, &c." SVENSKA RADIOAKTIEBOLAGET. May 21st. (Sweden, May 23rd, 1919.)

14,105. "Electrical apparatus for railway signalling." F. DOWNES and TYER & Co. May 21st.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications were printed and abridged, and all subsequent proceedings will be taken.

1916.

13,760. SIGNALLING IN WIRELESS TELEGRAPHY. H. L. d'E. Skipworth, H. Madge and H. Morris-Airey. September 27th, 1916. (Complete accep. May 31st, 1917. Patent sealed, May 31st, 1917.) (142,141.)

1918.

17,245. HIGH-TENSION CONTINUOUS CURRENT DYNAMO-ELECTRIC MACHINES. Bolliger. October 22nd, 1917. (120,883.)

1919.

1,423. ELECTRO-MAGNETIC APPARATUS FOR USE IN STEERING MOVING VEH... J. G. Gray. August 19th, 1919. (142,164.)

1,991. ELECTRICAL CONNECTIONS. H. Garde and C. G. Bennett. Jan. 27th, 1919. (142,175.)

2,038. CONSTRUCTION OF MAGNETO-ELECTRIC MACHINES. G. M. Turner. January 28th, 1919. (142,177.)

2,109. SPARKING PLUGS FOR INTERNAL-COMBUSTION ENGINES. J. K. W... and Baynes & Partners. January 28th, 1919. (142,180.)

2,121. IGNITION AND LOAD CONTROL FOR INTERNAL-COMBUSTION ENGINES. W. Bucher. January 28th, 1919. (142,182.)

2,216. DYNAMO-BATTERY IGNITION SYSTEM. F. H. Hocking and A. W. ... son. January 29th, 1919. (142,187.)

2,253. ELECTRICAL SWITCHES. T. W. A. Attwater and Southern Trans... Co. January 29th, 1919. (142,190.)

2,254. MAGNETIC CHUCKS AND OTHER MAGNETIC HOLDING-ON DEVICES. A... Norman and Southern Transport Co. January 29th, 1919. (142,191.)

2,395. IGNITION DEVICES FOR INTERNAL-COMBUSTION ENGINES. F. A. S... January 30th, 1919. (142,196.)

2,396. IGNITION DEVICES FOR INTERNAL-COMBUSTION ENGINES. F. A. S... January 30th, 1919. (142,197.)

2,492. SWITCH CONTACTS. F. J. Gill. January 31st, 1919. (142,199.)

3,047. ELECTRON DISCHARGE DEVICES. British Thomson-Houston Co. (Gen... Electric Co.). February 7th, 1919. (142,207.)

3,301. ELECTRIC STEP-BY-STEP MECHANISM. C. L. Walker. (142,211.)

3,724. APPARATUS FOR CONTROLLING THE SUPPLY OF LIMITED QUANTITIES ... ELECTRIC ENERGY. M. Anninger. February 14th, 1919. (142,214.)

3,761. ATTACHMENT TO THE TROLLEY OF OVERHEAD ELECTRIC TRAM-CARS AND OTHER ELECTRIC TRACTORS FOR FACILITATING THE REPLACEMENT OF THE T... ON THE WIRE. T. Forsyth. February 15th, 1919. (142,215.)

3,828. DOWEL FOR ATTACHING ELECTRIC-BELL COVERS, BOX LIDS AND ... SIMILAR PURPOSES. F. E. Wallis and A. E. B. Lloyd. February 17th, 19... (142,217.)

3,947. SOUND-WAVE CONCENTRATORS. A. Marr. February 18th, 19... (142,218.)

4,216. ELECTRIC SWITCHES. J. A. Crabtree. February 20th, 1919. (142,2...

4,217. ELECTRIC SWITCHES. J. A. Crabtree. February 20th, 1919. (142,2...

4,488. MULTIPLEX TELEGRAPHS. G. di L. Pestarini. April 3rd, 19... (123,758.)

5,012. SWITCHES OR APPARATUS FOR CONTROLLING ELECTRIC BATTERIES. ... & Shelvoke and H. F. Steventon. February 26th, 1919. (142,224.)

8,084. COOLING OF ELECTRIC TRANSFORMERS AND LIKE APPARATUS. ... Thomson-Houston Co. (General Electric Co.). March 31st, 1919. (142,25...

8,432. ELECTRIC SWITCHES FOR ELECTRICALLY-DRIVEN COMPRESSING APPA... C. Melano (F. Borgarello). April 3rd, 1919. (142,260.)

8,751. TELEPHONE SYSTEMS. Relay Automatic Telephone Co., L. C. Bye... and T. M. Inman. April 7th, 1919. (142,265.)

10,053. POLYPHASE ELECTRIC-HEATING FURNACES. E. C. R. Marks (... Fertiliser Works). April 22nd, 1919. (142,283.)

10,096. REGENERATIVE BRAKING SYSTEM FOR ELECTRICALLY-DRIVEN VEH... CRANES, AND THE LIKE. K. H. O. Lubeck. April 20th, 1918. (125,988.)

10,608. PROTECTIVE DEVICES FOR ELECTRICAL DISTRIBUTION SYSTEMS. ... Thomson-Houston Co. (General Electric Co.). April 29th, 1919. (142,29...

10,760. INSULATORS. British Thomson-Houston Co. (General Electr... April 30th, 1919. (142,295.)

13,663. MAGNETIC CORES AND METHOD OF MAKING SAME. B. Ames. ... 1919. (142,329.)

14,068. ELECTRIC RELAYS AND ELECTRIC RELAY CIRCUITS. L. B. Turner. ... 4th, 1919. (142,333.)

15,047. INDUCTION COILS. F. Weatherill. June 14th, 1919. (142,340.)

15,369. COUPLING FOR ELECTRIC CONDUITS, OR FOR TUBES, PIPES, SHAFTS ... THE LIKE. H. E. Hadwen and H. Willis. June 19th, 1919. (142,343.)

16,118. ELECTRIC HEATING ELEMENTS. A. Selvatico. June 26th, 19... (142,349.)

17,148. ARC-WELDING GENERATORS. H. Pollock and T. G. McKay. July ... 1919. (142,363.)

17,787. PROTECTIVE TRANSFORMER FOR PREVENTING THE PASSAGE OF CURR... OF DANGEROUSLY HIGH TENSION OVER ELECTRIC-SIGNALLING CIRCUITS. A. Pe... July 16th, 1919. (142,367.)

18,119. METHOD AND APPARATUS ALLOWING A MAGNETO, IN A STATE OF REST ... BE UTILISED FOR STARTING AN EXPLOSION ENGINE. N. Herzmark. April ... 1919. (141,008.)

18,829. HIGH-FREQUENCY ELECTRIC-SIGNALLING SYSTEMS. Western Electric ... (Western Electric Co.). July 29th, 1919. (142,371.)

19,709. TELEGRAPH SYSTEMS. Western Electric Co. (Western Electric ... August 11th, 1919. (142,375.)

19,723. MEANS OF ATTACHING THE HANDLE FOR VARYING THE POINT OF ... TO THE INTERRUPTER IN ELECTRIC-IGNITION DYNAMOS. Scintilla. September ... 1918. (132,500.)

19,725. DISTRIBUTORS FOR THE HIGH-VOLTAGE CURRENT OF MAGNETO-ELEC... IGNITION MACHINES. Scintilla. October 1st, 1918. (133,292.)

19,728. POCKET ELECTRIC LAMP. Nurmberger Metall & Lackierwaaren-F... Vorm. Geb. Bing Akt. Ges. May 1st, 1915. (131,294.)

24,618. SPARKING PLUG. G. Dubreiul and E. L. Nachon. October 8th, 1... (142,396.)

25,307. BAR-WINDINGS FOR ELECTRIC MACHINES. F. Punga and H. Ro... 4th, 1918. (133,961.)

1920.

1,216. BATTERY ARRANGEMENT FOR SMALL ELECTRICALLY-DRIVEN VEHICLES. ... Slaby. January 22nd, 1919. (138,072.)

5,136. ELECTRIC SWITCHES. J. A. Crabtree. February 20th, 1919. (Div... application on 140,180.) (142,430.)

Electrically-driven Battleships.—The super-dreadnought *Maryland*, the fourth battleship of the U.S. Navy to be equipped for electrical driving, was launched at Newport News, Va., on March 20th last. This vessel is sister ship to the *Tennessee*, launched in April, and the *California*, launched in November, 1919, at the Mare Island Navy Yard, California, and to the *New Mexico* already in commission. All four ships are similar in size and equipment. The *Tennessee* was expected to be commissioned last month.

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THE

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ELECTRICAL REVIEW.

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SCIENCE AND INDUSTRY.

Science states that Dr. Van H. Manning, Director of the U.S. Bureau of Mines, has resigned his post to take the position of Director of Research with the American Petroleum Institute, after 34 years' service. In his letter of resignation he points out that within the last few years it has been impossible for many men to remain in Government service; the competition of industry is taking the highly trained men of the scientific bureaus at salaries which the Government does not pay, or even approach.

Dr. Fred. G. Cottrell, Assistant Director, has been nominated by President Wilson to fill the vacancy; his process (based on the Lodge process) for precipitating fumes and dust is in world-wide use, but he assigned his patents to a non-dividend paying body, the Research Corporation, in order to encourage scientific research.

Prof. E. F. Nichols, of Yale University, has also resigned his post, to become the Director of Pure Science in the Nela Research Laboratory of the National Lamp Works of the General Electric Co., at Cleveland, U.S.A. He remarks that "the position offers complete freedom in the choice of research problems, and places at my unhampered disposal such human and material resources as no university I know of can at present afford. . . . The heightened opportunities of the new position are in everything else so advantageous, that the offer becomes finally irresistible."

Here is matter for earnest thought. Scientific experts are being welcomed with open arms—and purses—in the industrial world of the United States; the academic profession and the Government alike are unable to make it worth their while from any point of view to disregard the voice of the charmer. And be it noted that Prof. Nichols has a free hand to undertake *any* research in pure science that he thinks fit. This is very significant; it is not, however, surprising, for the General Electric Co., U.S.A., has proved beyond doubt that pure scientific research pays it handsomely. It would, on the other hand, be exceedingly surprising if any firm in this country adopted such a policy. We do not say this in a fault-finding spirit; we know only too well that circumstances in the past have not permitted of the adoption of so enlightened a policy. There is, however, a certain tendency to emphasise the importance of "industrial research" at the expense of "scientific research," a distinction of which we do not altogether approve; by the former is meant research which is obviously utilitarian, while by the latter is denoted research without an immediate utilitarian objective, research for the pure love of research, but obviously "research" which is not scientific is not worthy of the name.

Returning from this digression, we wish to point out that in this country also scientific men are leaving the employment of the Government and of teaching institutions for appointments in connection with industry. This is an excellent thing for industry at the moment; but it is a very serious matter for our scientific institutions in the present, and for industry in the near future. The teaching profession, always underpaid in this country in normal times, and now absolutely starved, is in danger of losing

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its scientific staff, and the students, who were never nearly so numerous as now, are in danger of being left without competent instructors. What that means to industry is only too plain.

Here again we have to face new conditions, brought about by the Great War. Industry now recognises the value of scientific training—colleges and universities are in urgent need of funds to make good the fall in value of the currency, and to provide for larger numbers of students. The key to the whole situation is, as usual, a golden one. If the universities and colleges are to be in a position to supply the demands of industry for scientifically-trained men, industry must supply them with the means. It will be a profitable investment, and the need is so pressing that delay will involve the gravest consequences.

The All-Electric House.

In our last two issues we have published articles describing, on the one hand, experience obtained by the Glasgow Corporation electricity department in the use of electricity for all domestic purposes—lighting, heating, and cooking—in two houses, over a period of one year; and, on the other, a complete installation from the source of energy to the consuming apparatus in a large country house, which, together with the estate cottages and offices, has been equipped for "all-electric" operation. These articles are of exceptional interest at the present time, when the merits of electricity are being closely scrutinised and debated by unfriendly critics, and are about to be discussed at a special meeting of the Institution of Electrical Engineers.

Regarding the latter example, it is, of course, somewhat exceptional; not many estates have at command 150 H.P. But there are many places where 10 to 20 H.P. could be obtained, and this would be ample for most requirements, with the aid of a storage battery. What can be done in this direction was well shown in the article by Mr. Thomas Smith in our issue of August 30th, 1918, in which he gave some particulars of 273 water-power electric installations carried out in 10 years in Wales by a single firm, the power developed ranging from 2 to 27 H.P. Complete records are being kept of the operation of this all-electric equipment, and we hope that eventually they will be available for publication; we understand that they are extremely interesting.

The former instance, however, is of much wider application, and deserves close study. The author, Councillor Denny, states that conclusive confirmation has been obtained of the fact that the domestic load is better distributed throughout the day, and may become far more important, than the power load, while if combined with the existing load it would greatly improve the load factor.

The advantages gained by the consumer by the use of electricity for all purposes are too well known to our readers to call for recapitulation here; they are obtained at a total annual cost for energy of £32 to £35 per house, which could certainly be reduced, as the author points out, by one-third if the domestic load were developed, and would then involve no great increase over the cost of coal and gas. We were about to say "for equivalent service," but this would be wrong; coal and gas cannot by any possibility render service equivalent to that of electricity, but they can, and do, introduce an intolerable amount of dirt, dust, labour, and pollution of the atmosphere, all of which have to be paid for in terms of health and pocket. Could these items be accurately costed, we have no doubt at all that the actual inclusive cost of the electrical supply would come below that of its grimy rivals—or rather, competitors, not rivals.

As we have said before, paper calculations regarding thermal units, &c., are incapable of demonstrating the facts in the comparison; they deal with only one aspect of the subject, and they entirely fail to take account of factors which cannot be neglected, not least of which is the great saving of labour effected by electrical methods. Public opinion does take these factors into account, and there is no room for doubt as to its verdict.

"Situations Vacant."

Last week we commented on the defects of the customary practice in connection with the filling of appointments which have been advertised in our pages, and urged that unsuccessful applicants ought not to be left in the dark as to the result of their applications. We might have mentioned that some of our advertisers in such cases notify the fact that a post has been filled, and courteously convey their thanks to those who have answered the advertisement by means of an announcement under the heading "Appointments Filled"; but human nature being what it is, the thought that our attitude was not altogether disinterested might have suggested itself to the cynical reader—if any of our readers are cynical.

We have, however, found a solution to the problem which we hope will commend itself to both advertisers and applicants. Our advertisement department has arranged to insert, free of charge, notices stating that specified appointments have been filled. An announcement to this effect appears in our advertising pages to-day, and in the interests of applicants we trust that advertisers will make use of this method of closing correspondence, which will involve the minimum of effort and expense while, we believe, fully meeting the needs of the case.

An Imperial University?

The demand of the Imperial College of Science and Technology for university status and the power to confer degrees was further pressed at a public meeting in London on Friday last; the audience consisted mainly of students, and several eminent men gave addresses in support of the claim. The Imperial College is independent of the University of London, but is recognised as a school of the University, so that its students may take the "internal" degree. It is pointed out that the diplomas of the College, while of deservedly high repute, do not carry the same weight as a University degree, which is recognised as a "hall-mark," and has a commercial value.

It cannot be denied that there is room for more than one University in London; three or four universities would not be too many for a population of seven millions. But what is a university, and what is the meaning of a university degree? It is not now given to any man to study all branches of knowledge, and even in a university specialisation is inevitable, but at least a university must provide instruction in all those subjects which are embraced in a liberal education, and afford facilities for the absorption of that general culture which is the only sound foundation upon which to erect a superstructure of specialised knowledge. Essential elements of that culture are the study of mankind, and the polish which is imparted by constant association with one's fellows in the atmosphere inherent to a university, where all are equals and comrades.

In those functions of a university the Imperial College is unquestionably deficient, at present; it makes no claim to teach the "arts," or, rather, the "humanities," a term which has been falsely arrogated to classical studies, but which in truth denotes "the highest and most harmonious culture of all the human faculties and powers" (Trench, *On the Study of Words*). We are not finding fault with the College on this score; on the contrary, we have the highest admiration and respect for it as a truly Imperial College of Science and Technology, an institution worthy of its great calling as the scientific focus of the Empire. But it is not at present organised or equipped to fulfil the functions of a university: what guarantee have we that, if endowed with authority to confer degrees upon its alumni, the new university will develop itself into a university in fact as well as in name?

That is the sole consideration which deters us from supporting the claim of the Governing body, the staff, and the students. In the absence of that development, the College will remain a College, while it becomes a pseudo-university, its degrees will be technological diplomas in disguise, and its graduates will lack breadth of culture.

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THE GLORY OF THE DAY'S WORK.

By "FEMINA."

IT is said that Walt Whitman, on seeing some labourers returning from their daily toil, exclaimed to his friends: "Ah, the glory of the day's work, whether with hand or brain!" Whatever may be thought of Walt Whitman's poetry, one cannot help feeling that it came from his heart; and as, according to an Arab proverb, he who speaks *from* the heart speaks *to* the heart, we may be sure that this utterance of his met with a ready response from all those who were working heart and soul, in any way whatever, to make America the great power in the world she is to-day. The greatest nation that this world will ever know will be the nation that feels in its inmost soul that the day's work, faithfully and conscientiously performed by every one of its people, man, woman and child, is indeed a glorious thing. This truth must be brought home to every worker, from the humblest drudge to the most gifted genius, before any nation can become in reality one of the Great Powers of the World.

The great masterpieces of the world are silent witnesses to the fact that this sense of glory existed in the past, and we have only to turn to the Old Testament to see that it was "as a burning fire" in the heart of the Jewish nation. I may quote as instances the making of the Tabernacle, the building of the Temple and the rebuilding of the Wall of Jerusalem. I suppose that in England to-day the majority of employers and workers would regard as idealistic nonsense the idea of there being any glory about the day's work—the idea of work for work's sake, for the sake of the prosperity of the industry, the prosperity of the country. They have become more accustomed to Mr. John Masefield's "ring o' roses" point of view: "Men work to get enough to eat, so that they may have strength to work to get enough to eat." Yet this glory has not really departed, any more than the sun departs from the heavens during a dense fog or a thunderstorm. It shone clear and undimmed during the war, although darkness has returned to the national soul since.

"There is no sentiment in business" we are told by both employers and employed, but then most popular catchwords are either fallacies or half-truths. We cannot afford to disregard the spiritual factor in industry or anything else, for it is the vital principle.

If this sense of glory once became general it would solve automatically many labour problems. The account in the Book of Nehemiah of the rebuilding of the Wall of Jerusalem is well worth studying by both employers and workers to-day, for it is a splendid story of a great engineering feat, a mighty effort made under great difficulty and in the face of the most strenuous opposition. We read that not only were the workers protected by armed guards, but the builders had their swords girded on at their sides and other workers had a tool in one hand and a weapon in the other. Yet the work of rebuilding the wall and restoring the many gates was finally brought to a most successful conclusion in record time. The secret of success is explained in one simple statement: "*the people had a mind to work.*" Moreover, there was a marvellous system of organisation and co-operation. The whole story makes one feel ashamed of the toluation in England s darkest hour of such treasonable tactics as the "ca' canny" policy, the limitation of output, and the exclusion from employment of the men who kept this country safe for those who stayed at home.

It is not now a question of rebuilding a city wall, but of reconstructing an entire continent—one might almost say a world. Yet where to-day shall we find men with the spirit of Nehemiah to say to those who would divert their attention from their colossal task: "I am doing a great work so that I cannot come down; why should the work cease whilst I leave it and come down to you?" And yet for want of such men reconstruction may share the fate of the Tower of Babel.

This is perhaps partly the fault of our system of education. For centuries we have been teaching our children that work is a curse—a punishment inflicted on the entire human race because of one man's sin; when we *should* have taught them that, like the other so-called curse—suffering—it is a means of salvation and redemption. As Emerson tells us: "A man's task is his life-preserver."

We also teach them to repeat glibly: "The whole is greater than its part," without showing them the spiritual meaning of this somewhat obvious statement, or its corollary—that the most infinitesimal part is essential to the completeness of the whole, or, as Kipling puts it, "The game is more than the player of the game, and the ship is more than the crew."

What we want is education for *Life*—not merely education for examinations. For this we must begin at the beginning—with the baby in the nursery school. Let us teach the child before his imagination is crushed out of him that there *is* a glory about his day's work, that it matters, and matters greatly, not only to the worker himself, but to his country and his God.

We must also get rid of the idea that there is only a glory about skilled or artistic work, and none about physical or mental drudgery. A man cannot become a skilled craftsman or an artist without serving a certain apprenticeship of drudgery. The world is learning slowly and painfully the lesson that each nation should perform its own drudgery, that it is a grave mistake to employ slave labour or foreign labour for this purpose. We are also gradually learning that it is a reproach rather than a distinction to belong to the "leisured classes." As the absolute necessity for increased production becomes more and more apparent, it is being brought home to all that, if England is to be saved from financial and national ruin, she can no longer afford to maintain idlers in her midst. Every man and every woman should have hours of work and hours of leisure. Alfred the Great was not so very far wrong when he divided the 24 hours' day into three parts—eights hours for work, eight hours for recreation, and eight hours for sleep; in other words, eight hours for useful work and 16 hours for recuperation. It is impossible to lay down general rules for the employment of leisure hours, as this depends on the kind of energy expended during the working hours; but part of the time should be devoted to the development of those faculties, talents, or powers that lie dormant during the performance of the daily round.

It has been said that labour leaders are the only politicians with vision and high ideals. But recent events and utterances seem to show that the vision is somewhat limited, and the ideals not so very high after all. The aims of Labour since the war have not reached any higher than the financial betterment of the working classes without regard to the prosperity of the industries to which they belong—the prosperity of their country so grievously afflicted by the Great War. They talk of "bringing the capitalist edifice crashing to the ground." Perhaps they do not remember the fate of Samson who brought a certain other edifice crashing to the ground. They are fond of saying that Capital is useless without Labour. May one be allowed to point out that Labour is also useless without brains to direct it and capital to finance it? In fact, Reconstruction in every direction is being hampered instead of helped by Labour. With regard to the housing difficulty the *Daily Telegraph* tells us:—

"The building trades are very much under-manned. Their numbers are less by 200,000 . . . . than they were before the war. Yet double that number of ex-Service men are unemployed at the present time, who would be very glad to join these and similar unions if admittance were not denied them. The whole country is crying out for houses . . . and yet, though tens of thousands of men are earnestly seeking work, they are shut out from the most obvious and most under-staffed field. The situation is aggravated by the decreased out-

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put of the men actually at work, and thus a situation is created which is preposterous in the circumstances and utterly incapable of defence."

There seems only one way of ending the present lamentable deadlock, and that is to make all concerned in any way in any industry realise that "a house divided against itself cannot stand," that they are members one of another—fellow-workers each doing his part in a great work, and fellow countrymen each contributing to the prosperity of his country. As long as the antagonism between Capital and Labour lasts we cannot hope to draw any nearer to the promised New Earth. "Hatred will never cease by hatred."

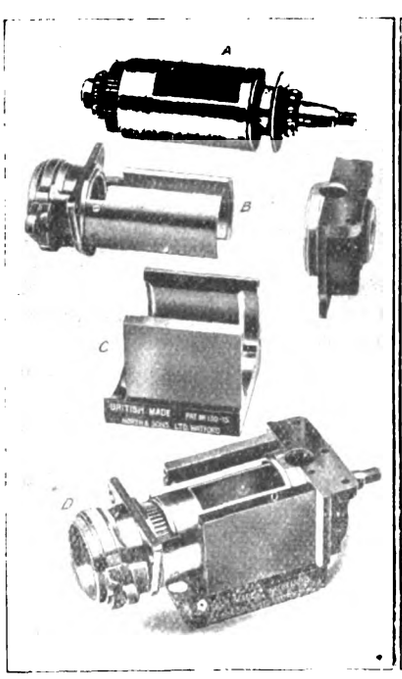
A just and at the same time practicable system of profit-sharing would, no doubt, do much to dispel the mists that at present obscure "the glory of the day's work." It has not yet been sufficiently recognised that profits are produced by the conjunction of money, brains and labour, and that any one of these factors is useless without the other two. But a greater incentive even than personal gain would be a change of heart, a change of attitude towards work, a re-kindling of that enthusiasm without which nothing great can be done.

A BRITISH MAGNETO WITH MANY DISTINCTIVE FEATURES.

By F. H. HUTTON.

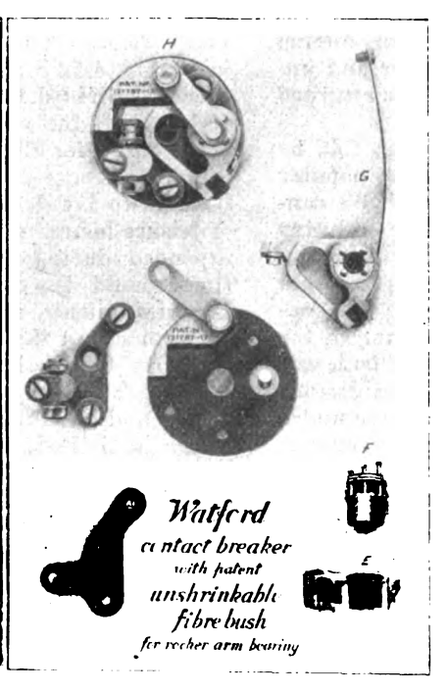
In these times it is pleasing to come across an industry which is in a thoroughly healthy state, producing machines of the very highest quality which embody many improvements over pre-war practice, and turning them out in satisfactory numbers to meet the enormous demand. A recent visit to the magneto works of Messrs. R. B. North & Sons, at Watford, showed all the foregoing remarks to be true in this instance. Being one of the firms who were up to the neck in magneto work all through the war, straining every nerve to produce machines for the arduous service then required, they can well claim that their present magnetos have come through an ordeal of fire in every sense.

A visit to these works is a real treat to anyone interested in fine engineering; the rows of beautiful little precision lathes, milling machines and grinders, the wonderful miniature automatics, &c., are an exhibition in themselves, while the foundry, a spot generally resembling a near approach to the lower regions, in this case is an apartment which might well be used as a dining hall! Such conditions, although they may not affect the design of the product, are generally to be found reflected in the class of workmanship turned out. Although a great deal might be said on this score, and on the extraordinary accuracy in the gauging of parts all through the works, it is time to proceed to details of the article manufactured—the new Watford magneto, of which the most noteworthy parts are shown in the illustrations. Briefly, the two main objects aimed at are to make the spark equally efficient throughout the whole timing range, and to improve the action of the contact-breaker by alterations in design. Dealing with the first point, we may remember that the worst fault of an ordinary magneto is that it produces its most effective spark only when the timing is set at one particular place. Since this place has to be arranged so that it suits normal running engine speeds (*i.e.*, high speeds) it follows that the correct positions for slow running and starting cannot be much used in practice. The reason is that a strong spark is only produced by the contact-breaker opening when the armature is in the most favourable position with regard to the magnets, in other words, when it is in the strongest magnetic field. These positions occur twice in a revolution, and are only momentary. The difference is made in the new Watford magneto by providing sliding pole-pieces or shoes for the magnet as shown in fig. 1, B and D. These extra pole-pieces, made of steel, are attached to the brass cam-ring, and project into the body of the magneto, fitting between the magnet itself and the armature. When the timing is altered by moving the cam-ring these extra pole-pieces move with it, the consequence being that when the contact-points open the magnetic conditions are always at their best. That is, whether the spark is timed early or late within the range provided, the spark is equal to that from an ordinary magneto at its maximum position. The idea of this improvement is admittedly not a new one, but in order to carry it out successfully the very highest class of workmanship is necessary, and to maintain this degree of accurate workmanship under the stress of ordinary commercial production is no easy task. This is the problem that Messrs. North & Sons claim to have solved. It will be realised that the sliding poles must be manufactured to the finest limits, and must maintain their position accurately under ordinary working conditions. In order to ensure this a small recess is cut in the end of the pole-shoes which engages with a spigot on the driving end-plate of the magneto, thus forming a guide and materially helping to keep the pole-shoes in place. The other parts illustrated in fig. 1 are the armature complete, the driving end-plate and the fixed pole-pieces.



A, Armature complete; B, Sliding pole shoes attached to cam ring; C, Magneto poles; D, Armature, magnet poles and sliding pole shoes assembled.

Fig. 1.—Magneto Parts.



E, Rocker (cut away to show bush housing); F, Unshrinkable fibre bush; G, Rocker with spring attached; H, Contact breaker assembled.

Fig. 2.—Contact Breaker.

The new contact-breaker, shown in fig. 2, is full of interesting features. The moving "arm" in this case consists of a triangular structure, very strong, but very light, being milled out of the solid with the greatest accuracy. The balance of this "arm" has been carefully studied with regard to neutralising the effects of centrifugal force at high speeds. An outstanding feature is the design of the fibre bush. Messrs. North & Sons are convinced that fibre is still the best material for this purpose, in spite of the alternatives which are available. They have therefore set about devising a bush made of this well-tried material which shall absolutely avoid the old trouble of swelling, and so causing the arm to bind. The result of their researches is seen in the illustrations E, F, and G, fig. 2. It will be noticed that the bush is larger than usual, that fine slits are made in certain places, and that a special

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manner of fixing is employed. It is claimed that this bush has been tried to the utmost under the worst possible conditions, and that it is absolutely proof against swelling. A buffer is provided over the moving arm to restrain the flinging action at high speeds. Other details of this interesting contact-breaker are shown in the illustration, the complete view being at the top. This design of contact-breaker, being a further improvement on the pattern used so successfully on Watford magnetos in air service during the war, is well worth attention.

LEAVES FROM AN INSPECTOR'S NOTEBOOK

By "ANODE."

One of the most interesting things in an insurance inspector's life is the examination of breakdowns. To say nothing of the uncertainty of these, it is distinctly exhilarating after a hard day's work, probably underground, to arrive at home and find a wire awaiting you, informing you of a breakdown, probably not two miles from the place you have been at all day.

I remember on one occasion receiving a wire asking me to proceed to a town some hundred odd miles away, after a journey in the corridor of a train for three hours. I left home next morning in no very amiable spirit, and on arriving at the scene of the catastrophe I found it was nothing more than a break in the shunt windings of a 2-h.p. motor. As the break was between the field coils, it was remedied in a few minutes, and naturally it did not improve my peace of mind; still it might have been worse, and for small mercies we must be thankful. Not all breakdowns, however, are so simple. Once I was out making an inspection of a large plant some distance from a station and had to hire a conveyance, and could only hire the car for the day. I did the inspection, and decided to visit a colliery some miles away, and make a part inspection at any rate. The electrician was a personal friend, both of us having worked in the same shop, so the visit was likely to be a pleasant one. On inquiring at the power house for my friend, I was informed that he was underground, and had been there for the past 24 hours, having had trouble with a 250-h.p. motor, which was insured. Now this was very awkward, as spats and light boots are not exactly healthy underground; and this colliery prided itself on its own particular and exclusive brand of slush underneath. If I had my way I would make it a criminal offence to have any colliery underground; they all ought to be on the surface, and near an important station. But we cannot always get what we want, so I had to make the best of it. I then had an idea that probably the trouble was with the pump, and not the motor, in which case my worthy colleague, the mechanical inspector, would have the jubilee. I got hold of the electrician on the 'phone and asked for the news, devoutly hoping that it was the pump. This reminds me of the occasion when I visited a friend in a hospital early one morning. He was in a bad way, and no hope could be entertained of his recovery. The nurse hoped that he would last out till 8 o'clock, and she seemed quite concerned about it. On my inquiring why she was so anxious, she calmly told me that if he died before eight she would have to lay out the remains, but if he lasted till after eight, the day nurses would have the job. I felt something like the nurse, thinking of my beautiful spats. But my luck at this part of the proceedings was dead out; it was the motor, so I reluctantly descended, and ruined my pretty spats.

On entering the chamber of horrors I was told that the trouble was overheating of the rotor, and that everything possible and impossible had been done, even to the extent of fitting new bearings and altering the taps on the starter. Now I knew this particular breed of machine. I looked very carefully at the junction of the rotor bars and short-circuiting ring, and found that the joints were black; this proved to be the trouble—resistance in the rotor circuit. My friend was not by any means pleased at the diagnosis, especially at the difference between his 24 hours and my 24 minutes.

It is surprising what a little thing will cause trouble in a motor. I well remember on one occasion being asked to look at a small motor which was sparking badly. It was an old type of machine, and had run for seven years without any trouble till then, when it started eating a set of brushes up in a week or so. I tried altering the brush position, but without effect; tested the armature thoroughly, everything correct; when I noticed that there were no flexibles on the brushes. The attendant, a new man, told me that he did not see the use of them, so he cut them off. On fitting a new set with leads on, the trouble ceased. Sometimes it is very easy to be too particular, and on one occasion I got badly let down, and my company let in for £20. At a large restaurant there was a small single-phase motor used for driving an ice-cream freezer, and the starting device was the usual phase splitter, the handle of which was missing. I pointed this out on my reports for some considerable time, until I decided that it was time my recommendation was carried into effect, so I interviewed the proprietor, and pointed out the danger of the attendant putting his fingers inside the starter to get hold of the cross bar, mentioning that 210 volts at a frequency of 93 was not healthy, and that if he had a weak heart, or status lymphaticus, there would be a coroner's inquest, and he would not come off lightly. That "status lymphaticus" fetched him, and he promised that the necessary would be done instantly, immediately, forthwith, and personally. This was on a Thursday, and on the following Monday I received a wire asking me to attend at a breakdown at this establishment. On arrival I found the motor burnt to rags and cinders. The machine was left O.K. on the Saturday night, and it was found burnt out on the Monday morning, when they opened the premises. All that I could find was that the starter was discovered to be in the running position, but the attendant was positive that he left it in the off position. In addition to having to report the details of the breakdown, I had to give the cause of it, which was not easy in this particular instance. While I was thinking it over, a cat jumped up to a window, via the starter, and in doing so it fouled the new handle, and pushed it into the running position.

Q. E. D.

SINGLE-PHASE METERS ON BALANCED THREE-PHASE, THREE-WIRE SYSTEMS.

By H. G. SOLOMON.

The use of one single-phase meter to register the consumption in a three-phase, three-wire network is still largely prevalent when the system is regarded as balanced. The method is, however, almost invariably wrong, and in many instances leads to totally incorrect results, even though the load actually constitutes a balanced load in itself. It should be entirely discarded, as it is not difficult to prove that a single-phase meter will only correctly indicate the three-phase consumption on the fulfilment of two conditions—perfect balance and unity power factor—which never obtain together in practice. These two conditions must go hand-in-hand, as however well-balanced the system may be, if a power factor less than unity be present, considerable inaccuracy dependent upon the magnitude of the power factor will ensue, apart from the characteristic errors of the meter itself.

The only proper method of measuring the consumption is the employment either of two single-phase meters on the well-known two-wattmeter connection, as indicated in the accompanying diagram, or of a three-phase, three-wire meter. The latter is simply a combination of two single-phase meter elements to form a single instrument, with one counter which registers the total consumption, and is connected in exactly the same manner as when two separate single-phase meters are employed. In the

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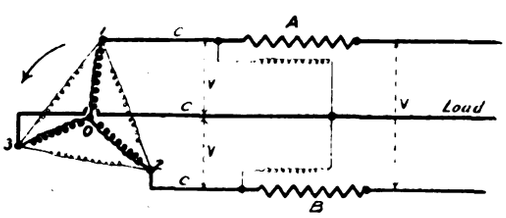
latter case the consumption is the algebraic sum of the two meter readings.

Referring to the diagram, if the phase voltages pass through their maxima in the sequence of 1, 2, and 3, then meter A will be in the leading phase, and meter B will be in the lagging phase. Since the system is supposed to be balanced, the voltages between any two of the mains will be equal to one another, and the currents in the mains will be the same. Representing the voltage and the current by V and C, as given by a voltmeter and ammeter respectively, and denoting the power factor by cos ϕ, then the mean power is—

$$P = V C \cos(\phi - 30^\circ) + V C \cos(\phi + 30^\circ) = \sqrt{3}\, V C \cos\phi.$$

Regarding the power as remaining constant over a given interval of, say, one hour, then the energy consumption in watt-hours will be represented by the same equation. The one meter A in the leading phase will read $V C \cos(\phi - 30^\circ)$, the other meter B in the lagging phase will indicate $V C \cos(\phi + 30^\circ)$, and the total consumption will be their sum, namely, $\sqrt{3}\, V C \cos\phi$.

A. Unity Power Factor.—When there is no displacement between the phase voltages and the currents, *i.e.*, when the power factor is unity, cos $\phi = 1$ and $\phi = 0$. A will thus give $V C \cos 30^\circ$, *i.e.*, $\frac{1}{2}\sqrt{3}\, V C$, B will indicate the same amount, and their sum is $\sqrt{3}\, V C$, the total consumption. It will be observed that in this case each meter, independently of whether it is in a leading or lagging phase, will register one-half of the total energy. Consequently, if one be employed, say A, connected in any one of the three-phase mains as a two-wire meter, and its dial reading be multiplied by 2, it will correctly give the total three-phase energy, but in this case only. When a single-phase meter is used in this manner, the dial reading, in general, gives



Connections of Meters.

the total amount directly, without the use of the multiplier 2, as this is taken into account in the gearing between the integrating train and the rotor spindle.

B. Power Factor less than Unity.—In this case the total energy is still $\sqrt{3}\, V C \cos\phi$, and the two meters read as before $V C \cos(\phi - 30^\circ)$ and $V C \cos(\phi + 30^\circ)$.

Suppose the load consists of a three-phase motor running at full load with a power factor of 86·6 per cent. for the given interval of one hour. Then cos ϕ = 86·6 per cent., and $\phi = 30^\circ$. The three-phase energy absorbed by the motor is $\sqrt{3}\, V C \cos 30^\circ$. Meter A shows $V C \cos(30^\circ - 30^\circ) = V C$; meter B indicates $V C \cos 60^\circ = \frac{1}{2} V C$. Their sum equals 3 VC/2 which is $\sqrt{3}\, V C \sqrt{3}/2 = \sqrt{3}\, V C \cos 30^\circ$, the total energy.

Although the load is a really balanced one, meter B, it will be seen, registers $33\frac{1}{3}$ per cent., and meter A $66\frac{2}{3}$ per cent. of the total consumption, which is simply their sum. There is, of course, nothing astonishing about this. It is merely a reiteration in different terms of the preceding statement, and is made in this way to emphasise the fact, which does not appear always to be fully realised, that, despite the balance of the system, when a power factor less than unity exists it is quite impossible from the three-phase principle for the meter readings to be equal. Their inequality does not point to a want of balance, but to an inductive load. If, therefore, the single-phase meter for three-phase balanced loads be used, for example, in the leading phase, such as A, it will read $2 \times V C \cos(\phi - 30^\circ)$, and since $\phi = 30^\circ$, its indication will be $2 \times V C$. The true amount is $\sqrt{3}\, V C \cos 30^\circ$, which is the same as $\frac{3}{2} V C$. Hence the single-phase meter when in the leading phase will be *over-registering* by $33\frac{1}{3}$ per cent. of the true amount. If connected, on the other hand, in the lagging phase as B, it can be shown in a similar manner that it will be *under-registering* to the same extent.

Next, suppose that the motor is running light, when its power factor may be of the order of 50 per cent., *i.e.*, cos ϕ = ·5, which means that $\phi = 60^\circ$. The true load is $\sqrt{3}\, V C \cos\phi$, or $\frac{1}{2}\sqrt{3}\, V C$ (C is now different in value from the full-load current). Meter A correctly gives $V C \cos(60^\circ - 30^\circ) = V C \sqrt{3}/2$, which is the total energy, and meter B gives no reading at all, as it has stopped ($V C \cos(60^\circ + 30^\circ) = 0$). Hence the single-phase meter for three-phase balanced loads in the leading phase will give $2 \times V C \cos 30^\circ$, *i.e.*, $\sqrt{3}\, V C$, which is twice the true total energy, and will thus indicate 100 per cent. high. Of course, in the lagging phase the meter will stop and not give any reading, whereas the actual total consumption is still $\frac{1}{2}\sqrt{3}\, V C$.

Even with so high a power factor as 97 per cent., which is rarely exceeded with purely lighting loads, the errors are not so negligible as they are commonly supposed to be. With this power factor the corresponding angle of lag is 14°, the true total energy is 1·68 VC, whereas, as is easily shown in the same way as in the other examples, the one single-phase meter for polyphase loads will have an error of + or − 14·3 per cent. of the total amount according as it is in a leading or lagging phase.

THE PROGRESS OF THE SPANISH ELECTRICAL INDUSTRY IN 1919-20.

In reviewing the progress of the Spanish electrical industry in 1919-20, the *Energia Electrica* places in the forefront the "transformation into Spanish of a great German electric undertaking," as it terms it, namely the Deutsch-Ueberseeische Elektricitäts Gesellschaft, under the style of the Sociedad Transatlántica Alemana de Electricidad. The transformation is due, it appears, to the exertions of the late Minister of Patronage, Don Francisco Cambó, to whom are owing other important financial and industrial innovations. The present financial situation in Germany and the enormous depreciation of the mark have forced the German company, in order to obtain capital for extensions and acquisitions of raw materials, to consider either a sale of the assets or the transformation of the company. The English and the Americans, according to the Spanish paper, contended together in offers for the many light and power concessions of the German company in the numerous cities of South America, but the outcome arrived at is owing to the exertions of Señor Cambó, and "the sympathy shown for Germany by Spain during the war." The headquarters of the new company will be in Madrid and its technical offices in Barcelona. Its capital will be 300,000,000 pesetas, a portion of which will be taken up by a Spanish group of bankers.

Besides the important event above chronicled, other noteworthy occurrences show plainly that, far from interruption of the rapid unfolding of the Spanish industry initiated some twelve years ago, that industry has continued to develop with ever-increasing speed. Passing by the 200,000,000 pesetas invested in electric installations now completed, new companies with strong capitals have been formed in the past year, to carry out already planned schemes which, it is to be hoped, will rapidly pass into the state of tangible realisation.

The Sociedad Electrica de Lima, which during 1919 raised its capital from 4,000,000 to 10,000,000 pesetas, has finished the erection of machinery for the first hydroelectric group of 8,750 KW., and has founded an offshoot, the Union Electrica Portuguesa, which, like the company of the same name in Madrid, is engaged in distributing current in Oporto, Braga, and other localities in the neighbouring country, the current being drawn from the falls of Lindoso, 12 kilometres from the frontier; it has both carried out the erection of the transmission lines to Oporto (80 km.) and completed the transformer station in that city. A Portuguese group subscribed 50 per cent. of the capital of the Union Electrica Portuguesa, the balance being put up by Spanish offshoots of the Hidro-electrica Iberica y Española, owning the Lima falls whose capacity is 20,000 H.P.

The Sociedad Hidroelectrica Iberica is continuing its works at the Cinca falls (Huesca), and to obtain further resources and to develop the Cinqueta falls (47,000 KW. from the two falls), besides the 20,000,000 pesetas of bonds raised in 1918, decided last month to increase its capital by 20,000,000 pesetas, bringing its total capital up to 60,000,000 pesetas.

The Hidroelectrica Española, prosecuting its development of the Dos Aguas falls, for which it has ordered two 23,000-H.P. Escher Wyss turbines, hopes by the end of the year to have working 20,000 H.P. of the 100,000 available.

The Sociedad Productora de Fuerzas Mortices issued in 1919 4,000 500-pesetas bonds in order to install a third electrogene

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group at its falls, already completed, of 20,000 H.P. capacity on the river Flamisell (Lerida); the greater part of its output (16,000 H.P.) is supplied to the Energia Electrica de Cataluña. This important company, whose capital is over 100,000,000 pesetas, finished in 1919 the installation at its Molino falls on the River Flamisell, its 20,000 H.P., with 40,000 H.P. from the Capdella station on the Flamisell, being supplied to Barcelona, Sabadell, Manresa, Granollers, Cornella, Badalona, Gerona, Palamos, Palafrugell and other localities in Cataluña.

The Cataluña de Gas y Electricidad, which is the oldest company supplying energy to Barcelona (having been constituted in 1843) and has a capital of 60,000,000 pesetas, continued its works at the falls of Puente Argone, on the River Esera, in 1919, where it has just started a Piccard-Pictet-Oerlikon 5,000-H.P. hydroelectric group. As this company harnessed in 1918 the Run fall, of 36,000 H.P., in three 12,000-H.P. units (the hydraulic installations and central being planned for four units, which with two groups of exciters, total 50,000 H.P. at the shafts of the turbines), it has disposable this year 41,000 H.P., which is absorbed by Barcelona and its industrial belt.

The huge Sociedad Fuerzas y Riegos del Ebro, which already disposes of 100,000 hydroelectric horse-power, has continued to prosecute its operations at the Camarasa fall at Noguera Pallaresa, without, however, installing the two groups yielding 36,000 H.P., which it expects to obtain from this installation. Similarly it has continued its operations at Electra del Viesgo on the Torina, capable of producing 10,000 to 12,000 H.P., and at the Camarmena fall (12,000 H.P.) on the river Cases, for which the machinery was ordered some months since in Switzerland. The Sindicato de Saltos de Agua del Cantabrico has continued its hydraulic operations at the group of three falls at Saja (15,000 H.P.) and bought the turbines for the equipment of an auxiliary fall of 200 H.P. to assist the works.

The Hidroelectrica de Navarra has inaugurated its works, built in the Laguna del Duque, where 1,000 H.P. is obtained from a 215-metre fall, supplying 60,000 volts to Salamanca and Penaranda; this power is capable of being raised to 6,000 H.P. by means of works already projected on the Laguna and at Trampal.

The Energia e Industrias Aragonesas Company, with a capital of 10,000,000 pesetas (formerly the Compañia Catalana de Productos Quimicos), began this year the building of a station at Biescas, and proposes to develop six falls, estimated to yield 50,000 H.P., at localities on the rivers Gallego and Ara.

The greater consumption of energy which has become noticeable in all centres of population and industry of any importance has forced electric undertakings to increase their means of hydroelectric production. Among those which have carried out works with this object may be cited the Union Electrica Madrileña, which formed last January the Electrica de Castilla, with a capital of 7,500,000 pesetas, which concern has begun works at El Jucar falls to yield 15,000 H.P., whose plant will be linked up, by a 100,000-volt transmission line, to the Falls of Bolarque which supply Madrid.

The Hidraulica del Cantabrico, 15,000,000 pesetas capital, has likewise undertaken construction, at its second fall, in order to increase to 12,000 H.P. the 6,000 H.P. now obtained at Gijon and Oviedo, at the same time acquiring the Candas fall, lines, power station, and distribution network of the Electra Asturiana.

The Sociedad Anonima Mengemor, which obtains 6,300 H.P. from its five falls on the rivers Ohanes, Quadelimar and Guadalquivir, issued in January last bonds for 7,500,000 pesetas to continue the works at its El Carpio fall, to yield 7,000 H.P., which will be absorbed in the provinces of Cordoba and Jaen.

The Compania Sevillana de Electricidad is developing the fall of Las Buitreras, affording 5,000 H.P. at Cortes de la Frontera (Malaga) to supply the Andalusian capital.

The Sociedad Electricas Reunidas de Saragoza has begun the operations of development of a 6,000-H.P. fall on the Gallego river.

Lastly, the Electro Industrial Coruñesa, owner of the Capela fall on the River Eume, is increasing its hydroelectric installations in presence of the growing calls of its clients in La Coruna and El Ferrol, where the lack of electric current, as also in Vigo, is principally owing to the great impulse given to maritime constructions. More than the 11,000 H.P. to be supplied by the works on the River Tambre now under construction will certainly be required by the Electra Popular de Vigo y Redondela to meet the demands of its customers.

Among the various concessions of water rights are worthy of mention (apart from the 300,000-H.P. scheme of the Sociedad Hispanoportuguesa) that recently secured by the Electra de Viesgo, of 55,000 H.P. on the River Sil. Its objective is mainly the development of mining operations in these regions. For this purpose it has further acquired the assets of the Energia Electrica de Asturias, with its Casomera fall yielding 2,000 H.P., and intends to acquire others.

Passing to electric traction, it may be mentioned that last year was opened to the public the first section (four kilometres) of the north to south line of the Madrid Metropolitan; following which are those of Barcelona and Bilbao, already under construction. There has been inaugurated the last section (Rubi to Tarrasa—9,242 metres) of the Barcelona to Tarrasa railway, which makes a total of 29.6 kilometres. Electricity has replaced animal traction on the Irun to Fuenterrabia tramway. Service has begun on the Vigo to Porrino tramway, the first section of the Vigo to Mondariz line, and a junction has been made at Pinos Puente with the Granada suburban system, owned by the Tranvias Electricos de Granada, which has an extent of 45 kilometres.

What has been said above justifies fully the statement, says the *Energia Electrica*, that the past year has seen a remarkable spurt in the Spanish electrical industry, the most noticeable feature of which has been the absorption of large capitals and the amalgamation of companies. No one can doubt that power is produced much more economically from the large hydraulic works than from the medium-sized or the small, hence these enlargements are more advantageous for the industry and the country.

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

A New Earthing Clip.

An ingenious and effective earthing clip has been brought out by the METALLIC ELECTRICAL ENGINEERING CO., LTD., of 153, Corporation Street, Birmingham. It is shown in the figure, which explains itself. The clip is made of brass, and

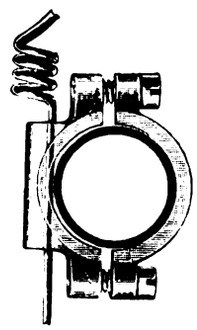

FIG. 1.—"METALLIC" EARTHING CLIP.

a sample before us shows that there is plenty of metal in it. No soldering is necessary, and the earth lead is firmly held. Five sizes are made, to fit tubes from ⅜ to 1 in.

A New Switch.

An ingenious tele-switch intended to replace the ordinary two-way switch, and to enable lamps to be controlled by means of pushes and bell wire, has been introduced by Messrs. J. CALVETTE, LTD., 11, Little St. Andrew Street, St. Martin's Lane, London, W.C.2. The switch itself is shown in fig. 2, and a diagram of connections indicating the general principle in fig. 3. It will be perceived that the tele-switch which controls the lamp or lamps is composed of a vertical electro-

FIG. 2.—CALVETTE TELE-SWITCH.

magnet with the poles extended horizontally, with a movable armature A pivoted to the lower pole. The electro-magnet is energised by means of a single dry cell, and the circuit is completed by push buttons, which can be fixed in any number of positions. If, for instance, the armature of the tele-switch

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is in the left-hand position as shown in fig. 2, and one of the buttons is pressed, the armature will take up the vertical position between the poles, and the small catch to be seen near the top of the armature will fit into the slot just beneath it, but when the push button is released, the armature falls to the right and closes the spring contacts seen in fig. 2, causing the lamp to be switched on. On again pressing the same button, or one of the other buttons, the armature is again acted upon by the electro-magnet and moved into line with the poles, thus opening the contacts, and when the press button is released, the armature falls to the left. Thus lamps can be controlled at any point where the press buttons are fixed, and bell wiring can be used instead of the more expensive electric light wiring enclosed in tubing or casing. Any number of pushes can, of course, be used, and the tele-switch can control a number of lamps, a fan, motor, or any other electrically operated apparatus, the only variation in the design necessary being that when heavy currents have to be dealt with mercury contacts B are used instead of the spring contacts illustrated. With a separate tele-switch connected in each pole of the main supply circuit it is possible to extinguish the whole of the lamps in a building simply by pressing a button. For hotel lighting this tele-switch is particularly useful, for pushes can be fixed outside doors in passages, in rooms, or pear-shaped pushes can be suspended near beds. All the lamps on staircases can be controlled by a push button at the street door, and if desired by similar pushes on each landing. There are many possible applications of the switch. When it is used in conjunction with a clock movement and battery circuit, electric signs can be controlled in various ways, and the switch can also be employed with advantage for controlling stage lighting. The tele-switch can, of course, readily be applied to existing installations. There is nothing that is liable to get out of order, and as low voltage bell wiring is used for the control circuits, the erection of the wiring is greatly facilitated and extreme neatness easily secured.

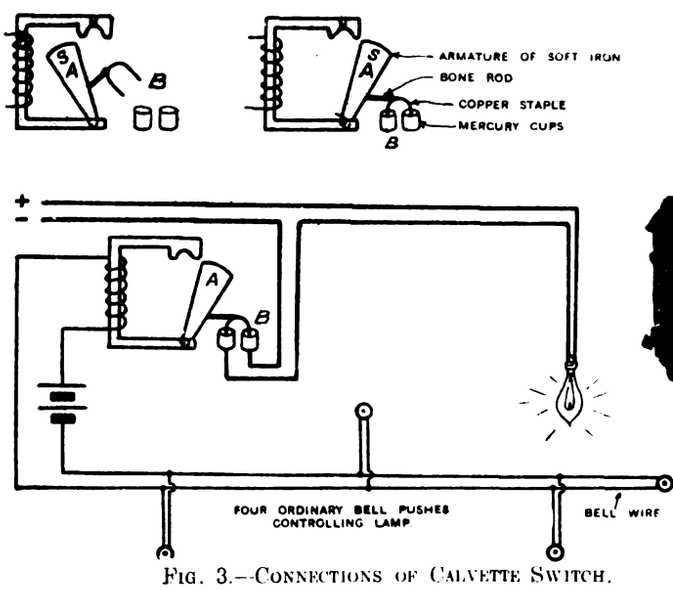


FIG. 3.—CONNECTIONS OF CALVETTE SWITCH.

Melbourne Railway Signalling Gear.

A new form of switchgear, specially designed for signalling circuits, is shown in the accompanying illustrations, figs. 4 and 5. This, in itself, is a complete small power-station switchboard, consisting of two generator and two outgoing feeder panels. The switches are for 30 amperes, 2,000 volts. The busbars also are completely enclosed, and are run in solid with compound. For synchronising purposes potential transformers are required with each panel, and these, as shown in the figures, are carried at the back of the busbars, where they are plugged in a similar way to the switches. Fig. 4 shows one potential transformer in position with the tank on, and another with the carriage drawn out and the tank lowered. It is claimed that the interlocking features of this gear are very perfect. It is impossible, without interference with the mechanism, to lower the tanks to get access to the conductors until the switches are drawn out and therefore safe to handle. Moreover, the switch or potential transformer may not be plugged in until the tank is reinstated in its correct position, thus ensuring great safety to the operators. The diagram, fig. 6, shows the connections of two panels, which form part of one of three inter-connecting boards. The apparatus was made by MESSRS. A. REYROLLE & CO., LTD., of Hebburn-on-Tyne.

G.E.C. Oil-break Switch.

Among the appliances illustrated in a recently published catalogue listing high tension switchgear manufactured by the GENERAL ELECTRIC CO., LTD., 67, Queen Victoria Street, E.C.4, is an oil-break switch with an ammeter attachment for mounting on a wall. This switch is suitable for three-phase circuits, and is fitted with two overload releases and time lags. The maximum current the apparatus will carry is 60 amps., and the overload trip coils can be wound for normal currents of 10, 30, and 60 amps. Fig. 7 shows the complete switch and attachment, and fig. 8 illustrates details, the tank and cover being removed.

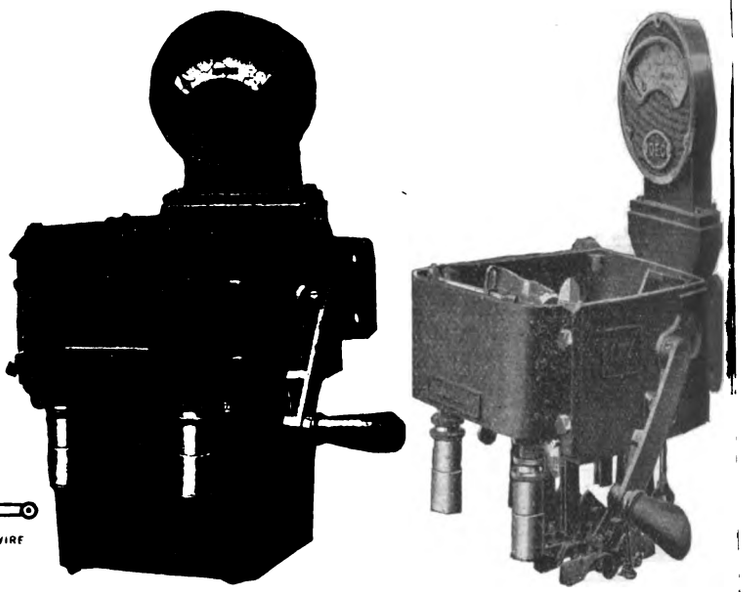
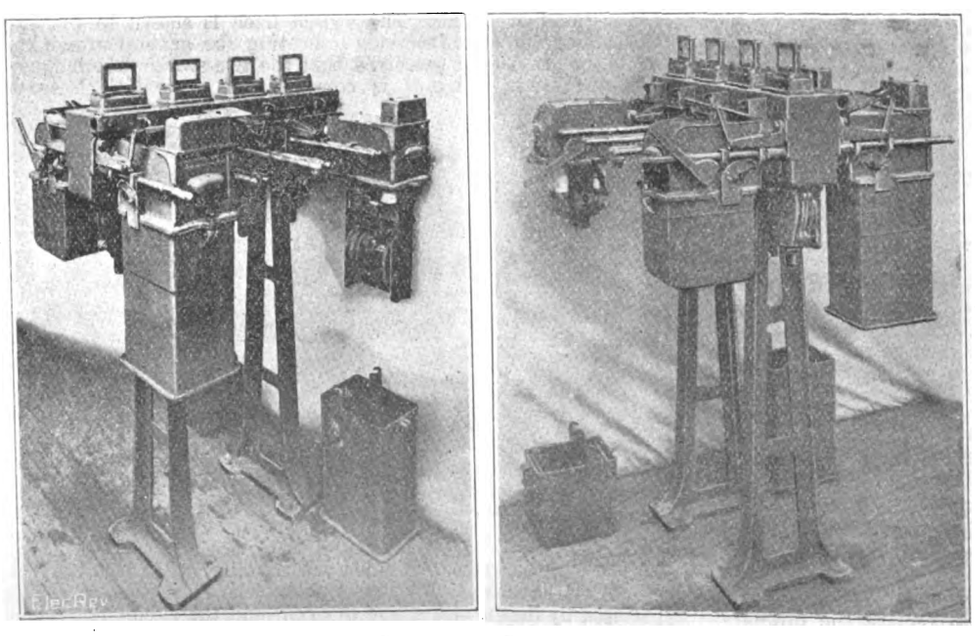


FIG. 7. G.E.C. OIL-BREAK SWITCHES. FIG. 8.



FIGS. 4 AND 5.—REYROLLE SIGNALLING SWITCHGEAR, SHOWING SWITCHES AND TRANSFORMERS IN POSITION AND DRAWN OUT.

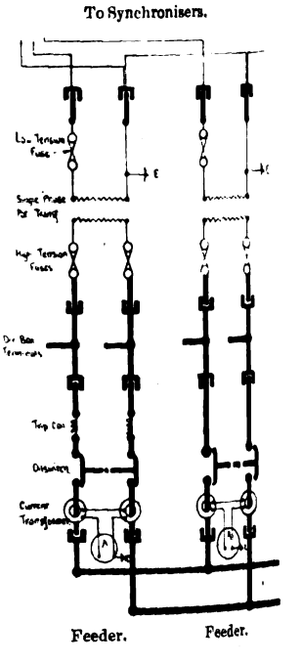


FIG. 6.—DIAGRAM OF CONNECTIONS OF TWO PANELS.

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LEGAL.

British Thomson-Houston Co. and Duram Litigation.

In the Chancery Division on Friday Mr. Justice Astbury heard a summons taken out by the plaintiffs in this action. Plaintiffs in their action allege infringement of their patent for the manufacture of tungsten filaments for electric lamps. The validity of the patent is denied by the defendants, and the infringement is put in issue. The summons of the plaintiffs was that they might be at liberty by their general managers, solicitors, and scientific witnesses to enter the premises and works of the defendants at Hanwell and to inspect work, and examine the process used by the defendants for the manufacture of their drawn tungsten wire. Defendants opposed inspection, and set up a secret process.

Sir A. Colefax, K.C., Mr. J. Hunter Gray, K.C., and Mr. Trevor Watson appeared for the plaintiffs; and Mr. T. Terrell, K.C., Mr. Kerby, K.C., and Mr. Courtney Terrell for the defendants.

His Lordship, in deciding the question raised by the summons, said the circumstances under which inspection ought to be ordered in this case and the safeguards which ought to be imposed required to be most carefully considered. Defendants set up a secret process, and it was obvious that there was a difficulty where a secret process was set up in infringement actions of this character to devise a course which would do real and substantial justice to both parties without doing a grave injustice to either. He was not prepared to accept entirely the view expressed in the expert evidence submitted. The specification of plaintiffs' patent was a long and intricate one, and apparently was for an improvement in certain earlier processes in patents of 1906 and 1907, and there were five claims. He had suggested that before deciding whether inspection was or was not necessary the defendants should answer candidly and plainly a series of interrogatories to be delivered by the plaintiffs, with the object of asking defendants as to each step which in their judgment was indicated and protected by their own letters patent. This defendants had offered to accept, and they had also offered to give a full admission that they produced their tungsten rods under heat, and that the rod was drawn down by successive stages to the finest wire. Plaintiffs were desirous, however, of having an inspection at once, but having regard to the defendants' expressed willingness to answer questions which the plaintiffs would be permitted to frame as they were advised, he proposed to allow the summons to stand over until after he had seen the answers which the defendants were willing to make to the plaintiffs' questions.

CORRESPONDENCE.

Letters received by us after 5 P.M. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Wiring Small Houses.

In the Electrical Review of May 7th there is an interesting letter from Mr. Inch on the wiring of small houses, dealing with the American method, in which no tees or elbows are used, the tubing being looped from point to point.

It would be very interesting if Mr. Inch would give further details of this method of wiring, particularly as many small houses are now being wired.

Installation.

June 1st, 1920.

"Situations Vacant."

I have just one little quota to add to the testimony of those who decry the use of box numbers by advertisers of vacant situations.

Recently I applied for a vacancy advertised under a Box No. in your journal. Being one of the very humble fry in this most excellent of all professions (or callings), I am in the habit of receiving many dismal reminders of my insignificance; especially subject am I and are mine to the snubs of those who by fortunate circumstance have climbed from among us. But there was one thing we would not stand, and that was a starvation wage, so we became members of a trade union, and thereby increased our remuneration doublefold, as well as established a fixed schedule of wages for our class of employment.

There are many economically minded chiefs who have very narrow views of what is adequate remuneration for their staffs, and who do not scorn the use of any method which will allow them to escape their obligations.

In reply to my application, I received a request to attend for an interview. This I did. At the interview I was offered a wage about 17s. 6d. per week less than the standard schedule rate, under the specious plea that the appointment was probationary—probationary for an undefined period.

I submit that the Box No. was used as a deliberate cloak to hide the identity of the advertiser in order that this individual might perpetrate his meanness undiscovered. To suggest a probationary period at less than standard wages to skilled, trained men of over 20 years' experience, is something which would not be done by the engineer and manager of a London municipal undertaking in an open public advertisement.

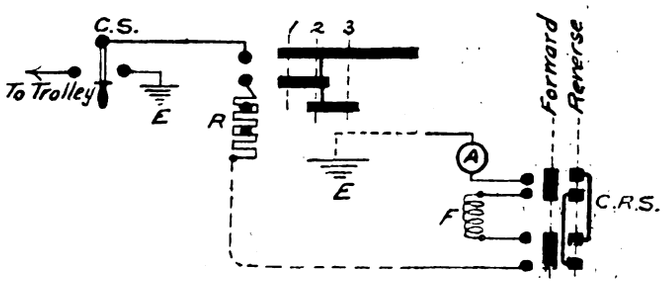
F. N. K.

June 7th, 1920.

Emergency Braking.

In your issue of the 21st May Mr. C. E. Slack asks if anyone can suggest a simple method of using regenerative control for emergency braking, with one motor defective and cut out of circuit. I cannot think of any means to this end without some addition to the wiring, and herewith offer the simplest method which has occurred to me. Either a two-way canopy switch or an additional one-way switch would be required; if the latter, it would preferably be interlocked with the canopy switch, so that both cannot be closed together.

The following sketch will probably explain my idea:—



C.S. = Canopy switch. A. = Armature.
R. = Grid resistance. F. = Series field.
C.R.S. = Controller reversing switch.

To obtain braking effect:—

1. Throw C.S. across to other contact. "Notching" arm of controller, of course, must be at "zero" position.
2. Pull reversing handle back.
3. Move "notching" arm carefully up on the *series* notches; the last notch will not be reached, as some resistance will always be required in circuit, at least until the speed has dropped to a low value.

I have not shown all of the main drum of the controller, but instead have dotted the leads to denote that other switches and apparatus lie between the canopy switch and the reverser, and also between the armature and ground.

As no alterations are required on the controller wiring or contacts, &c., this will not confuse anybody.

W. G. Stuart.

Trethomas, *May 26th*, 1920.

An A.E.G. Turbo-Alternator.

May I be allowed the hospitality of your columns to bring to the notice of those interested in the electricity industry the proposal of the electrical engineer for the Newport (Mon.) Corporation Electricity Department to place the order for repair to, and a new rotor for, the A.E.G. turbo-alternator installed at the power station with the A.E.G. of Berlin?

It would be interesting to know if our own manufacturers have been asked to quote for this work.

It may be that there are special features connected with this machine which make it essential to have the "Jerrys" on the job.

If such be the case, the quicker this machine is put out of commission the better, and replaced with one of British manufacture, made and capable of being repaired, if necessary, by British labour.

British.

The London Hospital.

Probably many of your readers have seen my recent letter in the *Times*. The London Hospital—the biggest in England and in London's most crowded corner—is on the rocks.

A few days ago we could not pay our week's bills, and we are still faced with the tragedy of closing.

The week's bills require £4,000, and I am thankful to say I have received two cheques for that amount from two gentlemen in the City—who prefer to remain unknown—each undertaking the upkeep for one week.

This way seems to lie salvation.

May I appeal to anyone whose business is flourishing to keep the whole hospital for a week? Failing that for a day or an hour—not a difficult calculation!

Knutsford,
Chairman.

Whitechapel.
June 5th, 1920.

E

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ELECTROLYTIC CAUSTIC SODA-CHLORINE CELLS.*

The principle of the electrolysis of brine for the production of caustic soda and chlorine is exceedingly simple. On the passage of a current of electricity through a solution of common salt chlorine gas is evolved at the anode, or remains dissolved in the liquid surrounding it, while at the cathode hydrogen is liberated and caustic soda is formed. Owing, however, to the secondary reactions which ensue the primary products of electrolysis are not available in a simple cell to the extent theoretically possible. In consequence numerous modifications have been introduced with the object of eliminating or controlling these secondary reactions.

If it were possible to remove the chlorine, caustic soda, and hydrogen as rapidly as they were formed, no current would be used in the secondary reactions, and the ampere-hour efficiency would be 100 per cent. In other words, each ampere-hour would yield 1.3220 gm. of chlorine, 1.4910 gm. of caustic soda, and 0.03759 gm. of hydrogen. In actual practice the ampere-hour efficiency ranges from 90 to 98 per cent.

The energy efficiency depends upon both the current and the voltage of the cell. The cell voltage comprises two parts, the voltage required to decompose the solution and the voltage necessary to overcome the resistance of the solution and of the electrodes. The decomposition voltage of brine is approximately 2.3 volts, and no current will pass through the cell until the applied voltage exceeds this value. The usual operating voltages are from 3 to 7 volts per cell dependent upon the design, temperature, and current density. With a cell having 100 per cent. ampere-hour efficiency operating at a pressure of 2.3 volts the energy efficiency would be 100 per cent. In practice the energy efficiency is between 30 and 75 per cent. The difference in the voltage of different cells depends almost entirely upon the current density and the length of the current path in the electrolyte. This is due to the fact that the resistivity of a 25 per cent., or nearly saturated, brine solution is 1.76 ohms per inch, or 2½ million times that of pure copper. Consequently a great area of electrolyte and a short current path are required to avoid an excessive voltage drop.

Of the electrolytic chlorine cells in commercial operation the *diaphragm* type is the most satisfactory at present on the market. In this type a porous partition, usually consisting of a moulded asbestos compound, separates the anode and cathode compartments, and the flow of the electrolyte itself is made to oppose the passage of the caustic soda to the anode compartment. The gases, chlorine and hydrogen, accumulate above the surface of the electrolyte and are readily drawn off. The caustic soda is removed from the cathode partially by the flowing salt solution and partially by gravity.

The earliest successful diaphragm cell was the Griesheim, first used in Germany in 1890. In this cell an iron container serves as the cathode. The anodes are plates of magnetic iron oxide, and the diaphragms formed of a composition of salt, cement and hydrochloric acid compose the walls of the box-shaped anode compartments. In use the salt dissolves and leaves a very fine porous wall. These cells are steam-jacketed, and the temperature of the electrode is kept between 80 deg. C. and 90 deg. C. The anode current density is from 10 to 20 amperes per square foot.

Of the diaphragm cells in use may be mentioned the Hargreaves-Bird in England; the Finlay in Belfast; the Gutheniu-Chalandre extensively employed in France, Switzerland, and Spain; the Billeter-Leykam in Austria; the Townsend, Le Sueur's, Billeter-Siemens, Allen-Moore, Wheeler, Jewel, and Nelson in the United States of America.

The largest single chlorine plant in the world is the U.S.A. Government plant at Edgewood Arsenal, Baltimore, where over 8,500 Nelson cells are installed for the production of 100 tons of chlorine gas per 24 hours. This plant was installed during the war in four months. In fig. 1 is given an illustration of the Nelson cell embodying the latest improvements. The body of the cell consists of a rectangular tank of ¼ in. steel plate in which a U-shaped cathode of perforated sheet steel is mounted, and acts as the form for the anode compartment. The cathode supports the asbestos diaphragm, and the U-shaped anode compartment is closed at the ends by blocks of cement mortar. The top of the anode compartment is closed by an inverted rectangular box of slate slabs which support the graphite blocks that form the anode proper. The anode blocks are 4 in. by 4 in. by 17 in., and the lugs are 2½ in. in diameter by 12 in. long. They are specially treated, with a consequent increase in their life of more than two years, and they have but one joint, which ensures maximum conductance. The cells are fitted with an automatic feeding device which is simple and has proved reliable in service. It consists of a float on which is mounted a dull knife edge which presses against a piece of rubber tubing through which the brine is supplied to the cell. The slightest rise of the float cuts off the feed entirely, and the smallest drop permits the flow to start again. No trouble is caused by dirt in the brine, as it is purified before passing into the cells, it being essential in the operation of a chlorine cell for iron, alumina, lime, and magnesia to be excluded. The rate of percolation of the brine through the diaphragm is kept uniform by means of steam in the cathode compartment, and this steam also assists in dissolving the caustic soda formed at the cathode as well as in heating the cell, and thus reducing its resistance. Should the pores of the diaphragm begin to close, due to the presence of excessively strong caustic liquor, they can be freed by increasing the amount of steam.

The normal operating period between renewals of the diaphragm is from six to eight months, and during this period the operating conditions remain practically constant. The cells are rated at 1,000 amperes, at which current the most efficient results are obtained, although they can be run as low as 600 amperes without serious loss of efficiency, and will stand a continuous overload of 10 per cent. without damage to the plant or product. The voltage drop is from 3.5 to 3.8 volts with a usual average of 3.7 volts over six months. Plant records show about 90 per cent. ampere-hour efficiency and a 60 per cent. energy efficiency. One of the best features of the cell is that it can be shut down either accidentally or intentionally for short or long periods as often as desired without damage to the cell or serious loss of efficiency. When operated at 1,000 amperes these cells are guaranteed to produce 60 lb. of chlorine and 68 lb. of sodium hydroxide per cell per 24 hours when supplied with a brine solution not exceeding 120 lb. of salt.

In the *mercury* type of cell anodes of carbon with a cathode of mercury are used. The sodium liberated by electrolysis amalgamates with the mercury, and the amalgam is transferred mechanically to an adjacent compartment containing

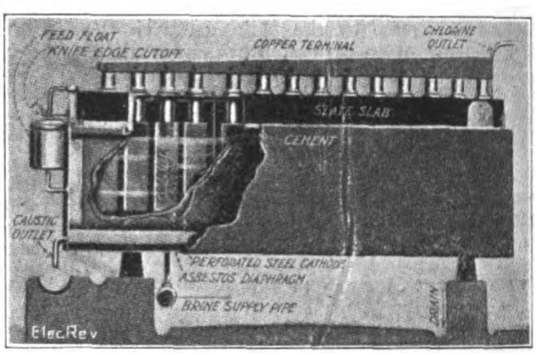

Fig. 1.—The Nelson Electrolytic Cell.

water, by which it is decomposed. Sodium hydroxide is formed with the evolution of hydrogen, and the mercury is freed, and is returned to the electrolytic chamber. The chlorine is collected above the anodes, and the caustic soda so formed is very pure.

In England the Castner-Kellner cell was an early representative of this type. Although the efficiencies are good the initial cost is extremely high. A plant having a capacity of one ton of chlorine per day would contain about 13,000 lb. of mercury. Other mercury cells are the Solvay-Kellner, the Rhodin, and the Wildermann.

The many advantages of the mercury cell are offset by the comparatively large capital outlay involved, and the large floor space required, coupled with the difficulty of removing the impurities from the mercury. The high fixed charges can only be compensated for by low energy costs, so that the mercury cell would appear to be restricted to regions of cheap electric power.

With the *bell* process no diaphragm or mercury is used; the partial separation of the caustic soda and salt solutions is effected by gravity. A bell of non-conducting material coated on its outer surface with sheet iron forms the cathode, and is supported in an open tank. Inside the bell a horizontally surpended carbon plate acts as the anode from which the current flows down through the salt solution, which is fed into the anode compartment, under the edge of the bell and up to the cathode. The chlorine evolved is drawn off through an opening in the top of the bell, and the heavy caustic soda formed at the cathode sinks and is drawn off at the bottom of the tank. The sodium chloride drawn off with the caustic soda crystallises out on concentration of the caustic soda by evaporation. In practice a tank contains 25 bells operating in parallel. Modifications of the original Aussig cell are the Jewell and the Jenkins.

The bell cells are free from diaphragm troubles, reliable in operation, and have small capital and maintenance costs, but they take up a large amount of room, and their energy efficiency is low.

Electrolytic chlorine plants constitute a load of the most attractive type for central stations. For many types of cells the steady amperage at low voltage may be taken directly from a rotary converter at the available pressure, say 110 to 500 volts. For example, cells using 1,500 amperes at 3.5 volts could be connected 30 in series on 110 volts, in which

* *Chemical and Metallurgical Engineering*, Vol. 21, No. 2, pp. 69-72 and Vol. 21, No. 3, pp. 133-136. Abstract.

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case the required converter capacity would be 165 KW. Such a plant would produce, say, 2,880 lb. of chlorine per 24 hours. Voltage regulation is unnecessary. In addition, such a plant, equipped with the proper type of cell, would permit of off-peak operation.

The increasing demand for chlorine, its numerous products and by-products must lead to the development of a recognised standard type of cell comparable in efficiency; durability, and ease of operation with other electrical apparatus. This ultimate type of cell will doubtless have an energy efficiency above 80 per cent.; it will operate with little attention; it will be unaffected by any interruption in the electrical supply; its elements will, as in the case of the storage battery, require but infrequent renewals; and ordinary impurities in the salt and water will produce no effect upon its efficiency, and will be periodically removed as simply as a boiler is blown off.

That a wonderful expansion is assured to the electrical chlorine industry in the immediate future is an undeniable fact, and is one which cannot fail to attract the closest attention, not only on the part of the chlorine manufacturer and the industrial engineer, but those in charge of electricity supply.

TIDAL POWER.

So far no tidal power development of any appreciable size has been carried out, although the idea is an old one. The present high cost of fuel and water power development in general has, however, revived interest in the subject, and the commercial possibility of such schemes is at the moment receiving serious consideration both in this country and in France. According to an article on the subject in the June 3rd issue of *Nature*, from which the following particulars are derived, the power which may be developed from a tidal basin of given area depends on the square of the tidal range, and since the cost per H.P. of the necessary turbines and generating machinery increases rapidly as the working head is diminished, the cost per H.P. of a tidal-power installation, other things being equal, will be smallest where the tidal range is greatest. It is for this reason that the western, and especially the south-western, coasts of Great Britain, and the western coast of France, are particularly well adapted for such developments, since the tidal ranges are greater than in any other part of the world, with the possible exceptions of the Bay of Fundy, Hudson's Bay, and Port Gallelos, in Patagonia.

In Great Britain the highest tides are found in the estuary of the Severn, the mean range of the spring tides at Chepstow being 42 ft., and of the neap tides 21 ft. In France the maximum range occurs at St. Malo, where it amounts to 42.5 ft. at spring tides, and about 18 ft. at neap tides. The tidal range in the Dee is 26 ft. at springs, and 12 ft. at neaps, while the mean range of spring tides around the coast of Great Britain is 16.4 ft., and of neap tides 8.6 ft. The article briefly outlines and compares the five most promising schemes of development that have been suggested, and goes on to point out that the great difficulty in developing a tidal scheme as compared with an orthodox low head water-power scheme arises from the relatively great fluctuations in head. In the case of the Severn, for example, the working head at springs would be twice as great as at neaps, and the energy output per tide would be four times as great at springs as at neaps, while at St. Malo the output would be 5.5 times as great at springs as at neaps.

Not only is the installation subject to this cyclical fluctuation of head, but in any simple scheme the turbines also cease to operate for a more or less extended period on each tide; and this idle period will gradually work around the clock, and will, at regular intervals, be included in the normal industrial working day.

In any installation, then, designed for an ordinary industrial load, unless the output is cut down to that obtainable under the minimum head available at the worst period of a neap tide, in which case only a very small fraction of the total available energy is utilised and the cost of the necessary engineering works per H.P. will, except in exceptionally favourable circumstances, be prohibitive, some form of storage system forms an essential feature of the scheme.

Various storage systems have been suggested. Electrical accumulators must be ruled out, if only on account of the cost, and the same applies to all systems making use of compressed air. The only feasible system appears to consist of a storage reservoir above the level of the tidal basin. Whenever the output of the primary turbines exceeds the industrial demand, the excess energy is utilised to pump water into the reservoir, and when the demand exceeds the output from the primary turbines it is supplied by a series of generators driven by a battery of secondary turbines operated by the water from the storage reservoir.

Evidently this method is available only when the physical configuration of the district affords a suitable reservoir site within a reasonable distance of the tidal basin. Unfortunately also considerable losses are inevitable in the process. Where two tidal schemes at some distance apart differ sufficiently in phase, it is possible to work the two in conjunction, but this does not affect the necessity of storage as between spring and neap tides.

The prospects of tidal-power schemes would be much more promising if the whole of the output could be utilised as it is generated. By feeding into a distributing main in conjunction with a large steam station and/or inland water power scheme, and delivering to an industrial district capable of absorbing a comparatively large night load, such a state of affairs might be realised, at all events approximately. There is also the possibility that the intermittent operation of certain electro-chemical processes may be developed so as to enable any surplus power to be absorbed as and when available, and, if so, power developed tidally will probably prove cheaper in this country than that developed from any other source.

Owing to the relatively large variations in working head in any simple scheme, and to the small working heads, the design of hydraulic turbines capable of giving constant speed with reasonable efficiencies, and of moderately high speeds of rotation, is a matter of considerable difficulty. Modern developments, however, promise much better results in both these respects.

Even with such turbines, the number of technical problems to be solved before a tidal scheme of any magnitude can be embarked upon with confidence is large. The questions of single- *versus* double-way operation, of storage, of the effect of sudden changes of water-level due to strong winds, of wave effects, of silting in the tidal basin and of scour on the down-stream side of the sluices, of the best form of turbine and of generator, and of their regulation and of that of the sluice-gates, are probably the most important, though not the only, subjects to consider.

On the other hand, the possibilities of tidal power, if it can be developed commercially, are very great. Assuming a mean tidal range of only 20 ft. at springs, and 10 ft. at neaps, and adopting the single-basin method of development with operation on both rising and falling tides, each square mile of basin area would be capable, without storage, of giving an average daily output of approximately 110,000 H.P.-hours. In such an estuary as the Severn, where an area of 20 square miles could readily be utilised with a spring tidal range of 42 ft., the average daily output, without storage, would be approximately 10,000,000 H.P.-hours.

At the present time it is difficult to obtain even a rough estimate of the total cost of such a scheme, owing to the uncertainty regarding many of the factors involved. The whole question would appear to merit investigation, especially on matters of detail, by a technical committee with funds available for experimental work.

British Canals.—A Committee on Inland Waterways has been appointed of which Mr. Neville Chamberlain, M.P., is chairman, and Mr. Arthur Sharp, Development Department, Ministry of Transport, 8, Whitehall Gardens, S.W.1, is the secretary.

The terms of reference are: To consider and report as to:—

1. What portions, if any, of the inland waterway system of the country should be acquired by the Ministry of Transport with a view to improvement, and upon what terms; what should be the form of ownership of such acquired portions, whether under the State, through a Department of the Ministry of Transport, or through a Regional Trust, or by any other methods; and

2. If a trust be recommended, what should be its constitution and the nature of its governing body?

3. What improvement should be carried out in such acquired portions? What would be the cost of the improvement, and how should the necessary funds be raised? Whether such acquired or improved portions would become self-supporting, and, if not, what deficit would be involved, also what indirect advantage would be obtained to compensate therefor?

4. What method should be adopted to ensure that any improvement in the value of the frontages should be secured, in part at least, to the body carrying out the improvement to the waterway?

5. In what manner could co-operation best be developed between transport by water and transport by rail or road?

The Output of Coal.—According to figures quoted in the *Times*, the output of coal for the week ended May 22nd was 4,830,707 tons, against 4,860,668 tons in the previous week and 4,674,302 tons in the corresponding long week in Northumberland and Durham. The output of coal from mines under the Coal Mines Act, which had fallen from 287,411,869 tons in 1913 to 227,714,579 tons in 1918, rose to 229,743,128 tons in 1919. The number of persons employed was 1,191,313, an increase of 182,446 persons on the figures for the year 1918, and an increase of 63,423 persons on the pre-war year of 1913. The figures show an increase on the pre-war figures of 5.6 per cent. in the numbers employed, but a decrease of about 20.1 per cent. in the output. The average output per person employed underground fell from 332 tons in 1913 to 253 tons in 1919, and the average output per person employed under and above ground from 267 tons to 201 tons.

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BUSINESS NOTES.

Cycles for Disabled Men.—A Rally and Demonstration of Cycles for war-maimed men is taking place to-morrow, Saturday, June 12th, at 2.30 p.m., in the Inner Circle, Regent's Park, London, N.W. It has been organised by the editor of the *Motor-Cycle and Motor Trader*. Eighteen British makers of hand-propelled and motor-assisted cycles have signified their intention of taking part in the Rally, with close upon 50 machines, but an open invitation is extended to all actual users of hand-propelled cycles in the London area to take part, and it is expected that in consequence fully 100 machines will be present. One of the firms participating is Messrs. Carters, Ltd., of New Cavendish Street, W., who are sending one of their electrically-propelled bath chairs.

Manchester Steam Users' Association.—The annual report of the above association for 1919, announces that the total number of members is now 2,006, and the total revenue for the year was £27,850, but there was a resultant deficit of £5,121. The gross number of inspections carried out was 22,256, and no boiler under inspection and guarantee burst during the year. The chief engineer received the honour of O.B.E. during the period covered by the report, for services in connection with the war.

Extension of the Uses of Rubber.—The Rubber Growers' Association has decided to offer £5,000 as prizes, in the form of a competition for ideas and suggestions for extending the present uses, or for encouraging new uses, of rubber. A pamphlet has been issued containing full particulars and conditions of the competition. Copies can be obtained from the Secretary of the Association, at 38, Eastcheap, London, E.C. 3. There will be one prize of £1,000, three of £500, ten of £100, and £1,500 will be divided between the remaining competitors whose suggestions are considered to be of value.

A Congress and Exhibition at the Hague.—A Congress of the Government and Local Roads Authorities will be held at the Hague from September 15th to the 26th this year. The Congress will consist of the Government engineers who have charge of the main roads, and the provincial councils and engineers who are responsible for the maintenance of the smaller roads, also the municipal authorities who have under their charge streets and town thoroughfares. An important feature will be that an exhibition is to be held at the same time of road-making materials, machinery, &c., and of the various makes of commercial motors suitable for road transport. As the question of road-making and maintenance is of increasing importance, in view of the development of road transport, the Exhibition Section of the Federation of British Industries, for the convenience of British manufacturers, has undertaken the representation of this exhibition in England.

With regard to commercial motor-cars suitable for road transport, no lorry manufacturers exist in Holland. There is only one firm manufacturing ordinary passenger automobiles, and only two firms manufacturing motor tires on a small scale. For the interest of British firms, manufacturers, and engineers, it may be said that the exhibits will cover everything to do with roads, including maps, models, and statistics, machines used in road-making, and all the equipment necessary for the beautifying and illumination of streets and thoroughfares. On the transport side, exhibits will cover motor-lorries, commercial vehicles, spare parts, tires, accessories, motor fuel, motoring equipment and clothing. The Federation is in possession of full information, and can arrange all details for those who wish to exhibit or to visit the exhibition. Inquiries should be addressed to the Exhibition Section of the Federation of British Industries, 39, St. James's Street, London, S.W. 1.

Annual Outings.—The staff of Messrs. Primrose and Primrose, electrical engineers, Glasgow, held their annual sports outing at Whistlefield, on Saturday last. The principals, Messrs. James and Clifford Primrose and Mr. R. Spencer Smith, were present. There were several exciting and amusing contests, including a five-a-side football match between the various departments. Mrs. James Primrose presented the prizes.

The staff outing of the Electrical Supplies Co., of 233, Tottenham Court Road, took place on Saturday, June 5th. The party travelled by motor char-à-bancs to Marlow, and carried through a very fine programme. At the luncheon, Mr. Percy L. Davies (managing director) thanked the staff for their energetic work during the past 12 months, particularly those who had borne the anxiety of the early days, and congratulated them on their having brought the year to such a successful termination. In the evening a concert programme, under the direction of Mr. S. A. Coleman, was rendered and thoroughly enjoyed.

The Strike at Levers and Co-partnership.—The electricians, E.T.U. men, who were recently on strike at Lever Bros., Port Sunlight Works, have had their co-partnership benefits cancelled.

The Wimbledon Dispute.—The dispute between the Corporation and E.P.E.A. with reference to the previous decision of the Corporation not to pay the bonus of £30 granted by the National Joint Board of Employers and Members of Staffs to the technical staffs of electricity supply undertakings has now been settled. The E.P.E.A. at the request of the Ministry of Labour and other authorities agreed to defer any action until after the meeting of the Council on the 2nd inst., whereat a resolution agreeing to pay the bonus was passed by the Council. This has been made effective by another resolution of the Council passed on the 4th inst., rescinding the previous resolution not to pay the bonus.

Mr. W. A. Jones, general secretary to the E.P.E.A., informs us that the satisfactory settlement of this dispute is due in no small measure to the persistent interest of the Electric Lighting Committee and its chairman, Councillor Hatherly-Mynott, in the staff of the department under its control, and the energetic measures taken by the Mayor, Alderman D. Stuart, to deal with the situation that had arisen.

The influence of the National Joint Board through its constituent associations was also an effective contributory factor to the settlement.

The Merchant Trade in Germany.—It is announced that a number of merchant and export firms in the electrical industry have formed a community of interests to protect themselves against the inconveniences which have arisen in connection with the supply of electrical manufactures to merchants and exporters by makers, and against the threatened stoppage of the export trade by Government measures, particularly the export duty of 6 to 10 per cent. of the value.

Motor-Cycle Records.—The new British motor-cycle records recently set up for 100, 150, 350, 400, 450, and 500 miles, and for 1, 2, 3, 8, 9, 10, 11, and 12 hours were made by riders using British magnetos—the C.A.V.

French Company Notes.—There has been established at Paris (95, Rue Saint Lazare) the Société Phénicienne de Force et Lumière, with a capital of 500,000 fr. for the utilisation of all forms of electric energy.

With a capital of 300,000 fr., the Société Voltampère has been constituted at Paris (30, Rue des Trois Bornes) for the manufacture and trade in electrical fittings.

Ferdinand et Jean Guerpillon is the style of a company formed at Paris (4, Rue du Borrégo) to carry on the business of electric measuring apparatus makers of Mrs. Graindorge. The capital is 250,000 fr.

There has been constituted at Paris, under the name of Chesni et Cie. (4, Rue Léon Cosnaro) a company with 100,000 fr. capital for the purchase, sale, and installation of electro-mechanical appliances, the installation of high and low-tension networks, power stations, transformer posts, &c.

The Société Andelysienne d'Electricité (11, Rue de la Tour des Dames, Paris) has written down its capital from 1,500,000 fr. to 750,000 fr., and increased its capital to 5,000,000 fr. Eventual increase to 10,000,000 fr. rests with the Directorate.

Hamès, Laborie et Cie. has been incorporated (109, Rue de Sèvres, Paris) for trade in electrical apparatus, more particularly an apparatus to prevent motor-car thefts.

The Société Hydroélectrique de la Haute Bourne, of Grenoble (capital 500,000 fr.) has been dissolved, its assets having been acquired by the Société Hydroélectrique de Vizille, which discharges the former's liabilities.

There has been formed at Lilas (Avenue Pasteur 98) as a company, C. Demarquest et Cie., for electrical and mechanical construction. Its capital is 150,000 fr.

Under the style of Le Progrès Mécanique L.Parmentier et Cie. has been constituted a company at Clichy (39, Rue de Villeneuve), with a capital of 100,000 fr. for the manufacture and sale of all kinds of telephonic, electrical and mechanical apparatus and accessories.

Australian Tariff Affects Tramways.—Schemes of tramway development in the Commonwealth, it is said, are likely to be checked, if not crippled, by the extra duties placed in the new tariff upon imported rails. A scrutiny of the tariff reveals that the duties on all steel rails, including tramway rails, have been raised from 17s. 6d. to 35s. and 65s. a ton, according to the country of origin. While these duties are intended to give extra protection to Australian manufacturers, it is pointed out that owing to plant suitable for the manufacture of tramway rails not being available it will be impossible for some considerable time to come to draw supplies from Australian sources.—*Melbourne Herald.*

British Empire Exhibition in London.—It is intended to hold in London in 1923, or at such earlier date as may prove possible, a great British Empire Exhibition, which will demonstrate the magnitude of the resources and productive power of all parts of the Empire. A meeting was held at the Mansion House on Monday last, at which communications from the Prince of Wales and the Prime Minister were read. Viscount Milner, Secretary of State for the Colonies, urged the claims of the Exhibition, and other speakers were the Right Hon. W. A. Watt, Sir George Perly, and Sir Robt. Horne (President of the Board of Trade). Mr. H. G. Williams, secretary of the Machine Tool Trade Association, speaking from the body of the hall, expressed regret that the Government had given approval to a long-period exhibition. Exhibitions were among the best advertising media, but six-months' exhibitions which formed a fair ground were not the best method of promoting British trade.

Plant for Sale.—Whitby Urban District Council invites offers for one 100-kw. Parsons turbo-alternator, and one 28-h.p. vertical-enclosed engine complete. Heckmondwike Urban District Council Electricity Department has for disposal one 75-kw. Reavell-Fowler generating set, and one 465/550-volt D.C. Fowler generating set. For further information, see our advertisement pages to-day

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Catalogues Wanted at Charleroi.—The British Vice-Consul at Charleroi (Mr. J. P. Macgregor) reports that a special catalogue and sample room has been opened there, and he would be glad to receive catalogues (if possible in French) from British manufacturers, as well as small samples of all kinds, for exhibition. Notices are sent to the local Press at regular intervals of all catalogues and samples received, and every effort is made to bring these to the notice of Belgian importers.

Lead.—Under date June 5th, MESSRS. G. CAWSON & Co. report :—

The export demand has been very poor, and general trade seems to have become decidedly worse, so that home consumers are only taking very limited quantities of lead. Even the demand for electrical purposes appears to be falling off. If this situation continues, we are afraid the prices may further decline. There is no lack of lead coming forward; in fact, it is sometimes difficult to get rid of metal, as it arrives without going to the expense of warehousing. Reports from producing countries look more favourable.

On the same date MESSRS. JAMES FORSTER & Co. reported :—

There is no change in the general position. . . . There is still no quotation of lead on the New York market, a condition which has existed for weeks past. On the other hand, consumers, as is usual in such market conditions as this week, are little in evidence. Export business is quiet, and conditions in the City, financial and otherwise, continue to exert an adverse influence all round. It may safely be said that, with anything like normal consumption and conditions, the supplies to be expected in the next few months are totally inadequate.

Tasmanian Hydro-Electric Plant.—A newspaper report from Tasmania states that the State Hydro-electric Department is making extensive purchases of machinery in connection with developmental work at Waddamana, Lake Rolleston, Launceston, and Bridgewater. It is alleged by the Department that, despite the fact that all machinery which cannot be manufactured in Australia is supposed to be admitted free of Customs duty, Tasmania has to pay many thousands of pounds a year in duty on machinery from England and America which admittedly cannot be made in the Commonwealth. Mr. Hayes (Minister for Works) stated, in April, that under the new tariff the Hydro-electric Department would be hit very hard, and he hoped that something would be done by way of amendment before the proposals passed the Federal Parliament.

The Norwegian Aluminium Co.—The report of the A. S. Hoyangfaldene Norsk Aluminium Co., which was presented at the annual meeting held at Christiania on June 1st, states that the production of carbide, iron and electrodes had been discontinued and the remainder of the raw materials been sold. The production of aluminium was started, and would be increased gradually as larger supplies of alumina were received, which would depend, in the first place, upon the output in France. Unfortunately, considerable disappointment had been caused through the delay in the delivery of machinery by the European firms, but the machinery had now arrived, and experimental working for the essential part of the works had been begun. The work undertaken in the direction of the production of alumina from Norwegian raw materials was continued and brought to a close in the course of the year. The method had been carried out by an expert committee, who characterised it both technically and economically as possessing the competitive capability of solving the question of the production of alumina from native clay. As, however, the war was over, and the delivery of supplies of alumina could be reckoned on from France, the directors did not find any reason for the present for taking up the production according to this method. During the work of endeavouring to ensure further supplies of raw materials, they had paid special attention to comprehensive and valuable deposits in Surinam, Dutch Guiana. The subsidiary formed by the company—the N.V. Nederlandsche Mijn Exploratie en Exploitatie Maatschappij—in which the company held the majority of the shares, had now been granted a concession by the Dutch Government for these deposits. In the case of the A. S. Nordisk Aluminium Industri, of Holmestrand, which is also a subsidiary company, the report states that the installation had so far been completed that it had been possible to commence production. The accounts show a deficit of 1,336,000 kr. for the year, during nine months of which practically no manufacturing was carried on. As to the future prospects, the directors remark that the demand for aluminium is considerable, and prices are favourable, and should yield good profits as soon as the works are in full operation.

Italian Government Electrical Contracts.—During 1919 the Italian Government placed contracts for the following electrical plant :—

Copper wire	10,000,000	lire
Telephone cable...	4,000,500	,,
Telephonic apparatus	1,000,000	,,
Cord	350,000	,,
Dry and wet batteries	230,000	,,
Covered wire	220,000	,,
Insulators...	1,300,000	,,
Poles	750,000	,,

The above is exclusive of contracts for large canalisation works, power station equipment, &c.

German Representation.—Judging by copies of a letter which we have received personally, and had brought to our notice otherwise, a German firm of meter makers is circularising the electrical profession broadcast with a view to securing a London representative. A correspondent suggests that this is the beginning of "peaceful penetration"; but that, we believe, began again in November, 1918.

A Canadian Exhibition in London.—The Canadian Industries Exhibition, which was formally declared open by Sir G. McLaren Brown, of the C.P.R., on Monday last, remains open until 17th inst. It is being held at the Royal Agricultural Hall, Islington, and any reader who wants to come closely into touch with Canadian affairs should make an effort to inspect the exhibits during the remaining few days. The display affords a very convincing evidence of the great industrial strides that Canada has made since 1914, directly as the result of war-time manufacturing operations. Six years ago the exports of Canadian products were chiefly of agricultural and raw-material descriptions, but since the war-time factories have turned over to peace-time operations, an export trade in manufactured goods has been developed, which bids fair to reach large proportions. Sir G. McLaren Brown said that the possibilities of Canada industrially were limitless, by reason of her geographical position, her vast and varied national resources, her practically unlimited navigable waterways, her healthy climate, and the energy of her people all of which made for low cost of production, operation, and distribution. This had been recognised already by their cousins to the south of the border, and many American factories had been established in Canadian territory. As a Canadian, he was glad that the advantages of Canada as a country for manufacturing were coming to be recognised by manufacturers in England who proposed to establish branch factories. They would never regret it.

The exhibits are of a varied nature, indicating activity in steel products, polishes, gas engines, bicycles, steam-heating apparatus, leather goods, agricultural machinery, paints and varnishes, electric irons, toasters and vacuum cleaners, enamelled ware, furniture, pianos and organs, lathes and hand-saws, petrol engines, engineers' tools, and products of the Canadian Electro-Products Co., Ltd., and the Canada Carbide Co., whose works are at the Shawinigan Falls. At the time of our visit the Hoover electric suction cleaner was receiving a good deal of attention. Cinematograph films of general life in Canada, also industrial films, are being shown free in the King Edward's Hall, morning, afternoon, and evening. Mr. H. Greville Montgomery, who has been responsible for the Exhibition, is to be congratulated upon the measure of success that has attended his efforts, in spite of most exceptional difficulties. The Exhibition is the first of its kind held in London, but it will, unless we are mistaken, be followed by many others as Canadian export trade grows, as it seems destined to do, in the coming years.

British Engineering Firms and Manufacturing in Australia.—According to the Melbourne *Age* for April 12th, representatives of Vickers, Ltd., have been on a tour of inspection of the various engineering works in the Commonwealth for the purpose of investigating the possibilities of the extension of the engineering industry in Australia. The members of the party included J. S. Redshaw, shipbuilding expert; L. Lawrence, marine engines; Captain F. W. Turner, Rolls Royce engines; A. E. Meaden, motor cars. "It is believed that the firm of Vickers, Ltd., which at present has a contract for the construction of three of the 15,000-ton vessels for the Commonwealth Government, is contemplating the extension to Australia of the various branches of its activities, including shipbuilding, aeroplanes, &c." Amongst the party was Mr. W. L. More, the representative in Australasia for Boving and Co., manufacturers of water turbines, and he was also investigating the possibility of the machines being constructed in Australia instead of, as hitherto, being imported.

The Salvage of Oily Rags, &c.—Oily rags have hitherto been numbered amongst the things that are difficult to dispose of, except in a furnace; but the war has taught us many things with regard to the salvage of waste materials, and the Ministry of Munitions erected special plant for extracting oil from rags, which were afterwards cleansed and sold to textile or paper mills. The manager of this plant was Mr. L. St. Clare Roberts, who purchased it after the Armistice was signed, and transferred it to his new mills at Plaistow. A company has been formed under the style of Roberts, Paton & Co., Ltd., Chapel Mills, Eve Road, London, E. 15, which delivers steel drums, free of charge, to customers in the London area, or free on rails for country customers, and collects them when full of oily rags, paying for the latter. Rags are much cheaper than cotton waste, and are more absorbent; for these reasons they were adopted in all the workshops of the Royal Air Force, and engineering firms are following this example.

Company Liquidations.—ELECTRIC SMELTING CO., LTD.—Winding up voluntarily. Liquidator, Mr. G. A. V. Narraway, 36, Queen Victoria Street, E.C. Meeting of creditors, June 14th.

SURREY ELECTRICAL CO., LTD.—Meeting of creditors is called for June 17th, at 227-8, Gresham House, Old Broad Street, E.C.

ELECTRIC TRAIN LIGHTING SYNDICATE, LTD.—A meeting is called for July 6th, at 4, Central Bank Chambers, Leeds, to hear an account of the winding up from the liquidator, Mr. G. Parish.

ROTASPHERE, LTD.—A meeting of creditors was called for June 10th. Liquidator, Mr. A. S. Jopp.

FULLER'S WIRE AND CABLE CO., LTD., FULLER'S CARBON AND ELECTRICAL CO., LTD., THE FULLER ACCUMULATOR CO., LTD., and J. C. FULLER & SON, LTD.—Final meetings of members are called for July 7th at Keenan's House, Crown Court, Cheapside, E.C. Liquidator, Mr. H. M. Morris.

D. HULETT & CO., LTD.—A meeting of members is called for July 1st, at 1, Walbrook, E.C., to hear an account of the winding-up from the liquidator, Mr. J. D. Broad.

FALKIRK IRON CO., LTD.—Meeting of creditors at 43, Vicar Street, Falkirk, on June 21st. Liquidator, Mr. J. Hastings. This liquidation is for purposes of reconstruction. All creditors will be paid in full.

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Catalogues and Lists.—The Imperial Electric Works, 7-12, Imperial Mews, St. Martin's Avenue, East Ham, E.6.—Illustrated leaflet describing Browning's electrically-heated soldering iron.

"Rainbow" Artistic Shade Co., 30, Laurel Road, Fairfield, Liverpool.—An illustrated folder giving designs and prices of various types of silk lamp shades.

Messrs. Bruce Peebles Co., Ltd., Edinburgh.—Pamphlet No. 21 D (20 pp.). An illustrated catalogue of self-contained, medium-size D.C. dynamos and motors. The list gives full specifications and weights and dimensions in British and metric units.

Igranic Electric Co., Ltd., 147, Queen Victoria Street, E.C. 4.—Pamphlet No. 6,007, an illustrated leaflet entitled "Electric Coil Winding," showing various types of coils and windings.

Book Notices.—"Report of the Labour Co-partnership Association for the Year 1918." London. 3d.—The annual meeting takes place in London (at the Guildhall), on Wednesday, June 16th, at 3 o'clock. Lord Robert Cecil, K.C., M.P., will preside; Mr. W. A. Appleton will deliver address, and Sir George Gibb will be one of the other speakers.

"Umsturz der Einsteinschen Relativitätstheorie." By A. Patschke. Berlin-Wilmersdorf: from the author.

"Lectures on Industrial Administration." Edited by B. Muscio. Pp. vii + 276. London: Sir I. Pitman & Sons, Ltd. Price 6s. net.

Scientific Paper No. 374 of the U.S. Bureau of Standards. "An Integration Method of Deriving the Alternating Current Resistance and Inductance of Conductors" (32 pp.). Washington: Government Printing Office. Price 10 cents.

"Report of the British Chamber of Commerce of Turkey and the Balkan States (Inc.) for the Years 1914-19." Constantinople.

Bankruptcy Proceedings.—C. J. T. Hayman, electrical engineer, 76, Malvern Road, Leytonstone.—Receiving order made June 2nd, on debtor's own petition. First meeting, June 15th; public examination, July 16th, both at Carey Street, W.C.

Bernard Pordes, lately carrying on business under the style of the United Electrical Manufacturers Co., at 18-22, Christopher Street, E.C.—Accounts have been filed at the London Bankruptcy Court showing total liabilities £7,190 (unsecured £6,525), and assets consisting of book debts for £448, estimated to produce £160. The debtor manufactured electric pocket-lamp batteries, and he attributes his present position chiefly to losses, estimated at £12,000, sustained through the supply of bad chemicals; also to loss of £2,000, costs of an action brought against him by a foreman for unjustifiable dismissal. The public examination was to have been held on June 8th, before Mr. Registrar Mellor, but Mr. W. Boyle, Official Receiver, reported that he had called upon the debtor to file cash and goods accounts, and both he and the trustee required time for purposes of investigation. By general consent the sitting was adjourned till July 20th.

A German Order.—According to the *South Wales Daily News* for June 4th, the A.E.G. turbo-alternator of the Newport Corporation Electricity Committee is out of repair, and the engineer reported that it was very likely it would be found impossible to find any firm in the United Kingdom willing to undertake the repairs. He thought that the Committee would have no alternative but to place the work with the A.E.G. Co., Berlin; but if this course was adopted it would be advisable to place an order for a new rotor, for which they had quoted £1,000 at a rate of exchange of 200 marks to the £1. The Committee recommended that the new rotor be purchased. The *Daily Sketch* of June 8th gave the price as £1,600, and stated that a section of the Council strenuously opposed the proposal to place the order in Germany, but the chairman of the Tramways Committee pointed out that as the original machine came from Germany, English firms would not consider its repair for fear their employés would refuse to handle it, and because they said they were overwhelmed with orders. The recommendation was adopted.

Cape Town.—The Electrical Trades Union sent in a demand, through the Federation of Trades' secretary, to the Electrical Contractors' Association at Cape Town for a minimum wage of 3s. 6d. per hour, with 75 per cent. of this amount for apprentices of four years' standing. The time limit was June 8th, at which date the demand of the building trades' employés for 4s. per hour also matured.

Trade Announcements.—Mr. E. M. Parsons, electrical contractor, who has been established at 67, King Edward Street, Hull, for over 17 years, is removing, on 14th inst., to larger premises at 38A, Brook Street, Hull. Telephone number unaltered: "Central 5180."

Mr. F. J. Hurst, for many years associated with the selling organisation of Messrs. Brown Bros., Ltd., motor and aircraft factors, has recently gone over to the Aircraft Disposal Co., Ltd., and is now installed at their sales headquarters at Regent House, Kingsway.

Mr. P. Baxter has commenced business as an electrical engineer at 29, Westgate, Grantham.

Mr. G. C. Barnes, electrical engineer, has opened new premises at Regent Street South, Barnsley.

Mr. A. B. Cartland has opened an office at 3, Creechurch Lane, Leadenhall Street, E.C. 3, where he is specialising in fuel-economising and smoke-abatement appliances, including the patent Sandwich system of boiler firing and the Gallagher-Crompton baffle bridge, also the boiler efficiency calculator.

Auction Sale.—By direction of the Disposal Board Ministry of Munitions, Mr. C. D. Phillips will sell by auction on June 22nd and following days at the National Carriage and Box Repair Factory, Newport, Mon., the factory plant, machine tools, electric motors, generating sets, &c. For full particulars see our advertisement pages to-day.

Dissolution of Partnership.—Munday & Prior, agents and engineers, Belfast and Dublin.—Partnership dissolved. Mr. E. P. Prior has opened offices and stores at 44, King Street, Belfast, as wholesale electrical engineer, and has been appointed agent in Ireland for the Electric Construction Co, Ltd., the Sun Electrical Co., Ltd., and the New Pelapone Engine Co., Ltd.

Foreign Trade.—May Figures.—The following are the values of imports and exports of electrical goods and machinery in May:—

	May. 1920.	*Inc. or dec.*	*5 months, 1920 Inc. or dec.*
Imports.	£	£	£
Electrical goods, &c. ...	111,417	— 12,717	— 119,699
Machinery	1,517,839	+ 404,834	+ 988,344
Exports.			
Electrical goods, &c. ...	1,005,210	+ 555,640	+2,366,684
Machinery ...	4,851,193	+2,348,683	+9,352,068
Re-exports.			
Electrical goods, &c. ...	15,913	— 8,422	+ 8,450
Machinery	157,067	+ 94,657	+ 349,996

Copper and Lead Prices.—Messrs. F. Smith & Co. report, June 8th:—Copper (electrolytic) bars, £110, £1 increase; ditto sheets, no change; ditto wire rods, £125, £1 increase; ditto H.C. wire, no change; silicium bronze wire, no change.

Messrs. James & Shakespeare report, June 9th:—Copper bars (best selected), sheets and rods, no change; English pig lead, £39, a reduction of 30s. on the week.

Draughtmen's Association.—At the half-yearly Conference of the Association of Engineering and Shipbuilding Draughtsmen, concluded at Blackpool, yesterday, the membership was stated to be over 15,000. Success in securing improved conditions was reported, and it was announced that the activities of the Association with regard to technical matters were increasing. Resolutions were passed protesting against the inclusion of draughtsmen and staff workers generally within the Unemployment Bill, and objecting to the further waste of public money on the maintenance of Employment Exchanges.—*Daily Telegraph.*

LIGHTING AND POWER NOTES.

Accrington.—Price Revision.—The Corporation has appointed a Sub-Committee to consider a further revision in the prices of electricity, consequent on recent increases in coal and working charges.

Australia.—Tasmanian Water Power.—Operations are to be commenced shortly upon the Lake Rolleston hydro-electric scheme, which has been designed to supply power to the Read-Rosebery Co. for treating zinc ore.

Sydney Electricity Supply.—The Sydney undertaking supplies over 30 municipalities with electricity, and, as all the agreements were made before the war, charges have not been increased, with consequent loss to the city. The only safeguard possessed by the Council at present is to demand a guarantee that a certain minimum quantity of power will be taken, before new mains are laid. The City Council is endeavouring to get the municipalities concerned to agree to an increase in prices to place the undertaking in a better financial condition.

Barnstaple.—Extensions.—The Town Council, on May 31st, adopted a scheme for extending the electricity works at an estimated cost of £39,000. Mr. J. S. Highfield, the expert called in to advise on the extension, is to carry out the scheme on the terms quoted by him, namely, 5 per cent. on the total outlay.

Batley.—Loan.—The Electric Lighting Committee is applying to the Ministry of Health for sanction to borrow £4,600 for mains extensions and services.

Belfast.—Loan.—The Corporation is applying for sanction to a loan of £30,000 for expenditure upon the electricity undertaking.

Birmingham.—Committee's Report.—A report of importance was presented at a recent meeting of the City Council by the Electric Supply Committee. It dealt with, among other things, the annual accounts of the department, which showed that the additional capital raised during the year amounted to £101,091, and the capital redeemed to £158,240. The outstanding debt was thus reduced by £57,149 to £1,881,628. The total amount of capital redeemed to date was equal to 34·3 per cent., and the net expenditure on this account was £110,879, chiefly in respect of the Nechells permanent station scheme. Dealing with revenue, the Committee stated that the quantity of electrical energy sold was nearly 128 million units, being a decrease of about 13 millions, or 9·22 per cent. There was a heavy fall during the earlier part of the year, but during the last half, the sales improved progressively,

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being 22½ per cent. greater during the March quarter than in March, 1919. This improvement was maintained, and the gross revenue from consumers exceeded the previous year's total by 12·4 per cent. The increased expenditure and costs per unit were, to some extent, met by the authorised increases in charges to consumers which applied to the last seven months of the year. The principal increases in expenditure were in respect of coal, repairs, and rates and taxes, and wages had also advanced. The Committee explained further that considerable capital payments would have to be met before March, 1921, in respect of the Nechells permanent station scheme, and it was deemed necessary to set aside a further £10,000 towards meeting interest charges, &c., on this temporarily unproductive expenditure during the construction period. They considered also that it was necessary to strengthen the renewals and special expenditure reserve, in view of the present heavy costs of engineering works which were likely to remain at a high level for some time. Having regard to the recent advance of coal, it was necessary to revise the charges for electricity supplies. It was recalled that the City Council had sanctioned an increase in July, 1919, since which date, in addition to the present advance in coal prices, many other costs of production had increased. The additional rates on the assessment of the undertaking this year would amount to nearly £30,000 more than in the year just ended, whilst wages, salaries, repairs, &c., were estimated to cost a further £32,000. The addition to the department's coal bill, due to the present advance, would be nearly £70,000; a large proportion of this was, however, automatically recovered from the large power users on the terms of their high-tension agreements, and this also applied to traction supplies.

Blackburn.—AUXILIARY TURBINE.—Blackburn Corporation has authorised the purchase of a turbine at Throstle Street Destructor Works, in order that it may be run by steam supplied by the cleansing department to relieve the pressure on the electricity works during the winter months.

Burnley. — DISTRICT COMMITTEE. — Burnley, Colne, Nelson, Accrington, and Rawtenstall have formed a District Committee to act together in all matters arising from the formation of a Joint Electricity Authority for this area under the Electricity (Supply) Act, 1919.

LOAN.—The Town Council is making application to the Electricity Commissioners for sanction to borrow £45,000 (making, with £75,000 previously applied for, £120,000) for carrying out proposed extensions at the electricity works, and the purchase and installation of the necessary plant; also for sanction to borrow £20,000 for the installation of mains during the ensuing two years.

Burton-on-Trent.—YEAR'S WORKING.—There was a net profit on the electricity undertaking during the past year of £1,427, as compared with £5,258 in the previous year. An additional capital expenditure of £2,385, however, has been contributed out of revenue this year, including £1,288 for an electric lorry. £1,000 of the profit has been contributed towards the relief of the rates, the balance being transferred to the renewal fund.

Ceylon.—HYDRO-ELECTRIC PROJECT.—The *Times of India* states that the Ceylon authorities are considering a proposal to develop the island's water power. The initial cost of the scheme would be about nine million rupees, and a further three millions would be required for later extensions. The difficulty in obtaining machinery and the probable reluctance of power-plant owners to scrap their present plant are two great difficulties in the way of this proposal.

Darlington.—EXTENSIONS.—The Town Council is applying for sanction to borrow £104,000 for extensions to buildings and plant. Accommodation is to be made for two 5,000-KW. sets, but only one set and boilers will be installed at present.

Dartford.—EXTENSIONS.—The Urban District Council has applied for a loan of £14,928 for a boiler, duplicate bus-bars, mains extensions, and a rotary converter. A low-tension main to cost £1,865 is to be laid, in order to supply electricity to the works of Burroughs, Wellcome & Co., Ltd., and the Monazite Products, Ltd.

Darwen.—MAINS EXTENSIONS.—Sanction to borrow £27,145 for extension of mains is being sought by the Corporation.

Dewsbury.—LOAN.—The Electricity Committee recommends application for a loan of £4,000 to cover the cost of mains and services for supplying electricity to Savile Town.

Dover.—LOAN SANCTIONED.—Sanction to borrow £1,000 for mains extensions has been accorded the Town Council by the Electricity Commissioners.

Falkirk. — EXTENSIONS APPROVED. — The Electricity Commissioners have sanctioned the carrying-out of extensions to the electricity works. These extensions consist of generating and converting plant and mains.

Grays.—LOAN.—The Urban District Council has applied for a loan of £1,500 for additional plant and mains.

Ilford.—DEFICIENCY.—The Electricity Committee has received a letter from the Ministry of Health, stating that the appeal submitted by the Council against the disallowance of £10,261 8s. 1d., made by the district auditor at his audit of the accounts of the Council for the year ended March 31st, 1919, has been considered by the Minister of Health, and that it appears that the sum in question represents a deficiency on the Council's electrical undertaking at March 31st, 1919; that the Minister is of opinion that the disallowance was lawfully made, and he accordingly confirms the same, but before expressing any opinion as to the steps to be taken in dealing with this deficiency, he desires to be furnished with a report by the Council as to the prospects of its extinction. The Committee instructed the Clerk to inform the Ministry, in reply, that a rate of 5d. in the £ had been made for the ensuing half-year, to meet the deficiency on last year's working.

Leyton.—YEAR'S WORKING.—The gross profit for the year ended March 31st last was £6,000. Of this amount half will be absorbed in payment of interest, and the other half placed to the reserve fund.

London.—BETHNAL GREEN.—The Electricity Committee has recommended the installation of two 500-K.V.A. transformers at an estimated cost of £1,800; switchgear, £600; and the carrying-out of mains extensions at a cost of £7,740.

Morley.—YEAR'S WORKING.—For the year ended March 31st last, the accounts of the electricity undertaking showed a total expenditure of £5,412, and a revenue of £7,883, the gross profit being £2,420. After paying off £2,138 in respect of interest on loans and sinking fund, there was a net profit of £281, as against a deficit of £1,759 in the previous year.

BULK SUPPLY.—The Corporation is considering terms for a supply of electricity in bulk for power purposes, and is in communication with the Electricity Commissioners regarding the matter.

Nottingham.—ELECTRICITY SUPPLY.—A report, which was passed for its first reading, was presented at the last meeting of the Nottingham City Council, dealing with future provision for electricity supply. Mr. J. H. Rider had been engaged by the responsible committee to deal with the question of a modern power station for the Nottingham district, such station to form a part of the general scheme for the East Midlands, and to supply an area extending in all directions beyond the boundary of the city. He has recommended the erection of a new station on the banks of the Trent, the plant installed, in the first instance, to be two 10,000-KW. sets, and future extensions to consist either of 20,000-KW. or 25,000-KW. sets. His estimate of the cost of the complete plant, including land, buildings, machinery, &c., is for the first section of 20,000 KW. installed, £752,000 or £37·63 per KW.; first and second sections for 40,000 KW. installed, £1,009,000 or £25·225 per KW. These figures, which are based upon actual costs at the present time, include a certain amount of expenditure on behalf of the future, viz., the whole of the land, river works for discharge channel, engine and pump cranes, accumulators, &c. The estimate for the first section also includes buildings sufficient for 40,000 KW. of plant. It will also be necessary to provide high-pressure feeder cables between the new power station and the present generating stations in the city at an estimated cost of about £50,000. A certain amount of transformer plant will be required. The economies to be gained by operating the new power station, as compared with the two existing stations, will be very great. The committee proposes that application be made to the Electricity Commission for sanction to the borrowing of £868,000 for carrying out the first portion of the scheme.

YEAR'S WORKING.—The annual report of the Electricity Committee, presented at a recent meeting of the Corporation, showed a surplus of £11,389, compared with a deficit of £8,912 in the preceding year. This is largely due to the increased charges which were put in operation for the last nine months of the period, together with the increase in the number of units sold. The demand is stated to be increasing both for lighting and power purposes, but there has been inevitable delay in making new installations, owing to the lack of necessary materials. The mileage of distributing mains at the end of the year was 72·793. The number of units sold during the year was 17,055,592—an increase of 764,422 for lighting, 624,360 for power, and 1,162,932 for traction.

New Zealand.—EXTENSIONS AT AUCKLAND.—In view of the inadequacy of the present plant, and of the fact that there is no immediate prospect of a hydro-electric supply, the City Council has decided to make large extensions to the electricity undertaking. The scheme adopted will entail an expenditure of £500,000.

WATER POWER.—Three large hydro-electric schemes are under consideration. The Wellington City Council proposes to develop the power of the Orongoronga River at a cost of £337,000, and the Wanganui Borough Council is borrowing £250,000 for the purpose of constructing a hydro-electricity works at the source of the Wangaehu River, about 30 miles from the town. The third scheme is for the development of Lake Monowai to provide power for Southland. The cost of this undertaking will be £1,500,000.

Price Increases.—Consequent upon the recent increase in the price of coal, a large number of undertakings have found it necessary to raise their charges for electricity. Among these are:—Dewsbury, Swansea, Leicester, Barnstaple, Lincoln, Bangor, Darwen, Canterbury, Chester, Crewe, Dover, Maidstone, Motherwell, South Shields and Nottingham. The local company undertakings at Windsor, Sevenoaks and Carshalton have notified their intention to apply for permission to increase their charges.

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Rotherham.—Strike.—The greater part of the electricity works was shut down on June 3rd, the employés striking in sympathy with the Sheffield workers. The men returned on Sunday, June 6th, and normal conditions were soon resumed.

South Shields.—Loans Sanctioned.—The Electricity Commissioners have agreed to sanction the borrowing of the sum of £31,439 repayable within 20 years.

With regard to a further application for sanction to borrow £37,513 for transformers, mains, sub-stations, &c., the Commissioners authorise the town clerk to let any urgent contracts or accept tenders for the works covered by the application, pending further examination of the figures by the Commissioners.

Turton.—Electricity Supply.—The Urban District Council has had before it a scheme prepared by the Lancashire Electric Power Co. for the extension of the electricity undertaking. This provides for four distinct areas which, whilst complete in themselves, will be linked together. The estimated cost for the four areas is:—Bradshaw, £5,300; Egerton, £6,015; Horrobin £300; and Edgworth, £6,240; a total of £17,855.

The Council has accepted the scheme, and decided to apply to the Electricity Commissioners for power to borrow £20,000.

Wallasey.—Dock Disaster.—Following the Mersey Dock disaster, caused by the breaking down of a dock gate and the release of many thousands of tons of water from the Albert Dock, Birkenhead, the electrical services of the Wallasey Corporation were seriously interfered with at the beginning of the week. The generating station is near the Birkenhead Float, which immediately adjoins the Albert Dock, from which the station obtained its water supply. In consequence of the sudden drop of 8 ft., the water supply was practically cut off. The power supply was considerably reduced, with the result that the electric lighting throughout the town was very poor, and between 40 and 45 tramcars had to be taken off the various services.

Whitchurch (Hants).—Lighting Scheme Abandoned.—Owing to the lack of local support, the scheme to supply the parish with electricity by water power at the Tower Mill has been abandoned.

Wigan.—Year's Working.—A profit of £13,071 was made during the year ended March 31st last, in spite of the fact that prices are much lower than the present average.

Woolston.—Purchase of Station.—The Town Council is considering the purchase of a local electricity undertaking, at a cost of £125,000.

Worthing.—Year's Working.—A surplus of £1,206 was the result of working of the electricity undertaking for the year ended March 31st last, which compares favourably with the deficit of £2,154 on the previous year's working. The capital expenditure upon the electricity works is £100,000, of which £43,000 has been paid off.

Wrexham.—Loan Sanctioned.—The Town Council has been informed that there will be no inquiry with regard to the application for a loan of £17,000 for extensions to the electricity works.

York.—New Plant.—The city electrical engineer has reported as to the cost of purchasing two Diesel engines, and of erecting and putting them in working order, together with foundations, cables, connections and contingencies, the whole amounting to the estimated sum of £18,640. The Electricity Committee recommends that it be authorised to proceed with the necessary purchases and completion of these works, and that application be made to the Electricity Commission for sanction to borrow the requisite amount.

TRAMWAY AND RAILWAY NOTES.

Ashton-under-Lyne. — Fares. — The Tramways Committee has refused to accede to an application from the Hurst Urban District Council to reintroduce penny stages.

Birmingham.—Canal Electrification.—It is reported that electrification of an important part of the canal connecting Birmingham with the Severn at Stourport is to be undertaken shortly. It is calculated that the speed of the barges will be raised to 4½ miles per hour, about double that of horse haulage, and that the method of propulsion will allow of this speed without injury to the canal banks. An overhead trolley wire system is proposed. There is a considerable existing traffic on this portion of the canal, and scope for the development which electrification should render possible.—*Engineering.*

Annual Report.—The Birmingham Tramways Committee has recommended the increase of the existing tramway fares by ½d. to meet the higher cost of administration. It states that it has had under consideration the estimated results of the current year's working of the undertaking, from which it would appear there would be a deficit of £283,537. The latter sum includes the cost of permanent-way renewals estimated at £200,000, which must be carried out during the year to enable the car services on some of the routes in the city to be operated with safety. The deficit could only be met by further increase of tramway fares. The Committee, in its annual statement of expenditure, points out that the amount borrowed for the tramway undertaking is £2,496,464. On the reserve account it is stated that the operating expenses show an increase of £166,091 due chiefly to the enormously increased cost of labour and material, and in a lesser degree to extra mileage—the averege cost per mile being 17·184d., compared with 15·013d. for 1918-19, an increase of 2·171d. per car-mile. The receipts, which constitute a record in the history of the undertaking, amounted to £1,378,704, an increase of £131,433, the net result being, however, a loss of £34,659, as compared with last year's working. By the ½d. increase per fare, it is hoped to raise the additional income required to meet present liabilities. The Committee points out that the tram track has a length of 79 miles, or 123 miles (reduced to single); the traffic revenue last year was £1,371,978; average traffic revenue per car-mile, 21·538d.; and number of car-miles, 15,288,095. The average number of miles per car per day was 82, the average number of car-hours daily 10·92; the number of passengers carried was 225 millions; and the percentage of working expenses to receipts was 79 per cent. In a special report on the subject of fares, the Finance Committee urges that the Tramways Committee might with advantage report to the Council after, say, three months' experience of the proposed new fares in order that the Council might have an opportunity of considering whether the fares were sufficiently increased to cover the rapidly rising working expenses. The loss of the profits of the tramways was in itself a sufficiently serious matter for the Corporation without running the danger of the tramways becoming a charge upon the rates.

Bolton.—Extensions.—The Tramways Committee has under consideration the question of extending its system from the present terminus at Dunscar to a point near the Cross Guns, Egerton, and from the terminus at Tonge Moor along Bradshaw Brow, Lea Gate, to Longsight, Harwood. The Turton Urban District Council has deputed a Sub-Committee to meet the Tramways Committee to discuss the matter.

Bournemouth.—Strike Ended.—Employés who were working upon the tramway track resumed work on June 2nd, after being on strike for a month.

Continental.—France.—The following particulars are gathered by the *Railway Review* from a statement by M. Claveille, Minister of Public Works and Transport:—It being highly important for France to make the most of its water power for generating electricity, particularly at a time when its supplies of coal are not sufficient to meet the needs of its industries, an inventory was made, at the end of 1916, of the available hydraulic power of the public water courses. The Special Committee on railroad service recommended the electrification of 5,220 miles of track as follows: Paris-Orleans, 1,926 miles out of a total of 4,839 miles; Paris-Lyons and Mediterranean, 1,367 miles out of a total of 6,040 miles; Midi, 1,926 miles out of a total of 2,525 miles. With the traffic of 1913, the energy consumption would have reached: Paris-Orleans, 280,000,000 KW.-hours; Paris-Lyons and Mediterranean, 550,000,000 KW.-hours; Midi, 330,000,000 KW.-hours; total, 1,600,000,000 KW.-hours a year. With the estimated traffic in the immediate future, the consumption would be: Paris-Orleans, 560,000,000 KW.-hours; Paris-Lyons and Mediterranean, 1,100,000,000 KW.-hours; Midi, 600,000,000 KW.-hours; total, 2,260,000,000 KW.-hours. In determining upon lines to be electrified, the Midi and the Paris-Orleans considered the relation of the cost of electric power as compared with the cost of power with steam locomotives, and the comparison showed that mountain lines with sufficient traffic should be among the first to be electrified. They also considered the location of the source of hydro-electric energy in relation to the lines, and the importance of this power to other industries. On the Paris-Lyons and Mediterranean, however, the possibility has been considered of using electricity on lines of low grades where there is a heavy traffic, even before mountain lines where the traffic is very small. The proposed sources of electric power are the following: For the Paris-Orleans, the Upper Dordogne river and its branches; for the Midi, the Pyrenees mountains; for the Paris-Lyons and Mediterranean, waterfalls in the central plateau and in the Alps, and the plant at present existing, or about to be constructed, in the region. The probable cost is estimated as follows, based on prices before the war: Paris-Orleans, $94,000,000; Paris-Lyons and Mediterranean, $93,000,000; Midi, $148,000,000; total, $335,000,000.

Austria.—In connection with the projected electrification of that part of the State railway system which is situated in the Alpine districts, it is proposed to extend existing and erect new hydro-electric power stations in different parts of the country, which are to supply 24,000 H.P. The length of the railways to be electrified is about 650 km., and the cost is estimated at 3,560 million crowns, which amount would have to be raised by a loan. According to figures supplied by the Government, the pre-war cost of the proposed works and of the rolling stock required probably would not have exceeded 80 million crowns.—*Financier.*

Hungary.—The State Railway authorities propose to electrify their lines, covering a total of about 1,400 km. This work is to be carried out during a period of nine years. Owing to the fact that all the waterfalls have been lost to Hungary, it will not be possible to utilise hydro-electric power, so other means will have to be used to generate the necessary power.—*Financier.*

Doncaster.—Probable Fare Increase.—The tramway fares in the town and district will shortly be increased in consequence of the heavy costs which have now to be borne in maintenance, wages, &c. The present fares are only 1d., and it is stated that since March last the Corporation has been losing £100 per week on the undertaking. It is probable that new routes will be opened out to the Carr House, Rossington, and Kirk Sandall districts.

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Exeter.—YEAR'S WORKING.—The total of the traffic receipts for the past year was £31,336, and the expenditure, exclusive of loan interest, &c., was £28,444, leaving a gross profit of £2,892.

Leeds.—FARE INCREASE.—At a recent City Council meeting, it was decided to increase the fares, after the first 1d. stage—which remains as it is—by ½d. per fare. About one-third of the passengers will not be affected by the increase, and about 50 per cent. will have to pay the increase from 1½d. to 2d. A loss of about £300 per day was being incurred, and it is expected that the present deficiency of £100,000 will be liquidated by the advanced fares. The Labour Party put up a strong opposition to the proposal, but their amendment to again refer the matter back for consideration was defeated. The increased charges will come into operation immediately.

Lincoln.—FARE INCREASE.—There was a net profit on the tramway undertaking of £313 on the past year's working. It has been decided to increase the tramway fares from 1½d. to 2d., the 3d. (workmen's four-journey) fares to 4d., and the parcel rates in the same proportion.

Liverpool.—PRICE INCREASE.—The Corporation has decided to increase the basic charge of 1d. per unit for electrical energy supplied to the tramway undertaking by 15 per cent. from June 30th, and a variation for fuel price adjustment is to be added to the increased charges.

London.—HIGH-SPEED CARS.—A new main road from West Ham to Tilbury, to serve the new suburb which the London County Council is erecting at Dagenham, is to have a double tramway track down the centre, fenced off from the rest of the road, to allow the cars to run at high speed.

Manchester.—STAGE REDUCTION.—To meet the anticipated serious deficit on the current year's working of the tramways, the Tramways Committee decided to reduce the 1d. stage in distance from 2 to 1½ miles, and this has been confirmed by the City Council.

Salford.—STAGE REDUCTION.—To meet the increased cost of running the tramways, the Town Council last week decided to reduce the 1d. stage to 1½ miles, instead of 2 miles, as at present. An amendment was proposed to put an extra ½d. on 1d. fares, but was defeated.

Sandwich.—TIME EXTENSION.—The East Kent Light Railway Co. has informed the Town Council that it is applying for an extension of time for the construction of the line from Shepherdswill to Sandwich, *via* Barfrestone, Eythorne, Eastry, Woodnesborough, Ash and Stonar, and the application is to be assented to.

TELEGRAPH AND TELEPHONE NOTES.

Australia.—ARC WIRELESS INSTALLATIONS.—The Minister for the Navy stated that the Naval Board had approved of the installation of the arc system of wireless telegraphy at certain Australian stations. The four installations that had been made were working successfully. The cost of the Melbourne and Perth stations was approximately £890. The Randwick wireless works had made 25 wireless receiving sets at a cost of £110 per set.

Communication with Russia.—The Great Northern Telegraph Co. has been negotiating lately with Litvinoff, over the resumption of telegraphic connection with Russia, which was broken off at the beginning of the war. The company's two cables can quickly be resumed, only the cable between Libau and Petrograd needing repairs.—*Central News.*

Greece.—FOREIGN TELEGRAMS.—The Greek Administration notifies that the English, French, Italian, and German languages are admitted in international telegraphic correspondence until further notice.

High-speed Telegraphy.—A telegram to the Prince of Wales, giving the result of the Derby, was handed in by the King at Epsom at 3.16 p.m. It was transmitted to London, thence to Halifax (Nova Scotia), reaching Canada at 3.19 p.m., crossed the country, and by means of the Imperial Pacific cable the message reached Australia 23 minutes after the finish of the race.

Japan.—TELEPHONE EXTENSIONS.—According to the *Taisho Nichi*, the Japanese Communications Department plans a big extension of the telephone service to be carried into effect during the next eight years beginning with the next fiscal year (from April 1st) at the estimated cost of yen 337,000,000. The present number of subscribers in Tokio is to be increased to 152,000; in Osaka to 91,000; in Kyoto to 30,000; in Yokohama to 21,000; in Kobe to 31,000; in Nagoya to 28,000; and in other places to 327,000. The above figures show the proportion of 49 subscribers per 1,000 population for Tokio; Osaka of 44; Kobe of 43; while others come to a rate of 40 or so. By 1926 Kobe will have six telephone exchanges, including the present three, to deal with the proposed extension. The city of Kobe now contains 9,100 or so subscribers, a number which is to be increased to 31,000. The Communications Department is at present studying the automatic exchange system now in vogue in America and Europe. The present 40 telephone circuits between Osaka and Kobe are to be increased to 100 in some places.—*Economic Review.*

Proposed New Cables.—Various announcements have been made from time to time regarding the laying of new cables, and the following particulars will show that cable factories will be very busy for some time to come:—The Commercial Cable Co. contemplates the laying of another Atlantic cable. Another Atlantic cable is contemplated by the Imperial Government, and one between Scandinavia and America. The Eastern companies are laying cables between England and Gibraltar; Malta and Alexandria; Aden and Bombay; Gibraltar and Malta; Madras and Singapore. A duplication of the British Columbia-Fanning Island cable may also be undertaken. Further cables are to be laid between Miami and Barbados; Barbados and Para; Buenos Aires and Monte-Video; Monte-Video and Santos. The West Coast of South America Co. intends extending its cables northwards; the Commercial Pacific Cable Co. will be duplicating its cables and the South American Cable Co. is establishing landlines between Buenos Aires and Monte-Video, and laying a cable between the latter place and Rio Janeiro. There has also been talk of connecting San Francisco by cable to Central America.

The Times announces that the Pacific Cable Board points out that the duplication of the Vancouver to Norfolk Island cable has not yet been considered by the Governments interested.

Signal Service Vacancies.—The War Office is appealing for a number of wireless operators and wireless electricians for the Signal Service. The normal period of engagement will be for six years with the Colours and six with the Reserve, but ex-soldiers and men who have not been in the Army will be accepted for two, three, or four years. A bounty of £100 will be paid to operators and £50 to electricians who pass the necessary tests.—*Times.*

Spain.—NEW CABLE.—The Government intends, says the *T. and T. Age*, to lay a submarine cable between Cadiz, Spain, and Larache, in Morocco.

Telephone Exchanges.—BUILDING STOPPED.—The Cabinet Sub-Committee on Retrenchment has decided that all buildings for, amongst other things, telephone exchanges, are not to be proceeded with for the present.

Telephones in Rural Districts.—Mr. Illingworth, Postmaster-General, states that during the last 15 months over 500 new telephone call offices have been approved in rural districts, and some of these could be of benefit to farmers.

"I hope," he adds, "that when more progress has been made in overtaking the arrears of work which accumulated during the war, it may be possible more freely to extend the 'phone facilities in rural areas."—*Daily Dispatch.*

Wireless Meteorological Reports.—The Air Ministry states that on and after June 1st meteorological reports for general use will be circulated by wireless telegraphy daily. Synoptic telegrams in the code hitherto used will be issued at 3.15 a.m., 8.45 a.m., and 8.15 p.m. A General Inference, in plain language, based upon the 7 a.m. and 6 p.m. observations, will be issued at 9.15 a.m. and 8 p.m. Call sign G.F.A., wave length 1,400 metres (C.W.). The synoptic telegrams from Aberdeen at 2.30 a.m. and 2.30 p.m. are unaltered. Call sign B.Y.D., wave length 3,300 metres (C.W.). The times given are G.M.T.

Wireless Telephones.—Radio-telephone stations to be used primarily for giving information as to the whereabouts of aircraft travelling, or about to travel, along a route, and for reporting weather conditions along the route to the machine, are being opened in various parts of this country, France, and Belgium. Stations are already open for work at Croydon and Lympne for the London—Paris and London—Brussels routes, and stations will shortly be opened for the London—Birmingham—Manchester—Glasgow route at Castle Bromwich, Didsbury, and Renfrew.

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the* ELECTRICAL REVIEW *in which the "Official Notice" appeared.)

OPEN.

Australia.—SYDNEY.—August 4th. N.S.W. Government Railways and Tramways. Two 1,000-KW. sub-station units. Chief Electrical Engineer, 61, Hunter Street, Sydney.

August 3rd. Department of Public Works. Turbines and generators for the Barren Jack hydro-electric development scheme. Department of Public Works, Sydney.

N.S.W.—Postmaster-General's Department. August 2nd and 5th. Aluminium sheet, brass rod, &c., scheduled 769; platinum wire, gold and silver wire, scheduled 768. (See this issue.)

WESTERN AUSTRALIA.—Postmaster-General's Department. August 3rd. 326 accumulators, schedule 668. (See this issue.)

Barnsley.—Electric light installation at Westgate Primitive Methodist Church. Mr. P. Pickersgill, 122, Dodworth Road.

Belgium.—June 23rd. The Société Nationale des Chemins de Fer Vicinaux, 48, Rue Monteyer, Brussels. Tenders for about 3,400 metres of underground armoured feeders for the electric railways in the Namur district. Particulars from the Services Electriques Department, at the address given above.

Bedford.—June 21st. Electricity Department. One 2-ton locomotive jib crane, with grab and track rails, steam and other pipework. (June 4th.)

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Belgium.—June 19th. The Belgian Post and Telegraph authorities at La Salle Madeleine, Brussels, are inviting tenders for the supply of 1,710 kilometres of covered copper wire.

Canterbury. — June 22nd. Electricity Department. 1,210 yards '25 sq. in. × '25 sq. in. × '125 sq. in. L.T. triple-concentric paper-insulated cable. (See this issue.)

Carlisle.—June 25th. Electricity Department. One 3,000-KW. turbo-alternator and condensing plant. (May 28th.)

Colne.—Electricity Department. Steam and water piping. (See this issue.)

Dartford.—June 26th. Electricity undertaking. Rotary converter, transformers, switchgear, &c., L.T. twin cable-feeder, pillar and feeder-panel. (See this issue.)

Dundalk.—June 15th. Urban District Council. Electricity Department. 750 yd., L.T., 3-core, paper-insulated, lead-covered and armoured cable; disconnecting boxes (pavement type) and joint boxes. (May 28th.)

Dundee.—June 24th. Electricity Department. Steam feed and water piping, two turbine-driven feed pumps. (See this issue.)

Edinburgh.—June 19th. Electricity Supply Department. E.H.T. and L.T. switchgear, &c., for Portobello station. (May 21st.)

Halifax.—June 18th. Tramways and Electricity Committee. Two natural draught chimney type water-cooling towers. (See this issue.)

Ince-in-Makerfield.—June 15th. Urban District Council. Waterworks Department. Motor-driven pumping sets; cables; alterations to winding engine from steam to electric drive; switchgear. (May 28th.)

Ingleton.—Ingleton Electric Lighting and Power Co., Ltd. Waterway across the River Greta. Particulars from Electrical Engineer to the Company, Electricity Works, Ingleton, *via* Carnforth.

Leeds.—June 14th. Electricity Department. 12,000-KW. steam turbine, alternator and condensing plant. (May 14th.)

London.—WIMBLEDON.—June 12th. Electric Lighting Committee. Two boilers, with mechanical stokers, induced-draught fan and motor pipework, steel chimney, &c. (May 28th.)

Manchester.—June 25th. Electricity Committee. Twelve months' supply electricity meters, time switches, potential and current transformers, motor-starting switches, C.C. and A.C. motors. (See this issue.)

New Zealand.—AUCKLAND.—September 1st. Harbour Board. For the supply of electric capstans and spares. Messrs. W. & A. McArthur, Ltd., 18-19, Silk Street, Cripplegate, London.

Newport.—June 26th. Electricity Department. Turbo-alternating plant, surface-condensing plant, boilers, economisers, draught plant, steel flue and stack, &c. (June 4th.)

Nottingham. — June 17th. Electricity Committee. Twelve months' supply of general stores. (See this issue.)

Nuneaton. — June 30th. Electricity Department. 1,000-KW., D.C., geared turbo-alternator, surface-condensing plant and pipework. (June 4th.)

Southampton. — July 3rd. Electricity Department. E.H.T. and H.T. switchgear and D.C. control panel. (June 4th.)

Swindon.—June 26th. Electricity Department. 2,000 yards 3-in. four-way stoneware conduits, light steel poles for overhead lines. (See this issue.)

Warrington.—June 15th. Electricity and Tramways Committee. Motors and transformers. (May 28th.)
June 29th. Electricity Department. Truck type ash elevator and hopper. (See this issue.)

CLOSED.

Australia.—SYDNEY.—City Council. Accepted.

Motor starters (spec. 590 sec. a. b. c. d.), £531; two 2,000-K.V.A. 5,000/10,000 three-phase oil-insulated water-cooled transformers for Pyrmont Power House (spec. 571), £5,015: two 2,000-KW. rotary converters (spec. 586), £31,400, Metropolitan-Vickers Electrical Co., Ltd.

Commonwealth, P.M.G.'s Department, Victoria.

Automatic switchboard equipment for Malvern, £12,658.—Automatic Telephones (Australia), Ltd.—*Tenders.*

Melbourne City Council. Accepted:

2,000 condenser tubes, £1,278.—H. V. McKay.—*Tenders.*

Belgium. — Seven home concerns submitted tenders recently to the municipal authorities of Antwerp for the electrical equipment of three transformer cabins at the Nos. 2 and 3 dock, the lowest being that of M. L. Desmedt, of Brussels.

Bradford.—Tramways Committee:

15 tons steel fishplates at £32 10s. per ton.—Walter Scott, Ltd.
10 tons C.I. brake blocks, £245.—Pease & Partners.

Electricity Committee:

Meter-testing generator, £505.—J. H. Holmes & Co.
Steam wagon for cable-drums and transformers, £1,800.—Yorkshire Commercial Motor Co., Ltd.
Steam piping, £855.—Stewarts & Lloyds, Ltd.
Fibre cable conduits, £2,512.—Key Engineering Co., Ltd.
Feed-water heater, £240.—Worthington Pump Co., Ltd.
Two hand-operated overhead cranes, £878.—Herbert Morris, Ltd.

Bolton.—Electricity Committee. Accepted:—

Worthington-Simpson, Ltd.—Condensing plant.
Stewarts & Lloyds, Ltd.—Steel piping for extensions at the Back-o'-th' Bank electricity works.

Dartford.—Urban District Council:

Boiler.—John Thompson Water-Tube Boilers, Ltd.—£5,641.
Duplicate bus-bars.—Johnson & Phillips, Ltd., £765.
Improvement of fire-alarm system.—E. E. Beaven, £460.

Dover—Board of Guardians:

Electric light installation, workhouse.—E. A. Pinto, £463.

Hammersmith.—Electricity Committee. Accepted:—

198 meters, various sizes, £662.—Electrical Apparatus Co.
148 house service boxes, £148; two disconnecting boxes, £15; 150 fuse boxes, £211.—W. Lucy & Co., Ltd.

Mains Extensions.—Switchgear; two-phase H.T. board, three-phase E.H.T. gear, sub-station equipment, isolating switches for existing boards:—

Ferguson & Pailin	**£11,167**	Delivery 18 to 19 weeks.	Recom.
G.E.C. Co., Ltd.	19,984	"	40 "
A. Reyrolle & Co., Ltd. ..	20,147	"	Not stated
Switchgear & Cowans, Ltd. ..	20,148	"	32 to 36 weeks
Park Royal Engineering Co. ..	23,390	"	78 "
Met.-Vickers Elec. Co., Ltd. ..	24,546	"	40 "
New Switchgear Con. Co., Ltd.	25,480	"	40 "
Johnson & Phillips, Ltd. ..	27,260	"	52 "

Cable Ducts.—Reference to the tender of Messrs. Sankey & Co. for cable ducts, accepted by the Council on April 28th. The firm notify that an award of the Industrial Reconstruction Committee for the clay industries has advanced the wages of the men by 8s. per week, and that this will increase the estimate by £153. As a stipulation was made in the company's tender providing for increased prices, the Committee has agreed to accept the revised offer.

Cable.—1,000 yards '1 L.T. concentric cable, £358; 500 yards '2 L.T. ditto, £304:—

Western Electric Co., Ltd., accepted.

Kingston-on-Thames.—Education Committee:

Electric light installation, manual training centre.—H. Offer.

Liverpool.—Corporation. Metropolitan-Vickers Electric Co., Ltd.—Switchgear, &c., in connection with the new 12,500-KW. generating set for the Lister Drive power station.

The Corporation has rescinded the acceptance of the tender of the Edison Swan Electric Co., Ltd., for the supply of insulated cables and wires for the 12 months ending March 31st next, and has accepted that of the Liverpool Electric Cable Co., Ltd.

London.—ST. MARYLEBONE.—Electricity Supply Committee recommended four 35-H.P. slow-speed motors and switchgear for the cooling-tower fans.

W. Hallen, Son & Co. (recommended) ..	**£2,763**	delivery 7 to 8 months.	
British Thomson-Houston Co., Ltd. ..	2,793	"	8 "
English Electric Co., Ltd.	3,116	"	12 to 14 "
Metropolitan-Vickers Electrical Co., Ltd.	3,914	"	10 "

Two turbine-driven rotary pumps, capacity 15,000 gallons per hour: £1,179, Messrs. Weir (recommended).

Circulating water pipes and valves: Aiton & Co., £1,856 (recommended).

Cables for generator and rotary converters:

British Insulated and Helsby Cables, Ltd. (recommended)	**£2,779**
Western Electric Co., Ltd	2,953
Callender's Cable and Construction Co., Ltd.	3,039
Pirelli-General Cable Works, Ltd.	3,152

House-service Meters.—The Committee recommends that the Council enter into contracts with Messrs. Chamberlain & Hookham, Ltd., and Ferranti, Ltd., for an indefinite number of meters, on the basis of their second alternative offer, for a period of one year.

General Purposes Committee. Set of Magneta electric clocks for the Town Hall, including master clock, 39 secondary wall clocks, and nine secondary mantlepiece clocks, &c.: £357, Magneta Time Co., Ltd. (recommended).

Motherwell.—Town Council:

Electricity meters for a year.—Chamberlain & Hookham, Ltd.

Poplar.—Borough Council:

Electric light installation, 144 houses.—Farndons Electric Co.

South Africa. — STRAND (CAPE PROVINCE). — Electric lighting for the municipality, Hubert Davies & Co., Ltd.
OUDTSHOORN (CAPE PROVINCE).—Hubert Davies & Co., Ltd., for the supply of the additional generating plant.

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FORTHCOMING EVENTS.

Physical Society of London. — Friday, June 11th. At the Imperial College of Science, South Kensington, S.W. At 5 p.m. Ordinary meeting.

Faraday Society.—Monday, June 14th. At Burlington House, Piccadilly, W. At 8 p.m. Ordinary scientific meeting.

Society of Engineers.—Monday, June 14th. At Burlington House, Piccadilly, W. At 5.30 p.m. Lecture on "Great Engineering Adventures," by Mr. E. Cressy.

Institution of Electrical Engineers — Wednesday, June 16th. At the Institution of Civil Engineers, Gt. George Street, S.W. At 6 p.m. Discussion on the following: Paper read by Sir Dugald Clerk, F.R.S., before the Royal Society of Arts, on "Distribution of Heat, Light and Motive Power by Gas and Electricity"; and on "The Report of the Coal-Gas and Electrical Supply Industries of the U.K. to the President of the Institution of Gas Engineers," by Sir Dugald Clerk, F.R.S., Prof. A. Smithells, F.R.S., and Prof. J. W. Cobb.

NOTES.

Inquiry.—Agents for the "Edel" electric iron are asked for.

Appointments Vacant.—Lecturer in electrical wiring, for L.C.C. Hackney Institute; armature winder, for the Rochdale Corporation Tramways; electrical engineer (£1,000), for the Southampton Corporation; head of mining department (£375), head of engineering department (£375), for the St. Helens Municipal Technical School; electrical engineer ($10,200; the Straits dollar is fixed at 2s. 4d.), for the George Town (Penang) Municipal Commissioners; two cable foremen (550 rupees per calendar month), for the Telegraph Department of the Government of India; shift engineer (94s. 2d.), for the Rawtenstall Corporation Electricity Department; mains assistant, for the Sale Urban District Council Electricity Department: assistant mains engineer (£290), shift charge engineer (£276), for the Walsall Borough Electricity Supply Department; lecturers in physics, electrical and mechanical engineering for the Birmingham Municipal Technical School. See our advertisement pages for particulars.

Educational. — Imperial College of Science and Technology.—On Friday last a public meeting was held at the Central Hall, Westminster, in support of the claim of the College to be invested with the power to confer degrees. Lord Morris presided, and amongst the speakers were Prof. Watts, Mr. H. G. Wells, Sir Ernest Rutherford, Mr. J. A. Spender, and Sir Alfred Keogh. The great majority of the large audience consisted of students of the Imperial College. A resolution urging the Prime Minister and educational departments to consider the matter seriously was moved from the chair, Lord Morris adding that if their aim was not accomplished in the regular way, there was another way to attain it. The resolution was carried, with one dissentient.

Cambridge University.—The Commercial Union Assurance Co. has presented a sum of £165,000 to build and endow a laboratory for research in biochemistry.

Electricity in Steel Making.—At a meeting of the London Section of the Igranic Engineering Society on June 2nd, an interesting lecture on "Our Part in Steel Making" was delivered by Mr. C. W. Yerger, M.A.I.E.E. The lecture covered a great deal of ground, the industry being traced from the coal and iron mines and limestone quarries to the finished products of a variety of descriptions. Dealing with the mines, the lecturer enumerated the many ways in which electricity entered into the working and described hoists, air compressors, pumps, locomotives, &c. The coke ovens then received attention, and many facts concerning belt conveyors, cranes, breakers, crushers, door-operating gear and other plant were presented to the audience, and by means of lantern slides, members were enabled to obtain a good idea of the ingenuity of the machinery. The electrical plant utilised in the blast-furnace process was given a good deal of time, and some excellent photographs of car conveyors for delivering the iron, coke, &c., at the furnace top were exhibited. Methods of using the blast-furnace gas were detailed, part being used for heating purposes, and part for the generation of electricity. The steel works and rolling mills with their powerful motors and generators were illustrated and described. Special attention was accorded the electric cranes, and the magnetic braking devices for operating upon any failure of power were exhaustively dealt with, much interest being evinced in the arrangement by which a torque motor connected in parallel with the main motor, operating a cam gear acts against a spring while in motion, releasing this to operate the brakes when the power is cut off.

Fatalities.—The Deputy-Coroner for Newcastle-on-Tyne inquired, on June 2nd, into the death of two men, which occurred while they were working on the mains of the Newcastle and District Electric Lighting Co., Ltd. The two victims were Thomas Farrer, a foreman jointer, and Murray Kennedy, an assistant foreman. George Carr, mains superintendent to the company, said on May 29th a complaint was received from a picture hall in Scotswood Road that they could get no light. Upon an inspection of the mains, witness found that the fault was in a pipe at the junction-box at the top of Forth Banks. A short circuit had been set up on a Scotswood Road cable, which had set fire to other cables. The junction-box contained eight pairs of cables. The circuits were disconnected at the sub-station, and left till Sunday, when repair-work was recommenced. Seven pairs of cables were discovered to have been burned through in the pipe, some 2 to 4 ft. from the box. One cable was intact. In order to identify the cables, the whole were pulled out and labelled. After testing the cables to see they were otherwise all right, it was decided to rejoin those cables necessary to get the current on to supply places of worship with light, and leave the Scotswood cable till last. At 5.30, five pairs of cables were jointed, and it was decided to put the current on. Before doing so, witness read to Farrer a list he had received from Mr. Cowe, the foreman in charge of the jointing. That was done in Mr. Cowe's presence, and witness asked if it were correct. The reply was in the affirmative. Witness then went to the power station and gave the list to the station engineer; proceeding thence to the sub-station, the switches were put in. In a few minutes a telephone message was received, asking that the circuits should be made dead. On examining the cables afterwards, witness found that the Scotswood B cable was fully jointed, but the Westgate B cable was only partly jointed, and he found that the two men had been working on the Westgate B when the current had been turned on. It was evident that the deceased must have made a mistake, and connected Scotswood B. instead of Westgate B, and given Westgate B as a finished circuit. R. T. Cowe, foreman cable layer, spoke to receiving the names of the finished cables from Farrer. After the accident he pulled Kennedy off the wire. Farrer had evidently made a mistake between the two cables. Witness did not check the cables, but accepted Farrer's word. A verdict of "Accidental death" was returned, and the Coroner expressed the opinion that Farrer had made a mistake.

Whilst following his employment as a colliery mechanic at Lord Ellesmere's No. 2 Mosley Common Pit, near Walkden, on June 3rd, Thomas Crook (35) was killed. He was seen to open a switchbox, although he had been warned not long before not to go near it, and had no business with it whatever. A lad named John Ivill, on going to him shortly afterwards, could get no reply from him, and he was found to be dead. The current was shut off, and the body removed.

Electric Vehicles for Invalids.—Mr. Granville Bradshaw, of A.B.C. Motors, Ltd., Walton-on-Thames, who was responsible for the A.B.C. aircraft engine, &c., has designed an electrical vehicle for the use of invalids. The machine, which has already undergone preliminary tests, consists practically of a motor-cycle side-car body on four wheels. A single electric motor drives the rear axle by chain, and a battery is carried having capacity for a distance of 35 miles on one charge. It is stated that simplicity is the keynote of the machine, which is so arranged that it can be controlled either entirely by hand or entirely by foot, or by any suitable compromise between these two methods.

Power Without Fuel.—According to a statement communicated to the International Press Service by Mr. Tom Emery, within a few weeks the public will see his invention in operation; it is described as an automatic, self-starting, self-stopping motor, which generates power without fuel "by an application of hitherto unexplored principles of mechanics." It is going to put the thermal engine out of commission, he says, and can drive anything from a watch to a super-Dreadnought. Strange to say, when the inventor advertised inviting applications for licences to manufacture his motors, only a few replies were received; so he has transferred all his rights to a limited company. The use of fuel being abolished, the cost of living is to be enormously reduced, the atmosphere of cities will be purified, the population will be diffused, and the National Debt will cease to be a burden. With wages high and working hours low, Bolshevism will be struck a mortal blow. There is nothing new under the sun, said the Preacher, and this epoch-making device is a familiar phenomenon to us. That Mr. Emery is an inventor is not open to question; and his description of the Emery motor is strictly accurate, in one respect. He says it is self-stopping.

Birmingham Electric Supply Department. — War Memorial.—The employés of the Birmingham Electric Supply Department have subscribed for and erected a memorial to their 31 colleagues who gave their lives in the war. It takes the form of a bronze tablet placed in the entrance hall to the offices in Dale End. It is a very artistic production. Surmounted by the City Arms, worked in enamel, it bears the following inscription on its centre panel:—

"This tablet was erected by the employés of this Department to perpetuate the glorious memory of their Colleagues who fell in the great war, 1914-1919."

Two side panels give a record of the names of the 31 employés who made the supreme sacrifice. Last Saturday afternoon, in the presence of a company representative of all sections of the department, the memorial tablet was unveiled by Mr. R. A. Chattock, the city electrical engineer. As befitted the occasion, which coincided with the fourth anniversary of Kitchener's death, the ceremony was a simple one, not unmingled with touches of emotion. After the unveiling, a few words from Mr. Councillor Beale, chairman of the Electric Supply Committee, and Mr. Jennings, secretary, brought the proceedings to a close. It has been arranged for photographic copies of the memorial to be sent to the relatives of the men whose names it bears.

Accident.—At the Oldham Corporation electricity works, last week, William Humphries, turbine driver, somehow touched one of the isolator switches and received a shock at 6,000 volts. He was rendered unconscious, but artificial respiration was resorted to, and after an hour-and-a-half the man was brought round. In a few hours Humphries had fully recovered his faculties. In such cases artificial respiration should be continued, if necessary, for three hours.

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The Gas Regulation Bill.—*The Board of Trade Journal* gives a résumé of the objects of this measure.

It is proposed to provide:—

1. That charges for gas shall be based upon the number of heat units supplied to the consumer instead of upon the number of cubic feet of gas supplied as at present.

2. For the necessary adjustment of standard and maximum prices and sliding scale provisions, and for an addition to the price to compensate for the increased cost of production and supply of gas.

3. For the more efficient testing of the gas; and

4. For facilities for the obtaining by gas undertakers of further powers without direct recourse to Parliament.

In effect, the Bill is one for the reconstruction of the gas industry and the adjustment of the statutory obligations imposed upon the industry with regard to the quality and price of gas in the light of modern requirements. The Fuel Research Board in a report dated January 29th, 1919 (Cmd. 108), recommended as a central principle that the existing system of charging the consumer for the volume of gas of a certain nominal illuminating or calorific value which passes through his meter, should be replaced by one in which he is charged directly for the potential thermal units he receives. The alteration in the system of charging necessitates a more efficient system of testing the gas, and the Bill, while allowing gas undertakers to supply gas of any calorific value, which they declare that they propose to supply, makes provision for the extension of the functions of the gas referees and of the chief gas examiner, which are at present confined to London, to the whole country, so that testing everywhere will in future be carried out according to their directions. It is proposed in Clause I to give the Board of Trade power to make departmental orders under which effect will be given to the principles of the Bill in accordance with the conditions of the individual undertakings.

The second clause contains the statutory requirements with which undertakers, who have obtained orders from the Board of Trade, will have to comply with regard to the composition and pressure of the gas supplied by them. Power is taken if necessary to impose a limitation on the proportion of inert constituents of the gas, but an important protection of the consumer against an excessive proportion of such constituents will lie in the fact that under the new system of charging by heat value he will not have to pay for them.

A restriction on the proportion of carbon monoxide in the gas has been advocated in the interests of public health by the Fuel Economy Committee of the British Association. The Bill places an obligation on the Board of Trade to cause an inquiry to be held into this question, and if as a result of the inquiry any such restriction is found to be desirable the Board will be authorised to make a special order relating to the matter.

It is intended under the Bill that the additional costs of production and supply shall be allowed for with a view to enabling undertakings as a general rule to earn approximately their pre-war rate of profit.

The costs of administering the Act are proposed to be met by the formation of a gas fund for which a levy not exceeding £15 for each 100,000,000 cu. ft. of gas is to be made; that is to say, not more than one penny for every 14,000 cu. ft. of gas. Undertakings making less than 100,000,000 cu. ft. in the year will not be required to contribute.

Concrete Pipe Manufacture.—The May *Journal* of the S.A. Institution of Electrical Engineers contains a paper upon the manufacture of concrete pipes by the Hume centrifugal process (Hume Pipe Co. (S.A.), Ltd.). The materials employed are crushed stone from the mines in the Witwatersrand area, cement from the Pretoria Portland Cement Co., and, for reinforcement, discarded winding ropes, of which large quantities are available. The ropes are cut into suitable lengths, annealed, and then unstranded. They are then woven into cages which are placed in the pipe moulds. The latter are made of light galvanised steel sheet with cast-iron end rings, which serve a treble purpose, securing the steel casing, forming the thickness of the pipe, and providing the running treads which come into contact with the revolving disks of the moulding machine. These machines are of simple design operated by variable speed motors or long cone pulleys. The moulds are placed on the machine and rotated slowly. The concrete is thrown into the moulds until the required amount is furnished, the machine is gradually speeded up, and the centrifugal force causes the material to be evenly distributed throughout the length of the moulds; water is also driven out by this method. If an exceptionally smooth internal surface is desired, a polishing bar of steel pipe is firmly applied to the surface of the concrete. The lengths of the pipes are usually as follows: Up to 15 in. diameter, 6 ft., and from 18 to 72 in. in diameter, 8 ft. Six 4 or 6-in. diameter pipes can be completed in eight or nine minutes, and four 15 or 18-in. pipes in fifteen minutes. Larger sizes up to 60 in. diameter can be finished in about twenty minutes. The joints are made by slipping a collar of the same material over the pipes, and packing with a sand and cement mixture for low pressures or a special plastic mixture for high pressures. Sizes up to 9 in. diameter will withstand a working pressure of from 300 to 350 lb. per sq. in., while larger sizes have been tested up to 210 lb. per sq. in.

Industrial League Convention.—The Industrial League and Council is organising a convention of employers and employes to be held on Tuesday and Wednesday next, 15th and 16th inst., in Manchester. We understand that the Manchester Engineering Council is cordially co-operating with the representatives of the League in the district in making the necessary arrangements. The Conference will be held in the Town Hall.

Registration of Engineers.—The May issue of the *Journal of the Engineering Institute of Canada* gives the texts of the professional engineering Acts that have become law in British Columbia and Manitoba to incorporate the associations of professional engineers. In New Brunswick and Nova Scotia it is expected that during the present sessions of the Legislative Assembly other Acts will have been passed, and the Alberta Act has been passed recently. In Quebec there has been established the Corporation of Professional Engineers. In Ontario the formulation of an acceptable Bill is in the hands of an Advisory Conference Committee established by the suggestion of the Ontario Provincial Division. In Saskatchewan changes were suggested by the Premier which caused the Bill to be withdrawn. In the Bills that have become law "professional engineer" means any person registered as a professional engineer under the provisions of the Act; "professional engineering" or "the practice of a professional engineer" embraces the designing, supervision, the advising on the design, or supervision and the advising on the making of measurements for the construction, enlargement, alteration, improvement, maintenance, or valuation of public or private utilities, industrial work, railways, bridges, tunnels, highways, roads, canals, harbour works, harbours, river improvements, lighthouses, wet docks, dry docks, floating docks, dredges, cranes, and other similar work, steam engines, turbines, pumps, internal combustion engines, and other similar mechanical structures, airships and aeroplanes, electrical machinery and apparatus, chemical and metallurgical machinery, and works for the development, transmission, or application of power, mining operations, and apparatus for carrying out such operations, municipal works, irrigation works, water works, water purification plants, sewerage works, sewage disposal works, drainage works, incinerators, hydraulic works, and all other engineering works. The execution by a contractor or his assistants of work designed by a professional engineer, or the direction of work as otherwise defined in this clause by superintendent of construction, or superintendent of maintenance, or their subordinates when working from designs or upon advice of a professional engineer, shall not be deemed to be the practice of professional engineering within the meaning of this Act.

In the U.S.A. a committee has reported to the Society of Civil Engineers on the advisability of legislation providing for the registration of licensing of practitioners of professional engineering, architecture, and land surveying, and has recommended a uniform registration law. The report states that in fixing the qualifications for registration these were purposely made high, but they have not been made unnecessarily difficult for reasonably competent men to meet. It is not intended that candidates would ordinarily be subjected to written examinations, but rather that the board of registration would pass upon the sufficiency of the professional record of each candidate. Minimum qualifications have been provided. In order to enable the board to pass upon candidates fairly certain qualifications are specified as, *prima facie*, evidence of fitness, which (unless other facts derogatory to a candidate are also in evidence) will permit the board to pass the candidate. The principal qualifications are: Long continued practice, graduation from a technical school of approved standing, with subsequent years of practice or membership in high-grade technical societies, in the absence of disqualifying facts.

Electrical Pumping in the U.S.A.—During the winter and spring of 1918-19, according to the *Engineering World*, 97 of the 206 public water works systems in Indiana were visited by members of the engineering experiment station staff of Purdue University, with a view to ascertaining the present status of electrical operation of such plant. Among the conclusions given are: (3) The energy consumption in properly designed plant may be expected to vary from 0.2 to 2.0 kw.-hours per 1,000 gal. per 100 ft. head, with 1.0 as a fair average. (4) The operating expenses for an electrically operated plant are low—considerably below those for a steam plant and appreciably below those for an internal combustion engine plant. —*Technical Review.*

U.S.A. National Electrical Code Revision.—The National Electrical Code was first promulgated 23 years ago, and has grown until to-day its rules are not much short of absolute law. The committee that revises the code includes representatives of the National Electric Light Association, American Institute of Electrical Engineers, American Electric Railway Association, National Electric Contractors' Association, U.S.A. Bureau of Standards, besides representatives of national and municipal bodies interested in fire prevention and underwriters' organisations. In March last, at New York City, the Electrical Committee of the National Fire Prevention Association held a public meeting on the recommended changes in the code. After the public hearing the committee held a closed meeting, at which the recommended changes were adopted with some few exceptions.

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INSTITUTION NOTES.

South African Institution of Engineers.—The May *Journal* gives further and more complete details of the scheme for providing a meeting place for the South African technical and scientific institutions and societies. The Institution will be known as the "Associated Scientific and Technical Societies of South Africa." The Institute of Engineers is contributing £500 from its funds, and the members are endeavouring to raise at least another £2,000 towards the cost of the scheme. The purchase of the Johannesburg Club will cost £22,500, and the Chamber of Mines has agreed to contribute 10s. for every £1 subscribed up to a total of £5,000, and also to meet interest charges on mortgages for the first two years.

South African Association of Municipal Electrical Engineers.—According to *Engineering in South Africa*, the Annual Convention will be held this year during the week September 13th to 18th at Pretoria, where Mr. T. C. Wolley-Dod, town electrical engineer, will act as President. Provisional promises for papers have been received from Mr. A. E. Val Davies, of Cape Town, Mr. Mordy Lambe, of East London, and Mr. G. Mercier, of Bethel.

Since the last Convention, says our contemporary, the Association has suffered the loss of a number of prominent members, amongst whom may be mentioned Col. Dobson, D.S.O., Johannesburg (Past President), Mr. D. A. Stewart, Bloemfontein (Member of Council), Mr. W. Bellad Ellis, Queenstown (Member of Council), and Mr. E. T. Price, Johannesburg (Member of Council), and their places will be hard to fill.

"Most of these past members are making the change from municipal to commercial life, and it would appear that the municipalities to-day have not a sufficient appreciation of the opportunities offering to technical men of initiative and experience, or else on the other hand, there must be a feeling that the restrictions and vexations of municipal work put too great a curb on their energies and ambition."

S.A. Institute of Electrical Engineers.—In the course of a discussion, on April 22nd, on the use of electricity in developing the resources of the Union, Mr. J. W. Kirkland, past president, referring to the use of electricity in connection with agriculture, said that he believed that the time of the dark farm, when the farmer and his wife got up in the dark of the morning to milk their cows, and went to bed by candle light, had passed, and that electricity was going to change farming into a more normal kind of life. It could only be done by electricity. The farming population would increase their happiness and increase the output of the farms by electricity; having learned the advantages of electricity by reason of the electric light, they would then find the other advantages of using electric power.

Mr. C. J. M. Constancon said that before the war a director of a large German electrical manufacturing firm told him that in Germany agricultural progress was principally due to the adoption of modern and scientific methods, and that electricity had made in this direction a great stride forward. He pointed out that one of their big items of manufacture came under the heading of electrical material for agriculture, such as motors, high-tension sets for electroculture, and special types of tractor sets. He also said that for certain types of cultivation, electricity had been extensively employed; that meant that bad soil had been greatly improved. Another great factor which showed in what measure electricity was used for agriculture, was the great system of generating stations which had been erected all over the country, and was known as the overland centrals. Mr. Constancon had also visited one of the large estates in Silesia, and was surprised to see what they were doing by means of electricity. Electrical ploughing was going on night and day, and most of the work, such as the milking of the cows, the pumping, milling, cutting, and pressing was all done by electricity. There was a great future for electricity in connection with agriculture, and especially for those farms which were near large generating stations.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW posted as to their movements.

Captain H. L. DIXON, late R.A.F., has resigned his position as chief engineer and manager to the Leatherhead & District Electricity Co., Ltd., held since 1906, to take up private work.

Watford U.D.C. has granted the following increases of salary: Chief electrical engineer, from £650 to £800; chief assistant and station superintendent (Mr. C. E. GREENHALGH), from £384 to £602 10s. (graded as power station superintendent); mains superintendent (Mr. J. E. Wallers), from £342 to £538.

Mr. A. S. HOOPPELL, late junior assistant engineer at the Southend-on-Sea Corporation power station, has been appointed a charge engineer at the Torquay Corporation works.

Mr. L. OSTICK, mains assistant at the Bridlington electricity works, has been appointed to a similar position with the Finchley Council.

Dover T.C. has appointed Mr. E. L. SHOESMITH charge engineer, at a salary of £200 a year, to be reviewed at the end of three months.

Mr. R. L. HORSFIELD, manager of the Walsall Corporation Tramways, who is leaving for a similar appointment at Cardiff, has been presented by the staff with an inscribed oak bureau bookcase.

The salary of Mr. WISHART, electrical engineer at Motherwell, is to be increased by £100 to £550 per annum. The A.M.E.E. requested the payment of £773, with £60 bonus, plus 30 per cent.

The American Academy of Arts and Sciences has awarded the Rumford Premium to Dr. IRVING LANGMUIR, for his researches in thermionic and allied phenomena.

The Willard Gibbs medal has been presented to Dr. F. G. COTTRELL, director of the U.S. Bureau of Mines, by the Chicago Section of the American Chemical Society in recognition of his researches on the precipitation of fumes and dust.

Bath City Council has increased the salary of Mr. F. TEAGUE, the City Electrical Engineer, from £700 to £850 per annum.

The Birthday Honours List.—In the list of Birthday Honours, which was published on Saturday last, the following gentlemen are awarded the honour of knighthood:—

Mr. Philip Dawson, for service rendered as a member of the Disposal Board, Ministry of Munitions.

Mr. William Noble, chief engineer to the General Post Office.

Professor J. B. Henderson, D.Sc., Professor of Applied Mechanics, R.N. College, Greenwich.

The ELECTRICAL REVIEW tenders its congratulations to these three gentlemen.

Obituary.—MR. O. V. THOMAS.—We regret to read in the *Times* of the death which occurred on May 30th, at Marseilles, from pneumonia, of Mr. Orlo Venning Thomas, Municipal electrical engineer, Penang, late P.W.D., Straits Settlements, age 51.

PROF. AUGUSTO RIGHI.—The *Times* correspondent at Milan reports that Prof. Augusto Righi, who held the Chair of Physics at Bologna University and was well known for his experiments in magnetism and electricity and light, died at Bologna on Tuesday at the age of 70 years.

NEW COMPANIES REGISTERED.

W. Canning & Co., Ltd. (167,927).—Public company. Registered June 1st. Capital, £450,000 in £1 shares. The objects are: To carry on the business of manufacturers of and dealers in polishing and plating plant, machinery, apparatus, and materials and preparations for the businesses of electro platers, polishers, electro depositors, enamellers, and lacquerers, metallurgical chemists and analysts, drysalters, electrical and general engineers, &c., and to adopt an agreement with E. R. Canning. The first directors are: E. R. Canning, Grey House, Hamstead Hall Road, Handsworth, Birmingham; T. R. Canning, The Tan House, Lapworth, Warwick; A. B. Canning, 5, Park Avenue, Handsworth, Birmingham; E. Williams, Benson Works, Foundry Lane, Birmingham; G. A. Pope, Southam Road, Hall Green, Birmingham. Solicitor: E. P. Beale, 12, Newhall Street, Birmingham. Registered office: 137, Great Hampton Street, Birmingham.

Vickers-British East Africa, Ltd. (188,013).—Private company. Registered June 4th. Capital, £2,000 in £1 shares. To carry on the business of manufacturers of and dealers in steel, iron, brass, and metals, shipbuilders, shipwrights, ordnance manufacturers, electricians, &c. The first directors are: Sir Francis Barker, Lowndes House, Lowndes Square, S.W.; S. V. Dardier, 48, Grange Road, Ealing, W.; N. Robinson, Westmoor, Green House, Slough (all of various other companies). Solicitors: Linklater and Paines, 2, Bond Court, Walbrook, E.C. Registered office: Vickers House, Broadway, Westminster.

Uno Co., Ltd. (167,790).—Private company. Registered May 27th. Capital, £5,000 in £1 shares. To carry on the business of electrical and general engineers, manufacturers of the "Uno" roaster, &c. The first directors are: P. B. Benkert, 159, Venner Road, Sydenham, S.E.; W. Bennett, 28, Amhurst Park, Stamford Hill, N.; C. P. Bennett, 28, Amhurst Park, Stamford Hill, N. Solicitor: W. N. Wyles, 4, Walbrook, E.C. Registered office: 90, Minories, Tower Hill, E. 1.

Hays, Standen & Co., Ltd. (167,869).—Registered May 31st. Capital, £50,000 in £1 shares. To take over the business of engineers, merchants and manufacturers carried on at 71, Southwark Street, S.E., as "Hays, Hunter & Standen, Ltd.," and to carry on the same and the business of dealers in machinery and plant, castings for electrical, motor, and allied industries, switches, lamp holders, &c. The first directors are: J. D. Garrett, 88, Ebury Street, S.W.; P. J. Hays, Bleangate, Purley, Surrey; H. W. Standen, Canterbury House, Sevenoaks. Solicitor: T. W. Hall, 61, West Smithfield, E.C. Registered office: 71, Southwark Street, S.E.

City Electric Welding Co. (Newcastle), Ltd. (167,863).—Private company. Registered May 31st. Capital, £5,000 in £1 shares. To carry on the business of electric and oxy-acetylene welders, automobile engineers, agents for motor lorries, cars, cycles, scooters, and motor and aeroplane accessories, marine engineers, ship builders and repairers, &c. The first directors are: A. Atkinson, 1, Lesbury Road, Newcastle-on-Tyne; W. C. Waller, Elderhurst, Granville Road, Newcastle-on-Tyne; C. Deuchar, Overdale, Lindisfarne Road, Newcastle-on-Tyne. Secretary: W. C. Waller. Registered office: 2 and 4, Stephen Street, Bridge End, Byker, Newcastle-on-Tyne.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Crampton & Co., Ltd. (109,328).—Capital, £2,500 in £1 shares. Return dated April 8th, 1920. All shares taken up and paid for in full. Mortgages and charges nil.

Lymington Electric Light & Power Co., Ltd. (57,985).—Capital, £30,000 in £5 shares (4,600 ordinary and 1,400 preferred). Return dated March 31st, 1920. 3,588 ordinary and 1,285 preferred shares taken up. £24,375 paid, including £10 on shares forfeited. Mortgages and charges, £9,000.

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Crossley Bros., Ltd. (51,970).—Return dated May 9th, 1920. Capital, £2,000,000 in £1 shares (403,390 preferred, 1,015,414 ordinary, and 581,196 unissued). All preferred and ordinary shares taken up. £533,200 paid. £885,604 considered as paid. Mortgages and charges, nil.

Chas W. Webber, Ltd.—Debentures dated May 17th, 1920, to secure £500, charged on the company's undertaking and property, present and future, including uncalled capital. Holder: F. E. Dove, Chandos Lodge, Weston-super-Mare.

British Union Lamp Works, Ltd.—Particulars of £20,000 debentures authorised May 20th, 1920; whole amount issued. Property charged: The company's undertaking and property, present and future, including uncalled capital, subject to £10,000 first mortgage debentures. No trustees.

Sutton-in-Ashfield Motor & Electrical Engineering Co., Ltd.—Debentures charged on certain land and premises in Sutton-in-Ashfield, and the company's undertaking and property, present and future, including uncalled capital, dated May 14th, 1920 to secure all moneys due or to become due from the company to London County Westminster and Parr's Bank, Ltd.

Lighting & General Traders, Ltd.—Satisfaction in full on April 14th, 1920, of debentures dated November 6th, 1919, securing £682 10s.

Whitchurch & Pangbourne Electric Supply Co., Ltd.—Satisfaction in full on April 29th, 1920, of charge dated August 14th, 1919, securing £300.

CITY NOTES.

United River Plate Telephone Co., Ltd.

The gross earnings for the year 1919 were £976,168, and the gross maintenance and other charges in Argentina and London were £764,076, leaving £212,092, from which debenture interest and preference dividend are deducted; 8 per cent., free of tax, is paid on the ordinary shares; £50,000 is put to reserve; £10,000 to reserve (war contingencies) fund; £35,700 is carried forward, as against £36,707 brought in. The directors have sanctioned the introduction into Buenos Aires of the automatic system. The shareholders are to be asked to authorise the increase of the capital to £2,500,000, with power to the directors to issue new shares at such times and upon such terms and conditions as they shall determine, as the general expansion of the undertaking of the company and the necessity of coping with the ever-increasing demand for new telephone facilities entail an outlay which can only be met by the provision of additional capital.

Callender's Cable and Construction Co., Ltd.

The report for 1919 shows a balance to the credit of profit and loss account of £161,525. Debenture interest absorbs £13,500; preference dividend £26,000; depreciation of buildings, plant, and machinery £37,500; depreciation of office furniture £500. The balance brought forward was £114,779, and the available balance is £198,803; 15 per cent., less income tax, on the ordinary shares requires £60,000; there is put to special reserve for war taxation £33,000, and carried forward £105,803. During the year an entire change has taken place in the business of the company, as the factories both at Erith and of the Anchor Co. at Leigh, have been converted from manufacturing war materials to ordinary commercial production. This conversion has involved much work, and has taken considerable time. During that period output was seriously interfered with, but the change-over is now complete, with most satisfactory results. The urgent necessity to increase the company's production, notwithstanding the working week being reduced to 47 hours, required a reorganisation of the factory conditions, and, after lengthy negotiation, a system of continuous working by three rotary shifts was established, with the result that output has now been substantially increased. In the early part of the year it became evident to the directors that additional plant and machinery were required to meet the increasing demands of the industry for cables capable of working at much higher voltages than in the past. Extensive new workshops were therefore erected for the manufacture of super tension mains of 33,000 volts and upwards, and these are now practically completed. The Picardy works, which were specially erected and equipped with machinery for the rapid manufacture of field telephone cables for the army, have been completely converted and re-equipped with plant for the manufacture of telephone cables for general use. The financial results of 1919 are regarded as eminently satisfactory, especially when consideration is given to the difficulties inseparable from the great change-over which has occurred, and the general reorganisation of industry. They believe that the full results of the new plant will only be apparent in the future, and, seeing that the volume of orders obtained is exceptionally large, they have every hope that the financial results of the current year will be even more favourable. The business of the Anchor Cable Co., Ltd., a subsidiary of this company, suffered from the process of conversion referred to above, but, nevertheless, the financial results have been satisfactory. An excellent feeling prevails between the operatives and the management. As the financial resources of the company, even with the additional capital issued in 1918, have not sufficiently met the requirements of the company's increasing trade, the directors, early in April last, took the necessary steps to increase the capital by the creation of 400,000 "B" cumulative preference shares of £1 each; these will be issued shortly and, with them, the unissued balance of 100,000 ordinary shares.

Marconi International Marine Communication Co., Ltd.

The report for 1919 states that the business continues to show substantial expansion. Gross revenue £772,019, an increase of £208,813 over 1918. This increase is in part due to an advance in ship subsidies in consequence of a large advance in salaries of telegraphists during the period and it is counter-balanced to a considerable extent by the increase in expenditure.

In consequence of unfavourable rates of exchange which obtained at the end of the year, considerable sums of money have been allowed to remain abroad on deposit or invested in foreign Government securities. A sum approximating £50,000 has been debited to profit and loss account, calculating the rate of exchange on December 31st, as though the money had been brought home at that date, and the loss incurred. The loss, however, has not been actually incurred, and when in the course of time exchanges improve as no doubt they will do, the sums written off will figure in a future balance sheet as a profit.

Notwithstanding this temporary depreciation and the writing off of some £20,000 representing depreciation in investments in Government securities, the profit for the year shows an increase over the preceding year.

Final dividend of 10 per cent. for 1919, making 15 per cent. for the year. 748 debentures of a par value of £14,900 were redeemed. The total number of public telegraph stations owned and worked by the company on the high seas increased from 2,549 to 2,842. The organisation of the company, together with that of its associated companies, has continued to render inestimable service in the saving of life and property. The Amalgamated Wireless (Australasia), Ltd., in which this company is interested, has paid a dividend of 5 per cent. in respect of the year ended June 30th, 1919. Of the 600,000 new shares offered to shareholders, at par, on May 10th, 1919, 592,726 shares were subscribed. Lord Herschell, G.C.V.O., has been appointed a director.

Cork Electric Tramways & Lighting Co., Ltd.

The revenue for 1919 was £90,869 and the expenses were £70,734, leaving £20,135 plus £3,649 brought forward. Interest on the debentures absorbs £4,600; there is put to reserve for depreciation and renewals, £6,500; to maintenance reserve, £4,000. 5 per cent. dividend on the preference shares requires £6,161, leaving £2,512 to carry forward. The revenue increased by £11,941 as compared with 1918 (of which £4,930 was from the tramways and £6,232 from lighting and power). Expenses increased by £13,349, chiefly due to higher salaries and wages and cost of coal and other materials. The gross profit shows a reduction of £1,408 as compared with 1918. An increase in fares was authorised in August, 1919, and the revenue since that date has materially improved. The increased revenue from lighting and power is mainly due to increased charges. Expenses have materially increased since the last revision of fares, and lighting and power tariffs and further adjustments of charges are now under consideration. Capital expended during the year (£13,290) was mainly for house services, cables and plant. A 2,000-KW. Curtis turbine is now in course of construction. The lease of the Lighting Order from the Cork Corporation which expired in August, 1918, has, after prolonged negotiations, been renewed for a period of 40 years; the approval of the Board of Trade is awaited.

Urban Electric Supply Co., Ltd.

Presiding at the annual meeting recently Mr. P. D. Tuckett said that last year, following on an increase of £28,000 in 1918, the higher price of coal and the rise in wages account for a further increase of £36,000, making a total increase of £120,000 since 1914 for those two items alone. They had repeatedly applied to the Board of Trade for sanction to increases in their charges to meet these increased costs, but the relief obtained had been wholly inadequate. They had hoped that the Bill which, together with Edmundsons' Electricity Corporation, they had promoted, would have given them the right to earn the reasonable return on their capital to which they were entitled and without which they could not properly discharge their statutory obligations. Whereas every other trader, including the Government, had long since met the conditions by a corresponding adjustment of price, this company was still suffering and, indeed, all but perishing, from inability to make such adjustment. It was the only remedy open to them, and it would be a monstrous injustice if it was much longer denied them—both to shareholders and to the staff. It was with much regret that he had to report the rejection of the Bill by the Select Committee of the House of Lords. Since then they had had an interview with the Electricity Commissioners, and they appeared to be alive to the seriousness of the position and professed their anxiety to find a remedy without delay. They were unable to specify the exact form which the remedy would take. The company would leave no stone unturned to get the Commissioners' good intentions converted into definite action at the earliest possible date. No further capital would be put into the business until there was a satisfactory assurance of a reasonable return thereon; yet no business was more dependent on a steady flow of new capital, if healthy development was to continue. But for the war they would have been able to show an available balance to-day of between £50,000 and £60,000 which would have amply sufficed to provide for depreciation and for the payment of a substantial ordinary dividend. Instead, however, of their being in a position to pay an ordinary dividend, they were unable to pay any preference dividend, and were not even able to provide at all adequately for the increased depreciation which the increased cost of

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plant renewals now entailed. The results were deplorable, and unless the conditions which had produced them were very shortly relaxed, it was quite obvious that the industry, so far as most of the smaller provincial undertakings were concerned, was going to be brought to a standstill. They were not only denied the right to earn a profit, but were compelled to supply at a heavy loss which it was altogether beyond their capacity to bear. So desperate were the straits to which some of the undertakings were reduced, that from sheer lack of funds it was no longer possible for them to pay their men the increased scale of wages which recent awards entitled them to claim. They had, therefore, most reluctantly been forced to adopt, as the only policy open to them, the purely retrograde one of doing everything in their power to discourage development. In the present uncertainty as to the treatment they were to receive, he hesitated to offer any advice as to the value of the shares, but it would be a pity if they were to allow the natural disappointment and discouragement of the moment to induce them lightly to throw their holdings. The enormous increase in the cost of plant and buildings had greatly enhanced the value of the property, and it was only the artificial and unfair restriction of their rates of charge that prevented it from producing a satisfactory return. Provided therefore that they were given the right to charge higher prices, which they were satisfied their consumers would readily pay, he saw no reason why they should look to the future with any less confidence than formerly. The demand promised to be greater than ever, but before they could increase their obligations they must have a reasonable expectation of earning a commercial return. Under the most favourable circumstances some little time was bound to elapse before they could make good the injury, and fully restore the position to what it should be.

German Companies.

The directors of the *A.G. Mix & Genest, of Berlin*, recommend the payment of a dividend at the rate of 7 per cent. for 1919, this contrasting with no distribution in the preceding year.

The Lloyd Dynamo Werke A.G., of Bremen, proposes to pay a dividend at the rate of 7 per cent. out of net profits of 188,000 marks in 1919, as compared with 7 per cent. and 201,000 marks respectively in the preceding year.

The accounts of the *Deutsche Kabelwerke A.G., of Berlin*, including the balance forward, and after making provision for depreciation, show net profits of 1,392,000 marks for 1919, as compared with 896,000 marks in the previous year. It is intended to pay a dividend at the rate of 10 per cent., being the same as in 1918.

The report of *Voigt & Haeffner A.G., of Frankfort-on-Main*, states that a scarcity of raw materials continued in 1919 and caused great restrictions in the production. The net profits amounted to 1,840,000 marks, as compared with 2,003,000 marks in 1918, the dividend being at the rate of 18 per cent., as in the preceding year. It is said that the prospects are not unfavourable provided that a sufficient supply of raw and semi-finished materials is available.

The report of the *Dr. Paul Meyer A.G., of Berlin*, states that the difficulties experienced in obtaining raw materials rendered it impossible fully to meet the demand in 1919, particularly in the new department for electricity meters. The net profits amounted to 675,000 marks, as against 437,000 marks, and a dividend at the rate of 10 per cent. has been declared on the increased capital of 6,000,000 marks, being the same rate as in 1918.

The Ges. fur Elektrische Unternehmungen, of Berlin, states that the tramways in which the company is interested experienced still more unfavourable results in 1919 than in the preceding year. The net profits were derived partly from the sale of foreign investments and partly from the improved results of electricity supply works, they having amounted to 5,792,000 marks, as compared with 4,485,000 marks in 1918. It is proposed to pay a dividend at the rate of 8 per cent., as against 6 per cent. in the previous year, and to devote greater attention to investments in manufacturing works in the future.

The report of the *Bergmann Elektrizitats Werke A.G.*, of *Berlin*, whose accounts have previously been published (12 per cent. for 1919, as in the preceding year) states that an abundance of orders was received for all departments, although the irregularity in the production specially prejudiced the export trade, as it was impossible fully to execute the orders resulting from the resumption of relations. In general manufacturing was limited to the satisfying of normal commercial requirements. Numerous light and power installations and portable motors were delivered for agricultural purposes, and the railway department was chiefly occupied with the completion of heavy high-speed locomotives.

The report of the directors of *Hartmann & Braun A.G., of Frankfort-on-Main*, states that the net profits in 1919 were the lowest in the history of the company. After applying 513,000 marks to depreciation, as against 425,000 marks in 1918, the accounts show net profits of 71,000 marks, as compared with 295,000 marks. Including the balance forward and 100,000 marks transferred from the transition reserve fund, the sum available for disposal is 267,000 marks, as contrasted with 357,000 marks in the previous year. It is proposed to pay a dividend of 6 per cent., as compared with 9 per cent. and 15 per cent. in the two preceding years respectively. As to the cause of the less satisfactory results last year, it was stated at the recent general meeting to be extremely difficult to calculate prime costs and sale prices in times of economic fluctuations, whilst if the coal supply became further reduced the worst apprehensions would be justified. It was also necessary to take into consideration the reserve manifested in the general business, and they would have to be prepared for still further reserve and extensive cancellations of orders.

Havana Electric Railway, Light & Power Co.—For 1919 the gross earnings totalled $9,397,452. Operating expenses and taxes $4,979,685, leaving net income $4,417,767. Net profits from operation and miscellaneous income $3,502,594, out of which has been set aside as reserve for depreciation $622,121, leaving $2,880,473, plus $2,639,025 brought forward, making together $5,519,498, from which has been deducted amortisation of bond discount and expenses $24,250, provision for sinking fund in respect to English bonds of Compania de Gas y Electricidad de la Habana $13,533, provision for sinking fund in respect of consolidated mortgage bonds of Havana Electric Railway $114,870, provision for sinking fund in respect to general mortgage bonds of Havana Electric Railway, Light & Power, $52,728, dividends paid during year (6 per cent. on preferred and common) $2,155,612, leaving to be carried forward $3,158,503.

A Swiss Investment Co.—The directors of the Motor A.G. fur Angewandte Elektrizitat, of Baden, Switzerland, which is a holding company connected with the Brown-Boveri group, state that the undertakings in which the company is interested developed favourably in 1919. The net profits amount to 2,150,000 fr., as compared with 2,271,000 fr. in 1918, and a dividend of 5 per cent. has been declared, as against 7 per cent. A loss of 3,604,000 fr. in exchange is recorded on foreign investments and credits, and has been placed to an exchange account to be redeemed.

Great Northern Telegraph Co., Ltd.—The directors propose for 1919 the distribution of a total dividend and bonus of 22 per cent., including the 5 per cent. already paid, and to transfer £61,111 to the reserve and renewal fund and £55,556 to the renewal fund for cable steamers; £41,667 has been allotted to the pension fund. It is further proposed to set aside £305,556 for extraordinary taxes, and to carry forward £141,607 to 1920.

Siemens Brothers & Co., Ltd.—The annual meeting was held on Tuesday. The dividend, 10 per cent. for the year, has already been mentioned here. According to the *Financial Times*, £5,000 has been placed to buildings reserve, £7,329 to pension fund and retiring allowances, £25,000 to write off from discount the sale of debenture stock, reducing the item to £37,500, £15,000 to general reserve, making £75,000, carrying £315,776 forward, subject to excess profits duty.

At the meeting, Mr. G. Mure Ritchie, the chairman, delivered a very interesting speech on the progress that was taking place in all departments of the business. We shall deal with the matter in our next issue.

Public Issue.—*W. Canning & Co., Ltd.*—The *Times* states that "another industrial flotation that is to be made in the very near future is the century-old business of W. Canning and Co., the Birmingham firm of electro-plate manufacturers and dealers. The present issue is 300,000 ordinary shares of £1, of which 100,000 will be taken by the vendor as part of the purchase consideration."

Stock Exchange Notices.—Application has been made to the Committee to allow the undermentioned to be officially quoted:—

London Electric Wire Co. & Smiths, Ltd.—400,000 7½ per cent. cumulative preference shares of £1 each, fully paid (Nos. 1 to 400,000).

Calcutta Electric Supply Corporation, Ltd.—The number of units sold to consumers has amounted to: Four weeks ended February 27th, 1920, 2,342,360; 1919, 2,009,647. Four weeks ended March 26th, 1920, 2,624,680; 1919, 2,379,613. Five weeks ended April 30th, 1920, 3,764,065; 1919, 3,283,030.

Yorkshire (West Riding) Electric Tramways Co., Ltd.—Interim dividend of 3 per cent., less tax, on the 6 per cent. cumulative preference shares for half-year ending June 30th.

Calcutta Tramways Co., Ltd.—Final dividend of 6s. 6d. per share, free of tax, making 10 per cent. for 1919 on the ordinary shares.

Greenwood & Batley, Ltd.—Net profits for year ended March, 1920, £60,044, plus £14,422 brought forward. Total dividend for the year on the ordinary shares 15 per cent.; £6,000 to depreciation; £10,000 to contingencies; £25,308 carried forward. £174,195 of reserve has been capitalised, and share for share distributed. As a result of revaluation of the works £150,000 appreciation on book value has been added to reserve.

British Electric Traction Co., Ltd.—Dividend of 4 per cent. on the ordinary stock for year ended March, 1920, carrying forward £150,000.

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STOCKS AND SHARES.

Tuesday Evening.

The dropping of the idea of a War Wealth Levy had less effect in the Stock Exchange than it might have done had it not been for the fears of dearer money which make themselves felt amongst all the investment markets. Nor is the anxiety confined to investment markets only, inasmuch as the possibilities of an 8 per cent. Bank Rate weigh also upon enterprise as it concerns more speculative operations, and checks business generally. There are those in the City who scoff at the idea of an 8 per cent. rate on this side of September, but the Bank and Treasury have given too recent evidence of their capacity for springing surprises on the monied community for a great deal of certainty to be felt in regard to Bank Rate stability at present. This, in fact, is the predominant influence in markets at the moment, and naturally it has a depressing influence.

The Home Railway market is troubled again by another batch of demands from the railwaymen. As the eel gets accustomed to skinning, so the market for these stocks is by now familiar with the persistent rise in expenses. Therefore prices are not flat. They are simply heavy. Underground Electric Incomes at 58½ are 2 points down, but the shilling shares came into some little request, and moved up to 5s. Districts are lower at 15. Metropolitans have been left unchanged at 19½. It may be worth mentioning that Metropolitan 3½ per cent. debenture can be bought at 57½, with an interest payment due in July, and the yield at this price is 6¼ per cent. on the money. London Electric 4 per cent. preference at 50½ pays practically 8 per cent., and District 4½ per cent. preference is on offer at 56, paying 8⅛ per cent. In spite of the demand that there is for a good many Home Railway prior-charge stocks, these Underground descriptions are somewhat out of favour, though for the longer shot some people regard them as worth picking up at current quotations in order to mix with securities that return less on the money.

Amongst foreign traction varieties, the principal feature is the strength of Anglo-Argentine Tramways 1st preference. The price touched 3¾ before coming back to 3½, the latter showing a rise of 5s. on the week. This is due to the directors' announcement that the company will pay off one year's arrears of dividend to the middle of 1918, leaving two years more, which in money is equal to 11s. per share, to be met later on. This resumption of dividends will have been expected for some time past by those who have followed this column. The company's 5 per cent. debenture stock gained 3½ at 59½, and the second preferences at 3⅛ are the fraction to the good. Brazil Tractions lost 2 points of their last week's jump, and in Mexicans there is nothing fresh to report. A rise of 2 in British Columbia Electric preference advanced the price to 57½. The various dollar securities are a little better on the week, but the rises are mostly confined to a point or so apiece, and no dramatic change has taken place throughout the list. Canadian General Electric preference at 109½ are 2 higher.

Cable companies' stocks exhibit a tendency to sympathise with dulness elsewhere. Eastern ordinary is 3 lower, and Westerns have shed 5s. The various recent issues in this group are somewhat lower, except Western Telegraph new at 3¾ premium for the £1 paid shares. Eastern Extension new are 3 to 3¼ premium, and Globe new 3¼-3½ premium, both £1 paid. The Eastern Telegraph shares, 2s. paid, have been 9s., but eased off to 7s. 6d. There is no rally from the slump in Indo-Europeans which occurred last week. United River Plate Telephones are to receive their usual dividend of 5 per cent., making 8 per cent. for the year, tax free. It is proposed to increase the capital by half-a-million pounds to 2½ millions, though not to make an immediate issue. The shares are of the nominal value of £5, and as the ordinary are quoted at 7½, there is a hint here of a possible bonus presently.

Active business is in progress in the Marconi group, and the shares of the parent company touched 3½ before there was a slight reaction. The price has come up steadily from 2⅞ to the present level of 3 7/16. As already stated here, the support is declared in the market to have come from Italian sources, it being said that certain Italian holders who had sold Marconis heavily, are now taking them back again. The gossip is repeated for what it may be worth, but at any rate the market is in a much more healthy condition than it has been for some time past. With the rise in Marconis has come a sympathetic improvement in Marconi Marines, the price advancing to 2¼, but reacting to 2 later on. The report just out shows that the gross revenue of £772,000 is £208,000 more than that of the preceding 12 months. The dividend of 10 per cent., making 15 per cent. for the year, is the same, however, as that paid for the last three years. The capital was increased some 13 months ago by 600,000 new shares, and, of course, the dividend has to be paid on the extra money then provided. Canadian Marconis remain at half-a-guinea. No market has yet developed in Radios, and, although some of the certificates issued in exchange for the American Marconis have reached this side, the Stock Exchange Committee have not yet given their permission for dealings to take place.

There is little fresh to say with reference to electric lighting shares. It is reported that a certain number of inquiries for the cheapest shares have reached the market, but they have not materialised into buying orders, and prices all round are dull. As one jobber remarked, it is hardly to be expected that people will buy electric lighting shares when they can see to read up to nine o'clock at night. On balance, the only quotable alteration on the week is a decline of 5s. in London Electric preference.

Manufacturing shares are quiet. General Electric ordinary hardened to 32s. 6d., while Henleys at 1⅞ are 2s. 6d. lower. Cromptons retained their rise at 22s., and British Insulated keep firm at 37s. Babcock & Wilcox at 2⅛ show no change. A new issue of Callender's Cable shares of 100,000 ordinary and 400,000 preference is announced. Underwriters were offered one new ordinary at 24s., in company with four new "B" preference at £1. The old ordinary stand about 9s. in the market, and the 6½ per cent. preference at 18s. 9d. Net profit for the year amounts to £161,500, and a 15 per cent. dividend is declared. Armament shares show a tendency to decline, Armstrongs and Vickers both leaning to the heavy side. The rubber market is steady, with the raw material close to a florin per lb. The public are taking little interest in rubber shares at the present time, and the same remark may be extended, indeed, to many of the other industrial sections which make up the Miscellaneous Market of the Stock Exchange.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1918.	Dividend 1919.	Price June 8, 1920.	Rise or fall.	Yield p.c.
Home Electricity Companies.					
Brompton Ordinary	8	12	68	—	17 13 1
Charing Cross Ordinary	4	7	84	—	8 6 8
do. do. do 4½ Pref.	4½	4½	23	—	8 8 8
Chelsea	8	4	24	—	8 0 0
City of London	8	10	14	—	8 17 10
do. do. 6 per cent. Pref.	6	6	17/-	—	7 1 1
County of London	7	8	84	—	9 17 0
do do. 6 per cent. Pref.	6	6	84	—	7 5 5
Kensington Ordinary	6	7	44	—	7 15 6
London Electric	Nil	2½	1½	—	6 0 0
do. do. 6 per cent. Pref.	6	6	8	— ½	10 0 0
Metropolitan	5	6	27	—	10 8 8
do. 4½ per cent. Pref.	4½	4½	24½	—	8 0 0
St. James' and Pall Mall	10	12	62	—	8 16 10
South London	6	6	24	—	9 13 0
South Metropolitan Pref.*	7	7	18/9	—	7 0 0
Westminster Ordinary	8	10	5	—	10 0 0
Telegraphs and Telephones.					
Anglo-Am. Tel. Pref.	6	6	77⅛	—	7 14 10
do. Def.	20/6	1½	18	— ½	8 6 8
Chile Telephone	6	6	8½	—	14 12 1
Cuba Sub. Ord.	7	7	9½	—	14 7 4
Eastern Extension	8	10	15	—	16 13 4
Eastern Tel. Ord.	8	10	150½	—3	16 13 8
Globe Tel. and T. Ord.	8	10	15⅝	—	16 7 8
do. do. Pref.	6	6	8½	—	7 1 1
Great Northern Tel.	22	—	21½	—	9 15 5
Indo-European	18	10	25	—	7 1 10
Marconi	25	—	3⅞	+ ⅛	7 5 6
Oriental Telephone Ord.	10	12	24½	—	14 14 9
United R. Plate Tel.	8	8	7⅞	—	15 5 5
West India and Panama	1/8	Nil	⅞	—	Nil
Western Telegraph	8	10	16½	— ½	16 9 0
Home Rails.					
Central London Ord. Assented	4	4	44½	—	8 19 9
Metropolitan	1	1½	19½	—	8 5 8
do. District	Nil	Nil	15	— ½	Nil
Underground Electric Ordinary	Nil	Nil	1⅜	—	Nil
do. do. "A"	Nil	Nil	5/-	+1/-	Nil
do. do. Income	5	4	58½	—2	6 16 9
Foreign Trams, &c.					
Anglo-Arg. Trams. First Pref.	Nil	5½	3⅛	—	7 17 9
do. do. 2nd Pref.	—	—	8½	—	—
do. do. 5 Deb.	5	5	59⅛	+8½	8 8 0
Brazil Tractions	—	—	51	—2	—
Bombay Electric Pref.	6	6	13½	—	4 11 3
British Columbia Elec. Rly. Pfce.	5	5	57½	+2	8 13 10
do. do. Preferrred	2½	5	48⅜	—	10 6 3
do. do. Deferred	Nil	8	45⅛	—	6 11 10
do. do. Deb.	4½	4½	52⅜	—	8 2 0
Mexico Trams 5 per cent. Bonds	Nil	Nil	28½	—	Nil
do. 6 per cent. Bonds	Nil	Nil	20	—	Nil
Mexican Light Common	Nil	Nil	12⅜	—	Nil
do. Pref.	Nil	Nil	21⅜	—	Nil
do. 1st Bonds	Nil	Nil	42½	—	—
Manufacturing Companies.					
Babcock & Wilcox	15	—	2⅛	—	16 4 4
British Aluminium Ord.	10	10	1⅛	—	9 8 3
British Insulated Ord.	12½	15	1⅛	—	8 2 8
Callenders	25	15	1½	—	8 4 8
,, 6½ Pref.	6½	6½	18,9	—	4 18 6
Castner-Kellner	20	—	4	—	5 0 0
Crompton Ord.	10	—	22/-	—	9 1 10
Edison-Swan, "A"	10	—	1⅛	—	8 8 0
do. do. 5 per cent. Deb.	5	5	79½	—	6 5 9
Electric Construction	10	—	21/-	—	9 10 6
Gen. Elec. Pref.	6½	6½	18/6	—	7 0 5
do. Ord.	10	—	32/6	+6d.	16 0 0
Henley	25	15	1⅜	— ⅛	8 0 0
do. 4½ Pref.	4½	4½	8½	—	6 18 6
India-Rubber	10	—	13½	—	14 11 0
Met.-Vickers Pref.	—	8	2⅛	—	6 18 6
Siemens Ord.	10	10	26/-	—	14 13 10
Telegraph Con.	20	20	23½	—	16 5 6

* Dividends paid free of Income Tax.

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DIRECT CURRENT COMPARED WITH 3-PHASE CURRENT FOR DRIVING STEEL WORKS PLANT.

By C. A. ABLETT, M.Inst.C.E.

(*Abstract of paper read before the* IRON AND STEEL INSTITUTE.)

THE principal advantage of a three-phase system is that it enables power to be transmitted cheaply over long distances at high voltages. It has, however, the disadvantage that three-phase motors are not capable of speed variation without considerable loss of power, unless they are of a complicated and costly type, and therefore not well suited to many steelworks purposes.

Direct current does not lend itself to cheap transmission of power over long distances, but in most iron and steel works this point is not of importance. Direct-current motors are capable of speed variation over a wide range without loss of power, and this and other natural characteristics render them very suitable for many steelworks purposes.

Most of the merchant mills and bar mills in the British Isles roll a large number of different sections, of which the heavier should be rolled at low speeds and the lighter at high speeds. To get the best results and output from the mills, each section should be rolled at its own particular speed. If such a mill be driven by a D.C. motor, the speed can easily be regulated through a very wide range by a shunt regulator in the motor field without entailing any loss of power, and, as the speed of the motor is reduced, the turning moment increases, so that the maximum turning moment is available where it is required for rolling the heavy sections at slow speeds. The speed remains at about the basis speed corresponding with the setting of the shunt regulator, so that the mill does not run up to high speeds when the bar is out of the rolls.

If an ordinary three-phase motor were employed, the speed could only be reduced by inserting resistances in the rotor circuit, which would cause waste of power nearly proportional to the reduction in speed of the motor. The three-phase motor cannot give any increased turning moment at the low speeds, but on the contrary tends to lose its overload capacity as the speed is reduced, so that to obtain large turning moments at reduced speed, a large and more expensive motor must be installed. When driving a mill at reduced speed, the three-phase motor tends to run up to full speed as soon as the bar leaves the rolls, and also tends to fall greatly in speed while rolling a heavy section; so that the speed varies greatly, which means a poor tonnage from the mill.

Figs. 1 and 2, which give a comparison between the working of a 1,200-H.P. D.C. motor and a 1,200-H.P. three-phase motor driving a mill, illustrate these points.

The full speed of both is 150 R.P.M., and the speed of each motor is reduced so as to drive the mill at 115 R.P.M. A few passes only are shown in the figures for the sake of simplicity.

Fig. 2 shows that the power lost in the three-phase motor is nearly three times as great as in the D.C. motor, and it should be pointed out that while, if the mill were driven by a three-phase motor, a 1,200-H.P. motor would be required, on the other hand, if it were driven by a D.C. motor, a smaller motor than this could be employed with a corresponding reduction in the amount of power lost.

Fig. 1 shows that the speed of the three-phase motor cannot be properly controlled, as it varies from 95.2 R.P.M. to 147 R.P.M.—a variation of 44.8 per cent.—the speed rising to 147 R.P.M. when the bar leaves the rolls. The variation in speed of the D.C. motor is 8.5 per cent., this variation being allowed to enable the flywheel to assist the motor, and this speed variation is capable of being reduced. Fig. 1 shows how greatly the output from the mill would be reduced if it were driven by a three-phase motor, owing to the impossibility of keeping the speed under control.

A number of devices have been used to overcome these inherent difficulties of the three-phase motor; while they enable speed regulations to be obtained without excessive loss of power, and some of them enable the speed to be kept reasonably under control, they usually entail the use of more than one machine, are always much more expensive in capital expenditure, are less economical, and more complicated than the plain D.C. motor.

The operation of a rolling-mill motor and flywheel must next be considered, as the majority of rolling-mills are provided with flywheels. To enable the flywheel to take a part of the power required during a pass, the motor must automatically fall in speed during the pass. This variation in speed under practical conditions—that is, with a flywheel of moderate size and without undue variation in the power taken by the motor—can easily be 10 per cent. to 15 per cent. of the motor speed.

If a D.C. motor be used to drive the mill, this automatic variation in speed can easily be arranged by providing a compound winding in the motor field, which does not entail loss of power. On the other hand, if a three-phase motor be used, the variation in speed is obtained by inserting resistances in the rotor circuit, so that, when the speed falls by 15 per cent., practically 15 per cent. of the motor power is wasted. If the speed variation is to be less than this—which is, of course, an advantage from the point of view of obtaining a greater output from the mill—either a greater variation in the motor power must be allowed or a heavier flywheel must be used; and there is not much scope in the latter direction, as the practical limit in flywheel weight is soon reached.

Devices employed for varying the speed of mill motors intermittently, such as the so-called automatic slip regulator, are too slow in action to be of value with the type of mill which is here referred to.

The foregoing remarks show that three-phase current is unsuitable for driving merchant and bar mills. Compared with direct current it is either wasteful of power, involves loss of output from the mill, or involves an unduly high capital cost. Three-phase current has, however, been extensively used in America for driving mills, but there commercial conditions are different from those prevailing in the British Isles, for the tendency in America is for large tonnages of a particular section to be rolled in one mill, so that the question of speed regulation becomes of less importance than in Great Britain, and consequently the three-phase motor is not at so great a disadvantage. In visiting American mills the author has nevertheless seen a number of cases where three-phase current has been used where better results would be obtainable with direct current.

It may be pointed out that where means are available for readily varying the speed of the mill, increased output is sometimes to be obtained by gradually increasing the speed of the mill as each billet is being rolled, so that the first passes on the billet are made at a moderate speed, and the last passes on the finished section are made at a high speed. This method of working has been developed to a considerable extent in certain large three high continental mills where very large tonnages are obtained. While the majority of mills of this description have been driven, with good results, by a motor coupled to a flywheel, there is, in the author's opinion, too great a tendency to accept the flywheel without

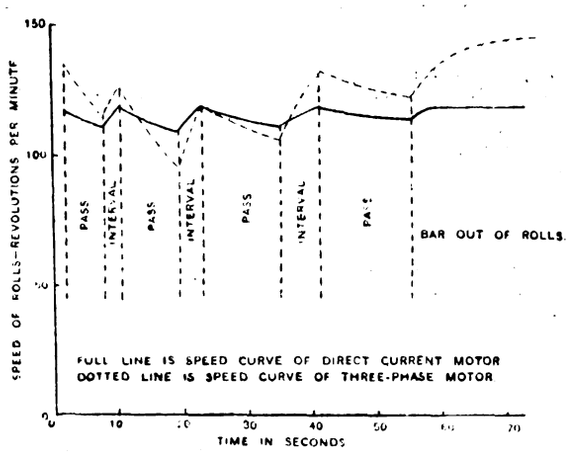

FIG. 1.—SPEED VARIATION OF DIRECT-CURRENT AND THREE-PHASE MOTORS WHEN SPEED IS REDUCED.

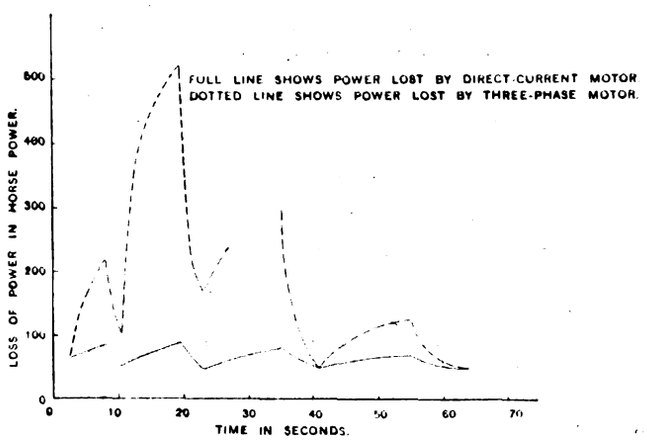

FIG. 2.—LOSS OF POWER IN D.C. AND THREE-PHASE MOTORS UNDER THE SAME CONDITIONS AS FIG. 1.

LOSS OF POWER IN THREE-PHASE MOTOR IS 2.92 TIMES THAT OF DIRECT CURRENT MOTOR.

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considering the possibility of obtaining an increased output if it were dispensed with. When a new mill is being put down, this point should receive full consideration. A rolling-mill motor should not be regarded merely as a motor to drive a rolling-mill, but, if the best results are to be obtained by electric driving, the rolling-mill plant, if new, and the mill motor should be suited to one another, and both the mill and motor be considered as a combined plant.

It should be remembered that rolling-mill plants have been developed in connection with the steam drive. The electric motor has certain different characteristics from the steam-engine, and full advantage should be taken of these differences.

The proportion of sheet and tinplate mills which are driven electrically is not so great as the proportion of merchant and bar mills, and the statement has frequently been made that it is cheaper to drive hot mills by steam than electrically. The author believes that there is a foundation for this statement, and that the reason is as follows:—

The speed of the rolls in such mills is usually from 30 to 40 R.P.M., depending on the roll diameter, and when driven by a steam-engine, the engine is generally direct coupled. Where electrical driving has been adopted, a motor running at a comparatively high speed has been used which drives the mill by ropes or by gearing. Now, the variations in the power required to drive such mills are very great indeed, perhaps greater than with any other type of mill, so that the average power consumption is only a small fraction of the maximum power.

The rope or gear drive entails a certain loss of power which is going on continuously, so that, while this loss of power may be only a small percentage of the maximum power, it still forms a very substantial addition to the average power, so that it materially increases the energy consumption measured in kilowatt-hours per ton rolled.

If a three-phase motor were installed to drive such a mill, this loss of power would be accentuated by the loss which occurred in the resistances connected in the rotor circuit, which are necessary to enable the flywheel to give up power when required, and these losses, while they may be only a small percentage of the maximum power, make a substantial addition to the average power taken, thus materially increasing the energy consumption expressed in kilowatt-hours per ton rolled. Now, in the author's opinion, if such a mill be driven by a low-speed motor running at 30 to 40 R.P.M., the running costs of the electrical drive would be found to be considerably cheaper than those of the steam-engine, for these various losses of power would be eliminated. From results in the author's possession, he considers that the adoption of the direct drive would be found to reduce the consumption expressed in kilowatt-hours per ton by something like 40 per cent.

There is no engineering difficulty in installing a D.C. motor running at a speed of 30 R.P.M. for driving a sheet mill. Such a motor would be larger and more costly than a high-speed motor, but when all the circumstances are taken into account the savings to be effected should be found to make a very substantial return on the extra capital cost. On the other hand, there are serious engineering difficulties in constructing a three-phase motor to run at a speed of, say, 30 R.P.M. If the electrical supply were 50 cycles, the motor would have to have 200 poles, and the power factor would be so low that the operation of the power generating plant and supply system would be very adversely affected.

The above remarks apply only to the hot mills in sheet and tinplate works, and not to the cold rolls, which require practically constant power to drive them at a constant speed, so that for cold-roll driving there is very little to choose between direct and alternating current.

The reversing mill is driven by a direct current motor, supplied with current from a motor-generator set coupled to a heavy flywheel.

The motor of the motor-generator set would have a normal power of about one-fifth or one-sixth of the power given by the mill motor when at work, and the question is whether it is better that this set should be driven by an A.C. or a D.C. motor. For example, a 2,000-H.P. motor may be used to drive the set, of which the flywheel at full speed would have a total stored energy of 200,000 H.P.-seconds, of which 72,000 H.P.-seconds would become available for neutralising the variations in the power.

The speed of this motor would be so varied by some form of relay connected in the circuit supplying the motor that the power in the circuit would be maintained at as nearly a steady value as possible—that is to say, that the speed of the motor would be reduced when the bar was in the rolls, so that the flywheel could supply part of the power required by the mill motor, and when the bar was out of the rolls the speed of the motor would be increased, thus increasing the stored energy of the flywheel. In some works this relay has been connected in the main power circuits of the power-house, so that the flywheel of the reversing rolling-mill equipment is not used merely to maintain the power required to drive the reversing mill at a constant value, but for a much more useful purpose—namely, to keep the power supplied by the power-house as constant as possible by providing the power required for heavy peaks of short duration, which may be caused by other parts of the plant, from the stored energy of the flywheel. This is a valuable asset, because if the power is supplied from a gas-engine station, of which the overload capacity is not very great, it may save an additional engine, and in any case the more constant the power-house load is kept, the cheaper the supply of electrical power becomes.

If the 2,000-H.P. motor driving the motor-generator set is a D.C. motor, it will not only cease to take power from the power station if a heavy peak occurs elsewhere in the works, but can act as a generator and supply electrical power drawn from the stored energy of the flywheel to help the power station. For a peak of short duration the motor thus acting as a generator can work up to double its normal capacity, and can help the power station to the extent of something approaching 6,000 H.P. for a short time. If, however, a three-phase induction motor be used to drive the motor-generator set, it cannot generate power to help the power station, but can only cease to take a considerable portion of its power from the power station. Thus the D.C. motor is about three times as effective as the three-phase motor in helping the power house to overcome peaks.

It has also been pointed out that the motor-generator set has to be made to fall in speed artificially so that the flywheel can give the surplus power required by the reversing mill motor; this fall in speed would be of the order of 20 per cent. If a D.C. motor be used to drive the motor-generator set, this fall in speed does not entail any loss of power, but if a three-phase induction motor be used, the 20 per cent. fall in speed means that a considerable proportion of the power supplied to the motor is wasted.

On the average it may be taken that 10 per cent. of the power supplied to the three-phase motor is wasted, which would increase the kilowatt-hours per ton and consequently the cost of energy for rolling by 10 per cent.

A motor-generating set driven by a three-phase alternating motor is limited to certain speeds corresponding to the synchronous speed of this motor. If the supply be 50-cycle, the synchronous speeds within the practicable range are 600, 500, 428, and 375 R.P.M. It may happen that the flywheel or the variable-voltage generators can run at higher speeds than the corresponding synchronous speed, so that if they are driven by three-phase A.C. motors they are not being used to the best advantage, and if a D.C. motor were used the motor-generator set could be run at a higher speed, and thus the capital cost of the reversing rolling-mill plant could be reduced.

The electrical drive of the live roller gear requires careful consideration, for if live rolls cannot be handled rapidly a good output cannot be obtained from the mill, however good it may be. The following considerations will show that live roller gear driven by D.C. motors can be handled more rapidly than if it were driven by three-phase motors.

The turning moment of the D.C. series motor varies with the square of the current, while that of the A.C. motor varies directly as the current. Therefore the D.C. motor can accelerate the live rolls much more rapidly than the A.C. motor. Conversely, in decelerating the live roller gear, the D.C. motor gives a much more powerful retarding effect than the three-phase motor, so that the former proves a more effective machine for reversing live roller gear than the latter.

Another disadvantage of the three-phase motor is that its turning moment is proportional to the square of the voltage, so that if the voltage falls, say, 10 per cent. the turning moment is decreased by 19 per cent. The turning moment of the D.C. motor is directly proportional to the voltage. This tends to make the three-phase motor sluggish where voltage variations occur.

In a certain large American steelworks where there is a large power house in the works generating three-phase current, direct-current live-roll motors have been installed throughout for this very reason, and the whole of the power for driving these motors is converted to direct current by rotary converters supplied for this purpose.

The cheapest way of obtaining power in iron and steel works is to utilise the blast-furnace and coke-oven gases, or other sources of waste heat, to the fullest extent. If these natural resources of the works are utilised in the most economical manner it will generally be found that they will provide all the power required by the works.

Where large low-speed alternators are driven by gas engines some peculiar resonance effects can be produced, and these have proved exceedingly troublesome in certain power houses. If the alternator be driven at a uniform speed by its engine, it can be set swinging, say, by a sudden overload or other causes, at its natural time of vibration about its uniform speed of rotation. If the alternator and flywheel are properly designed, these vibrations, when once started, will die away quickly. If, however, the natural time of vibration happens to coincide with the time which elapses between the successive working strokes of the engine or certain multiples of them, the vibration may become so violent that it is impossible to run the engine.

If a number of gas engine-driven alternators be running in parallel, serious difficulties can occur by the natural time of vibration of one of the alternators coinciding with the time between the working strokes of an engine driving another machine, so that it becomes impossible to run the two machines in parallel. The author has had experience of several cases of this kind.

To avoid the possibility of such resonance the proper weight of the flywheel has to be selected. Gas engine-driven D.C. machines are usually cheaper in capital cost than gas

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engine-driven alternators, and have the advantage from the engineering standpoint that these resonance troubles do not take place.

Steam turbines directly coupled to three-phase alternators have been built in such large sizes and have proved themselves to be so reliable that they call for no special comment.

Direct-current turbo-generators with a high-speed turbine driving a comparatively slow-speed dynamo through some form of double-helical gearing have been built in sizes up to 6,000 kilowatts, and it is probable that natural development will lead to the construction of considerably larger sizes and that the turbines will run at higher speeds than 3,000 R.P.M., which is the highest possible speed of a three-phase, 50-cycle turbo-alternator. Such gear-driven sets have proved very reliable in operation, and from the engineering standpoint there is little to choose between three-phase and D.C. turbo-generators.

The capital cost of the D.C. geared turbo-generator is higher than that of a three-phase turbo-generator. The question to be decided, therefore, is what return the more economical application of direct current in the steelworks will make on the increased cost of the power house.

It has been shown that direct current should be adopted as the system of supply of a steelworks, and this leads to the consideration of the question of linking-up with power supply authorities which supply three-phase alternating current.

The following reasons have been advanced in favour of linking up:—

(*a*) That the power supply authority provides a standby to the works power house.

(*b*) That the power supply authority provides a possible market for the surplus power of the works.

It is evident that if a power supply authority undertakes to provide a standby of, say, 1,000 kilowatts, it must invest capital in an additional 1,000 kilowatts of plant in its boiler house and power station, and also invest a considerable capital sum upon its distribution system over and above the plant needed for its normal requirements.

The authority has capital, depreciation, and maintenance charges to meet on this additional plant, and must provide for a definite payment per kilowatt which it contracts to keep as a standby.

For the purpose of illustration, assume the capital cost to the supply authority of the plant and distributing system for providing 1,000 kilowatts standby to be £40,000. Then the power supply authority would make a minimum annual charge of the order of £6,000 to recompense it for out-of-pocket expenses—namely, capital, depreciation, maintenance charges, &c.—on the standby plant, whether this plant is used to supply power or not, and in addition if power is required from this plant it would make the ordinary charge per unit of electricity supplied.

The standby supply may be regarded as an insurance against exceptional circumstances. It is necessary for the works owner to assure himself that the power supply authority is carrying out its obligation by installing the plant necessary for providing a standby supply at any time.

It would appear better for works having blast-furnace gas, coke-oven gas, or other sources of power, to install their own standby plant rather than pay other people to do it. If they install their own plant and charge themselves annually a similar sum to that which they would be paying a power supply authority, the cost of the plant will soon be paid off. If, on the other hand, they rely upon the authority, this annual charge goes on perpetually.

In considering the second point, the question arises what price the power supply authority would be willing to pay for surplus power. A power supply authority is usually willing to pay 0.05d. per unit of surplus energy delivered to it by a works, and as on the other hand the authority usually charges about 0.5d. to 1.0d. per unit in selling its power to a works, the authority is apparently making a very substantial profit on any surplus power which it buys. If this be considered from the authority's point of view, it will be seen that surplus power is not of great value because, as a rule, it cannot be supplied when it is of value.

The works as a rule need the full output of their own power plant for themselves during the ordinary working hours of the day, and could only supply surplus power to the power supply authority at other times, when the authority does not need it, and when it is in consequence of little value.

It is evident, therefore, that the interests of the iron and steel works having their own power resources and those of a power supply authority do not coincide; there appears to be no advantage in linking-up with the power supply authority, and it would be more profitable to the iron and steel works to find a means for using their own surplus power, which is one of their valuable assets.

Protection against X-Rays.—At the Academy of Sciences, on May 27th, M. Daniel Berthelot announced that an important discovery had been made by Dr. Pech, which would ensure the protection of operators against the effects of X-rays. It consists of a process which neutralises the ultra-violet rays by the simultaneous application of infra-red rays.

WATER POWER IN SCANDINAVIA.

The Council of the Swedish Water Power Association (Svenska Vattenkraft Forening), reporting to the members at the tenth annual meeting, held in Stockholm, on May 27th, stated that the active interest manifested in the utilisation of the national water powers during the years of war slackened somewhat during the past year. In explanation of this fact it was mentioned that the construction of hydro-electric works, and the prosecution of the electrification of the country districts, were proceeded with at a slightly slower rate in 1919 than in the preceding years owing to the decline in the period of prosperity in certain districts and "the increased supply of fuel oil."

Mr. Sven Lubeck then discussed the present situation of the question of power and fuel supplies. At present, he stated, the water powers already in service represent 1,150,000 turbine horse-power, whilst plant for a further 250,000 H.P. is in course of construction. The normal imports of pit coal at the beginning of the war ranged from 5,000,000 to 6,000,000 tons per annum. On the assumption that further water power representing 2,000,000 H.P. is brought into use within a period of 40 years forward, corresponding to 50,000 H.P. per annum, and allowing for normal development of consumption, it is calculated that it will afterwards still be necessary to import 5,725,000 tons of fuel per annum, including 250,000 tons of crude oil, petroleum, and benzine. In the opinion of the author, the hydroelectric industry is confronted with three principal problems: (1) The rational utilisation of available water powers by the regulation of the lakes and profiles; (2) the electrification of the country in connection with the economic distribution of power on a systematic basis; and (3) the facilitation of the industrial use of the Norrland water powers. In judging the question of economy in power, it is submitted that consideration must be given to the circumstance that after years of normal development the water powers in the South and in Central Sweden have practically all been brought into use. The solution of the power question in different parts of the country must gradually take place by the exercise of the greatest possible economy in the water power resources, the uniform regulation of the waters, the provision of reserve stations at appropriate places, particularly along the coast line, the use of peat, and the supply of power from the more richly endowed district of Norrland, and possibly also from Norway in the course of time. Indeed, the author is of opinion that some of the Norwegian water powers in future may find use in connection with Swedish interests to the advantage of both parties. At present hydroelectric power finds an increasing use in the Swedish wood and iron and steel and textile industries, but more particularly in the electrochemical industry, and the future prospects for the use of the power lie chiefly in the electrochemical and electrometallurgical branches.

The second contribution to the meeting was made by Mr. Ingvar Kristensen, director of the Norwegian waterfall administration, who dealt with the question in relation to Norway. Leaving falls of less than 1,000 H.P. out of consideration the author mentioned that the available water power represents 12,000,000 to 13,000,000 turbine H.P. per annum, of which only 1,400,000 H.P. is being utilised. The Government has purchased water powers amounting to 2,000,000 H.P. in different parts of the country so as to be able to have power available in connection with the conversion of the railways and the general supply of power, and for other public purposes. In fact, by this means and by the revision of the legislation concerning water courses and the strengthening of the water administration, the State is able to exercise a regulating influence over the use of water powers, which can now only be utilised on the grant of a State concession for the purpose.

GAS ON TRAINS.

We recently mentioned briefly the report of a collision on an Indian railway, which was followed by a fire in which many people were burned to death. Particulars have been published in the *Pioneer Mail* of April 30th from which we derive the following details:—

The collision occurred near Mewa Newada station, Oudh and Rohilkhand Railway, near Moradabad, between an express and a goods train. Two vehicles at the rear of the goods train were smashed. Two vehicles at the rear of the goods gas fitted, were smashed and burned.

The accident occurred at 2.30 a.m. on April 26th.

The first three bogie carriages were completely smashed, and with the bursting of the gas-holder, caught fire. All the carriages were overcrowded, and among the passengers were three Hindu marriage parties and 50 Gurkha soldiers. Of the former only three, and of the latter only four, are reported to have escaped. All the rest were either killed outright or burned to death. The first bogie was a third-class and the

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second an inter-class; the third was half full of men and half full of women passengers. Few of the women and children came out alive. Sixty-two wounded were brought to Moradabad in a relief train.

An eye-witness gives a heartrending account of the sufferings of those who were killed, burnt to death, or wounded. Most of the wounded went without any medical aid for ten or twelve hours, until they were admitted to the hospital.

Professor W. G. P. Wall, of the Training College, Allahabad, gave the following details:—

There were only four Europeans in the carriage in the centre of the train. So far as the Indian passengers (mainly third-class) were concerned, the train, unhappily, was crowded.

Professor Wall was awakened by a violent shock, and was first out of the train to see what had happened, closely followed by other Europeans. The train was at a standstill, and the first portion was even then blazing furiously. They ran along the train, and as they ran they saw an Indian running across a field with his clothes on fire. They extinguished the flames, but the man was so terribly burnt that he died a few hours later.

They then hurried to the wrecked carriages, where the sight which met them was a terrible one. The day had been very hot and dry, and all the woodwork was like tinder. The collision must have shattered the gas cylinders under the third-class carriages, and when the gas caught fire all the wreckage burnt rapidly and inextinguishably.

Meanwhile, the dry wind which had been blowing seemed to increase greatly in strength and carried the flames along the train. Most of the passengers succeeded in escaping out of the third bogie with slight injuries, though the bogie itself was burnt; but in the first two bogies the majority of the passengers were pinned under the heavy tangled wreckage, from which it was impossible to extricate them.

After the European passengers, with two or three Indians who rendered eager and useful help, had pulled out all the injured who could be reached, there were still a large number of sepoys in the first carriages and men, women and children in the second bogie, caught under bent steel framework or woodwork, who could not be brought out.

They could be seen struggling vainly with the flames rapidly spreading towards them, but nothing could be done. "I could not sleep last night," said Mr. Wall, "because of the memory of it."

We do not wonder at this; it is painful enough to imagine the scene without having witnessed its horrors. When will the use of gas on trains, with the frightful possibilities by which it is accompanied, be abolished? It is like carrying live shell with the safety devices removed—but worse, for instantaneous destruction is vastly preferable to the mental torture of the approaching flame, followed by the physical agony of roasting to death.

THE MID-LANCASHIRE ELECTRICITY DISTRICT.

THE Electricity Commissioners, as briefly stated in our last issue, have taken their second step under Sec. 5 of the Electricity (Supply) Act, 1919, this time with reference to the re-organisation of electricity supply in part of the county of Lancaster, by the issue of a notice that they have provisionally determined that the undermentioned area shall be constituted a separate electricity district for the purposes of the Act, that is to say: The county boroughs of Blackburn, Blackpool, Burnley, and Preston; the boroughs of Accrington, Bacup, Chorley, Clitheroe, Colne, Darwen, Haslingden, Nelson, and Rawtenstall; the urban districts of Barrowford, Brierfield, Church, Clayton-le-Moors, Croston, Fleetwood, Fulwood, Great Harwood, Kirkham, Leyland, Longridge, Lytham, Oswaldtwistle, Padiham, Poulton-le-Fylde, Preesall, Rishton, St. Annes-on-the-Sea, Thornton, Trawden, Walton-le-Dale, and Withnell; and the rural districts of Blackburn, Burnley, Chorley, Clitheroe, The Fylde, Garstang, and Preston; which area is more particularly delineated on the accompanying map.

Objections or representations may be made on account of the inclusion of any area in, or the exclusion of any area from, the district so provisionally determined, and all such representations must reach the offices of the Commissioners not later than September 30th, 1920.

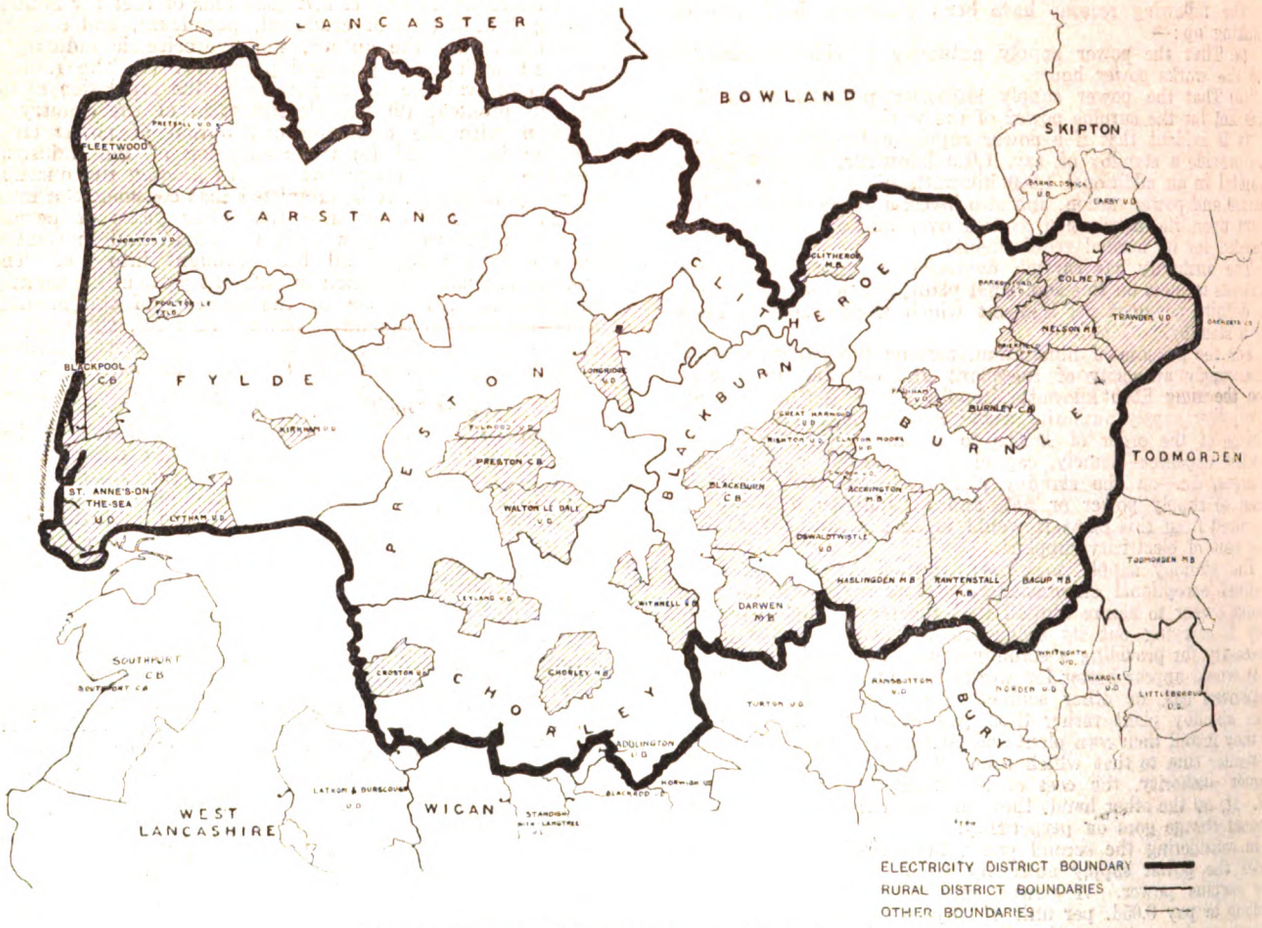
It being apparent to the Electricity Commissioners that the existing organisation for the supply of electricity in the district so provisionally determined should be improved, notice is further given that they intend to hold a local inquiry into the matter, and any authorised undertakers as defined in the Act may, before September 30th, 1920, submit a scheme for effecting such improvement in organisation, including the formation of a Joint Electricity Authority for the district, and any proposals for altering or adjusting the boundaries of the district so provisionally determined.

Notice is to be given of the date of the proposed inquiry.

It will be noted that the two notices have again, as in the case of the Lower Severn District, been issued in one document, which may be taken as a desire to concentrate and curtail the proceedings.

In contrast to the first provisional district, the present area is a thickly populated industrial one. Except for the western boundary of the district which follows the sea coast, the boundaries are not marked by any topographical features. On the east and north-east the county boundary is followed, while on the north and south rural district boundaries mark the limits.

Blackburn and Preston form the centre of the area, and it is in these two adjacent districts that the two largest generat-



MAP OF PROPOSED MID-LANCASHIRE ELECTRICITY DISTRICT.

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ing stations will in all probability be located, indeed the building of one of them has already been commenced.

Several of the larger electricity supply undertakings included in the district are in urgent need of extension of their plant, and a commencement has already been made on such work in some instances. It will be remembered that the foundation stone of the new Whitebirk station at Blackburn was laid last month. This enterprise will cost about half a million sterling, and there is ample scope for future extension. The initial installation will comprise two 10,000-KW. turbo-alternator sets generating at 6,600 volts three-phase, and it is hoped to have one set in operation by the end of this year. The station is in close proximity to railway and canal; there is also a large quantity of peat on the site, and a Scandinavian expert has reported favourably on its use as a fuel. Mr. P. P. Wheelwright, engineer-in-chief, may also have considered the feasibility of the use of gas from the Greenbank gasworks as a fuel should circumstances necessitate such a course. A second new station will very likely be established in the area. This will probably be commenced next year on the south bank of the Ribble at Preston, where a dam is proposed to be constructed. A link between the Preston, Blackburn, and Burnley stations is also contemplated, and the latter undertaking is proposing to borrow £150,000 to cover the cost of extensions that are needed. In April the chief engineer at Burnley reported on the extensions required in the undertaking, and the proposed linking up with other undertakings in connection with the establishment of the area. Nelson contemplates the expenditure of over £152,000, and tenders for part of the extension were accepted in February last. At Blackpool new plant is also to be installed and negotiations have taken place between the Corporation and the Fylde Water Board, upon which, in the event of the present works being extended, the Corporation will be dependent for an adequate supply of water for condensing purposes.

The whole of this activity has taken place this year, but the demand for electricity is increasing to such an extent, owing to the electrification of mills and factories, &c., in the area, that most of the additional output that will be available when the various extensions are completed has already been fully booked up.

To make a prediction in conclusion, the next area to be provisionally determined will most likely be that of the North-West Midlands in the Black Country. Such an area would include the two proposed large stations at Stoke and Rugeley on the river Trent, and that at Ironbridge on the Severn. This district would embrace Staffordshire, with the important stations existing at Wolverhampton, Walsall, Tipton, West Bromwich, and Stourbridge; part of Shropshire, including Shrewsbury; and part of Cheshire, including Crewe. Moreover, it would lie between the two areas that have already been defined on the south and north.

An Electrically-Propelled Ferry.—Sketches were recently published by the *Pacific Marine Review* of a double-deck ferry boat 191 ft. long by 44 ft. beam; the propelling machinery consists of two Diesel engines driving dynamos which in turn supply a motor directly connected to the paddle wheel shaft, and in order to ensure efficiency at a low rate of revolution, the motor is made of large diameter.—*Technical Review.*

ELECTRIC FURNACES.

THE electric furnace, which by reason of its cleaner and more economical working is still finding more and more favour in the eyes of the metal industries, is rapidly extending its field. The Leeds Electrical Construction Co. has recently supplied us with details of its products, which include furnaces of many types for various employments, and some of these are now described. The heat treatment of carbon and special steels to be a success requires above all a method of adjusting and maintaining temperature within very fine limits. By the use of an electric furnace this is assured to a reasonable degree of accuracy. The special type manufactured by the company for this purpose is the R.M.D. rotary furnace, an illustration of which is given (fig. 1). This is of the resistance type, the furnace chamber being constructed of special refractory material to withstand a maximum working temperature of 1060 deg. C., and possessing high thermal conductivity and a low coefficient of expansion. The chamber containing the heating element is effectively heat insulated from the outside case of the furnace by material of low conductivity. The energy is conveyed to the heating chamber by means of phosphor-bronze slip-rings mounted on a refractory extension of the chamber, and the connections are enclosed in a cast-iron protecting cover. The furnace is encircled by a worm-wheel which engages with a worm on a shaft rotated by a small motor. This motor and the heating element are connected in parallel so that when the motor is switched off the heating energy is also cut off. The control panel includes a thermostat and cut-out which can be set to switch the power on or off within limits of a few degrees. The current through the heating element is adjusted by means of the resistance shown in the illustration. Another type of rotary furnace suitable for heating rivets is built on similar lines, and is supplied either for stationary work or as a portable unit; in the latter case it is the usual practice to mount the furnace on a trolley. In this set the motor-shaft, ending in a worm, engages directly with the wheel encircling the body of the furnace, and the rotation automatically produces travel of

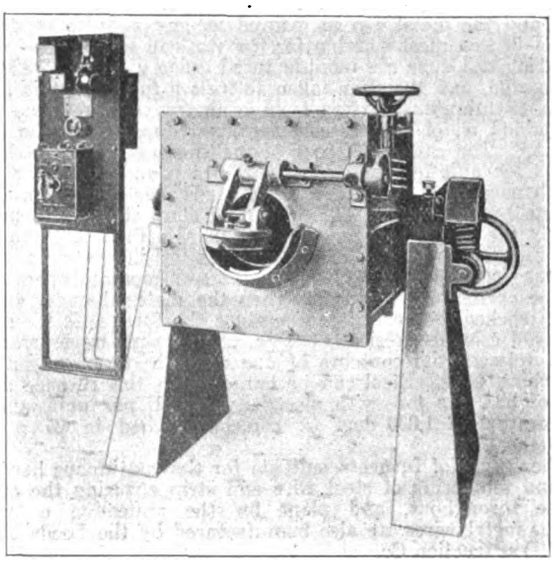

FIG. 2.—ELECTRIC TILTING FURNACE (TILTED).

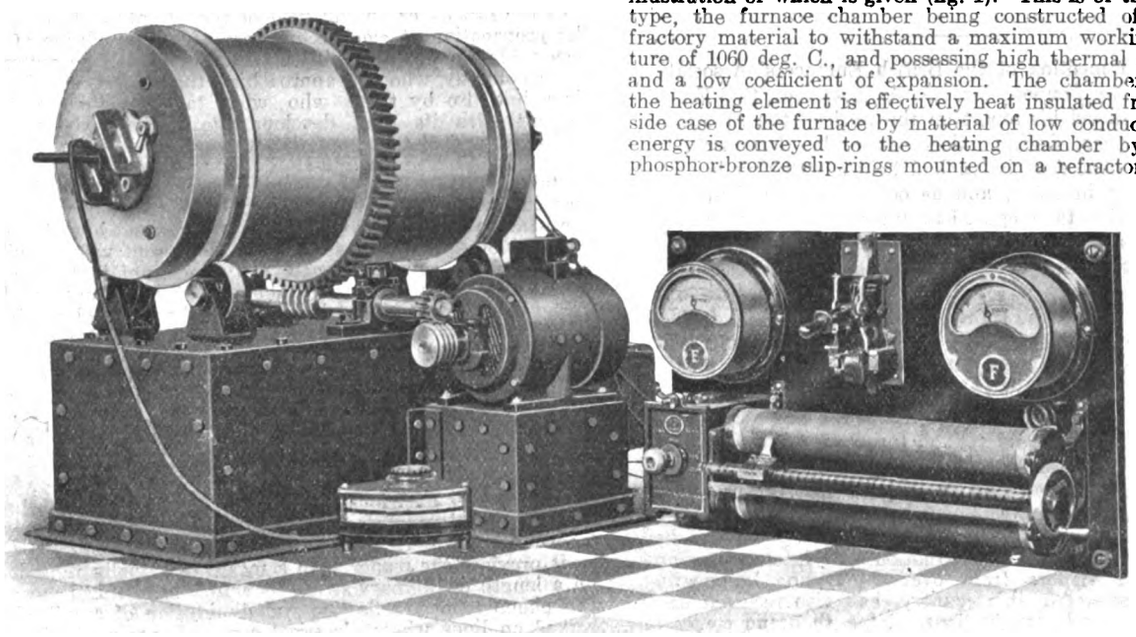

FIG. 1.—ELECTRIC ROTARY FURNACE.

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the rivets through the furnace. The rivets are fed into one end of the furnace, and the speed of output at the other end is adjusted to suit the various sizes. A notable feature of this furnace is its portability, as owing to its size, roughly 2 ft. × 2 ft. × 1½ ft., the complete equipment can be located in the hull of a ship and other parts generally difficult of access. It is stated that the total energy consumption of this type, when heating ¾ in. diameter rivets at the rate of four per minute, is three units per hour, including the necessary power for the motor. Tilting furnaces such as that shown in fig. 2 are also among the manufactures of this firm. The furnace illustrated is primarily intended for the melting of aluminium, brass and other non-ferrous metals, and is of the resistance type. The metal is contained in a chamber possessing a non-oxidising atmosphere, and there are no products of combustion to be dealt with. The temperature is under control, and the metal can be poured at any definite predetermined degree most suitable for the work in hand. The sizes in which this type are manufactured range from 50 to 300 lb. per charge, and the time taken to melt a full charge is from 35 to 40 minutes, starting from ordinary temperatures, and the period is, of course, considerably reduced after the first "heat." The calculated cost of melting brass, on the basis of 1d. per unit for energy, is .12d. per pound. Another tilting furnace manufactured by the Leeds firm is one designed for the heat treatment of carbon and alloy steels, and particularly for use in tool production. In this furnace there are two separate heat chambers, each under independent temperature control, and by this means two separate operations can be carried out at once. When the material under treatment reaches the desired temperature the furnace is tilted by means of a hand-wheel at the side, and a spring latch arrangement releases the contents of one or both chambers into a quenching tank. Steel can be hardened in this furnace at a cost of 32*s.* per ton with electricity at 1d. per unit, and a temperature of 1,000 deg. C. can be reached in 25 or 30 minutes.

Other types of furnaces suitable for the continuous hardening and tempering of steel wire and strip ensuring the same degree throughout, and plant for the annealing of non-ferrous metal wires are also manufactured by the Leeds Electrical Construction Co.

THE BRITISH ENGINEERS' ASSOCIATION.

At the annual meeting of the British Engineers' Association recently held in London, Mr. D. A. Bremner, O.B.E., the Director, submitted his report on the work of the Association in the past year, during which time he had held his appointment. The Association had held a watching brief for the engineering industry, and as occasion arose, had taken appropriate action to safeguard its interests, sometimes alone, and sometimes acting in conjunction with the Federation of British Industries and other organisations. The matters receiving such attention were: Import, export, and anti-dumping legislation, taxation, transportation, coal supply, fuel oil, petrol, standard forms of contract, and Board of Trade statistics. Considerable attention had been devoted to the development of the utility of the Trade Inquiry, Inspection, and Information Bureau. The offices had been extended to provide for its expansion, and though the staff was a small one, they were able to deal with communications in eight foreign languages. From May, 1919, to March, 1920, 693 trade inquiries were sent out to the appropriate groups of members. Foreign embassies, legations, banks at home and abroad had frequently applied to the Association for information and assistance, and visitors from overseas, having engineering business to transact in this country, had also received helpful information and introductions. Nine thousand copies of the Anglo-Spanish, Anglo-Portuguese, and Anglo-Italian editions of the B.E.A. official directory of members had been dispatched to carefully selected addresses. The 1920 directory would be an all-English edition for circulation at home and in English-speaking countries overseas. Mr. Bremner referred to the reports that had been sent home by Mr. G. C. Sanderson, the Association's special commissioner in Brazil. Sixteen reports had already been circulated to members, and others were to follow. He had sent home privately a good deal of valuable information relating to Brazilian trade matters. Reports were now coming forward from the West Coast of South America, from Capt. R. T. Hird, their special commissioner for Chile, Peru, and Bolivia. In many matters the Association acted in close co-operation with the F.B.I., the National Union of Manufacturers, the British Commonwealth Union, the Industrial League and Council, and National Propaganda. An intensive recruiting campaign was in progress which should lead to an increase in the membership, which was now 580, as against 539 a year previously. A number of members had increased their voluntary assessments for subscription, but the Association must further increase its income or it could not develop.

The annual meeting, held on April 29th, was presided over by Col. O. C. Armstrong, D.S.O. Among other points referred to by him was the burdensome nature of the Corporation tax. After the deduction of fixed interest bearing charges, the whole tax of 1s. in the £ on the total profits would be borne by the ordinary shareholders, and in many cases it might amount to 2s. in the £ on the profits divisible among them, thereby reducing their dividend by 1 per cent. The corporation tax was therefore a more serious matter than would appear at first sight. Later speeches emphasised the need for members to support the Association in its work and in obtaining new members. A resolution was passed recording an emphatic protest against the continuance and increase of the excess profits duty. Mr. Bremner referred to the need for members to strengthen the organisation in every way possible, making it more representative and therefore more powerful, placing at its command the financial resources necessary to make it really effective. Their policy was to serve their members, who were all busy men, rather than to call upon them to sit on innumerable committees, coming up to town from time to time to attend meetings, and more or less dissipating their energies which might be much more usefully applied at their own seat of wealth production. He and the B.E.A. staff were the people who should do the work. In sending out communications their difficulty was to get at the men who mattered; it was difficult to get past the office boy. They were, with that in mind, limiting the number of their communications to those that appeared to be really justifiable to the minds of business men. Mr. H. Allcock referred to the fact that they had in the B.E.A. a weapon to carve their way into the markets of the world. "We want that weapon to be kept bright and sharp and clean and strong, so that when we need it we shall find that it has not rusted in the meantime."

REVIEWS.

The Propagation of Electric Currents in Telephone and Telegraph Conductors. By J. A. Fleming, M.A., D.Sc., F.R.S. Third edition, revised and extended. London: Messrs. Constable & Co., Ltd. Pp. xiv+370, figs. 19. Price 21*s.* net.

In the rapidly extending field of the literature dealing with the propagation of electric currents, this new edition of Professor Fleming's work will be given a cordial reception by those not only who are approaching the subject for the first time, but also by those who wish to keep themselves *au courant* with its later developments. When the lectures, which formed the basis of the work, were first delivered at University College in 1910-11 the utter hopelessness of trying to take notes and at the same time intelligently follow the amazing rapidity with which Dr. Fleming filled and refilled the blackboard with mathematical proofs, must have been felt by most of those who attended. The present volume will go a long way to supply the gaps in the notes of that time, and in other respects to amplify them. It is a long cry from "Short Lectures to Electrical Artizans" to the volume before us, but the same clarity of expression of treatment which characterised the author's early work is still conspicuous in his latest. The distracting mistakes which marred the first issue of the work have been rectified, and the reader is fairly safe to begin the perusal of the book without fear of being arrested by misleading expressions for the value of $\tanh (a+jb)$ or of that for $\int_0^\tau \sin pt\, dt$.

Of the later additions to the original volume, the chapter on the vibrations of loaded strings and their analogies with loaded telephone cables is particularly interesting, inasmuch as it provides the reader with a means of actually reproducing on a length of ordinary string by simple mechanical means all the phenomena of reflection and diminution of amplitude observed on lines whose electrical constants are non-uniform in character. In the chapter dealing with the speed of signalling in cables reference is made to the "cable constant," which is defined as the product of the capacity of the cable, its resistance and the letters per minute which can be sent through it. This, however, is a very arbitrary quantity, which has already been badly upset by such delicate receiving instruments as the Orling and Heurtley relays, to say nothing of the possibilities inherent in the modern amplifier.

The method and description of the Fleming-Dykes capacity bridge for the determination of capacities at any temperature and frequency, as well as the dielectric constant and specific conductivity, is interesting. Values are given for the ratio S/C for various cable dielectrics.

A brief description, with diagrams, is furnished of the Franke alternator for the measurement of the attenuation constant of cables, and a fairly lengthy outline of present day practice in the use of loaded cables and loaded aerial lines.

The remaining chapters deal mathematically with the effect of leakance on loaded cables, the predetermination of the constants S/C and R_1/L_1, and on reflection losses at their junctions.

A. F.

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Machine Drawing for Electrical Engineers. By EDWARD BLYTHE, A.M.I.E.E. Pp. 81; 18 plates. London: The Cambridge University Press. 21s. net.

Text books on machine drawing for mechanical engineers are innumerable, and many excellent works have been published; for some reason, however, very little has been done in this direction for electrical engineers and students.

In the majority of Technical Institutes and Engineering Schools, electrical students take the ordinary course of instruction in mechanical engineering detail, very little effort having been made to specialise in electrical engineering details.

The great development in recent years in the science of electrical engineering and the important part that this branch of engineering will play in the future, demand suitable text books. The above work is an excellent attempt to fill the gap which undoubtedly exists, and is the outcome of the experience of the author, both as an electrical engineer and a technical teacher.

The author has presented a number of systematical progressive exercises, which lead the student through the elementary stages of projection of simple pieces of apparatus, to the preparation of drawings of a similar nature to those found in the modern workshop, and it has been attempted to familiarise him with the method of constructing and reading workshop drawings dealing with purely electrical fittings and detail.

It is pointed out that from contact with pupils in the drawing office, the author has found that most beginners encounter considerable difficulty in forming anything like a clear conception of the construction of an object, from the plans elevation and section executed on the orthographic projection principle, and for that reason small isometric or perspective views have been inserted, with the object of affording assistance in overcoming that difficulty.

The illustrations in the book are large and clear, and are first-class examples of draughtsmanship. The various examples have been selected with the view of illustrating not only the fundamental principles, but also modern types of electrical apparatus. The book will be of great use for teaching purposes in Technical Institutes, and also to all those engaged in preparing electrical drawings. It is a well-thought-out and excellently arranged work, and will have many imitators in the near future.

E. P.

The Management Problem. By EDWARD T. ELBOURNE. London: The Library Press, Ltd. Pp. xi+144+24. Price 4s. 6d. net.

This book is one of those included in the Manufacturing Problem Series, of which series the author is the general editor.

It opens encouragingly enough by saying that while there is to-day great talk of the relations between capital and labour there is too little talk of the connecting link—management. Our readers are already aware that we have lately devoted a good deal of attention, in our editorial columns, to various aspects of industrial relations, and we had hoped to find that Mr. Elbourne's book was one which we could recommend to their notice as carrying the matter further at a single journey than is possible in a weekly paper. The limitations of space, and the demands made upon it by other topics of current interest and importance, exercise inevitable restraint in the case of the periodical; while the book may be expanded to any reasonable length required to carry its subject to a definite point.

We were, therefore, sorry to find, on proceeding with the book, that except for the opening sentence and a passing reference to the unwisdom of management in acting almost entirely as the agent of capital, whereby the distrust of labour had been aroused, it rapidly degenerated into a dissertation on the handling of the workpeople at a factory at Ponders End. Certain general conclusions are drawn from the wartime experience obtained there, but the whole book can best be described as an expression of the author's views and opinions on the right way to run an employment department.

Of the relations between capital and management, management and labour, in their various spheres, we find no helpful word, and of the duty of management to itself no word at all. There is still room for someone to deal at length with this last problem, and it should be done quickly. If management, or, as we have called them, the trained brain workers, will get properly into their place in industry, they will be able to contribute more to the solution of industrial problems than either capital or labour. The management problem is, for this reason, quite the most urgent of all at the present time.

Electricity. By R. E. NEALE, B.Sc., A.M.I.E.E. Pp. viii+136. London: Sir Isaac Pitman & Sons, Ltd. Price 2s. 6d. net.

The aim of this book is to review in a simple way "the general nature of electricity, the methods of producing it, and the services to which it is applied." This forms a rather formidable task, but on the whole the author succeeds remarkably well. He starts off with a chapter on the "sources of electricity" and "kinds of current." This chapter is the weakest part of the book, but those which follow amply compensate for it. A vast amount of useful information is packed into the 136 available pages, and where fundamental principles are dealt with they are clearly and convincingly stated. The author uses arithmetical values to illustrate practical applications at every opportunity, and these should be useful in fixing the ideas of the class of reader most likely to use the book. Chapters VII, VIII and IX, dealing with domestic applications of electricity, are very valuable, and supply authorities would do well to disseminate the information contained therein amongst their consumers. The chapter on electric welding and cutting (No. XIII) is particularly interesting, and is quite up to date. It is singled out for special mention, as its very suggestiveness brings into prominence one of the few serious failings of the book, namely, the lack of references to works on special subjects. Another useful addition would be a short glossary of the technical terms, as it will be impossible for the average reader to get full benefit from the book without this. It would also be advisable to state definitely the relation between the standard units of heat and of electrical energy, as this would provide an absolute base for all the figures quoted relating to costs of electrical processes. The literary style of the work is well up to the usual standard of scientific books, although the value of effusions such as "electrical energy is employed in many forms and degrees between which there are distinctions analogous to those between the mountain and the grain of sand, the precipitous ravine, the undulating foothills and the plain," is not apparent to the reviewer. There are few actual mistakes—kilowatt-amperes (p. 39), within, for with (p. 40), the rectifiers . . . *yield* high efficiency (p. 44) being the most glaring. The illustrations as usual are drawn from the catalogues of manufacturers, but this is not very objectionable considering the object of the book, and the author takes the unusual course of honestly acknowledging their source in all cases. Generally they are good, but fig. 17d is almost valueless. The idea of fig. 13, which shows the principal features of a generating and distribution system, is good. The execution is, however, only mediocre. The printing and binding of the book are excellent, and it can be recommended to all who wish to acquire an intelligent view of modern electrical practice without going deeply into any special part.

C. W. M.

Flow and Measurement of Air and Gases. By ALEC B. EASON, M.A., A.M.I.E.E. Pp. xii+251, figs. 56. London: Charles Griffin and Co., Ltd. Price 25s.

A perusal of this book gives rise to two outstanding impressions, the one a feeling of admiration for the great and painstaking industry of the writer; the other a realisation of the extreme difficulty in arriving at even an approximate generalisation of the laws of flow of gases in pipes.

Whatever formula is adopted, the varying value of the coefficient of friction militates against reliability in practical applications. Mr. Eason fully realises this. He still makes a brave effort to produce order out of chaos, and in Chapter II, after an examination of formulæ of various authorities, gives figures for the value of the coefficient of friction applicable to different classes of work. These no doubt offer a working compromise.

The chapter dealing with loss of pressure in fittings breaks no new ground, and again emphasises the conflict between the values of losses given by various authors.

In his treatment of pneumatic tube problems the author displays a ready familiarity with the subject. There is a not unwelcome lack of that copious quotation of authorities which marks the greater part of the book.

Fig. 4.1 connecting quantities of air used, velocities of air and transit times is particularly interesting. Its usefulness, however, would be enhanced by an account of practical experiments made by the author to test the accuracy of the curves.

One would have liked to see the theoretical aspect of various types of meter supplemented by illustrations and sketches of actual meters, with some remarks upon their practical behaviour. In this connection, the author mostly draws attention to the excellent paper, by Hodgson, on the commercial metering of air, gas, and steam, read before the I.C.E.

In the last few chapters of the book, a return is made to the mathematical disquisition upon the work of various experimenters, only the briefest mention being made of practical matters. Mr. Eason has given us an able summarised mathematical compilation of the work of various authorities. His contribution to the literature on the subject of gas measurement and flow pressure will, however, be regarded by the average engineer as academic. To the designer, the book will prove of value. The curves are well drawn, but would be more valuable if accompanied by fuller explanations, without recourse being necessary to the context.

Two good features of the book are the list of reports, books, and authorities consulted, and, at the end of each chapter, a summarised explanation of the symbols used.—T.W.

The Costing Problem. By EDWARD T. ELBOURNE. Pp. 138. London: The Library Press, Ltd. Price 4s. 6d. net.

This book contains, in addition to the author's remarks, extracts from the cost-finding system of the Federation of Master Printers of the United Kingdom of Great Britain and Ireland; Federation of British Industries' Report "Commercial Efficiency," and Lieut.-Col. O'Meara's paper on "The Functions of the Engineer."

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Chapter I, "The necessity for costing," deals with certain fundamentals, the relationship between capital and labour, the technical use of costs for establishing production efficiency, which the author states is an instrument of management that has been sadly neglected. Scientific management as practised in America evidently does not appeal to the author, who states that "it cannot be said to give much inspiration to us in this country; it is our privilege and responsibility to work along different lines." This statement is rather difficult to understand, as most of these works on scientific management deal very thoroughly and minutely with the very subject the author chooses for his title.

Chapter II, "All-in Costs," deals with the well-known principles of allocation of costs between prime cost and production "on cost," &c.

Chapter III, "The Functions of Factory Accounts," is self-explanatory.

Chapter IV, "Approximation in Factory Accounting," deals with the distribution of burden charges, &c.

Appendix A, extracts from the Federation printers' cost-finding system, is an example of an up-to-date system, and it is not the first time printing trade costing systems have been quoted in works on costing.

Appendix B, extracts from report of Committee on Commercial Efficiency appointed by Federation of British Industries, dated September, 1918, dealing with fundamentals of costing, is a valuable general treatise. The work concludes with an extract of that very able paper "The Functions of the Engineer: His education and training," by Lieut.-Col. W. A. J. O'Meara, C.M.G., which was read before the Institution of Electrical Engineers in February, 1919. Although this work does not contain anything that has not already been dealt with previously in quite a number of works on costing and scientific management, the book, with many more of its type, is welcome, inasmuch as they emphasise the necessity of ascertaining "true costs of production," which is a *sine qua non* if British industry is to compete successfully in the world's markets.

J. C. P.

NEW PATENTS APPLIED FOR, 1920.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. Sefton-Jones, O'Dell and Stephens, Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

14,137. "Amplification of telephone currents." T. F. Wall. May 25th.

14,172. "Dynamometers." Heenan & Froude and G. H. Walker. May 25th.

14,179. "Insulating fish-plates from rails in electric railway track circuits." T. Hardiman and T. J. Wheeler. May 25th.

14,186. "Electric projector lamps for motor-vehicles." A. J. Curnow and Howes & Burley. May 25th.

14,224. "Control of dynamo-electric machinery." D. P. Alexander. May 25th.

14,268. "Machines for laying-up or twinning conductors for dry-core, &c., cables." W. T. Henley's Telegraph Works Co. and H. Savage. May 25th.

14,290. "Electric systems containing X-ray, &c., apparatus." H. Pilon. May 25th. (France, August 19th, 1915.)

14,309. "Electric heating apparatus." D. Corsi. May 25th. (France, February 7th, 1919.)

14,313. "Electric soldering-irons." R. K. Hearn. May 26th.

14,318. "Railway signalling systems." Automatic Telephone Manufacturing Co. and A. E. Hudd. May 26th.

14,321. "Distributors for high-tension electric currents." A. Kirk. May 26th.

14,333. "Electric conduit fittings." M. J. Railing and T. Taylor. May 26th.

14,348. "Electrical magnetic self-driving power unit." F. Read. May 26th.

14,354. "Means for regulating speed of electrically-driven rolls on paper-making machines." A. L. Boyle. May 26th.

14,357. "Sound amplifier." P. R. Gonsky. May 26th.

14,360. "Dual ignition for starting internal-combustion engines." H. A. Savage. May 26th.

14,361. "Dynamo-electric machinery." H. K. Whitehorn. May 26th.

14,410. "Electric switches." F. E. Williamson. May 27th.

14,414. "Electrical cut-out." W. H. Illingworth. May 27th.

14,415. "Electrically-heated kettles, &c." W. W. Soutter. May 27th.

14,433. "Electric starting and regulating switches." G. O. Donovan. May 27th.

14,469. "Fuses for protecting electrically-heated utensils from over-heating." E. G. Nicholson. May 27th.

14,500. "Electric accumulators." A. Pouchain. May 27th.

14,509. "Electro-magnets." G. C. Cummings. May 27th.

14,514. "Controllers for electric motors, &c." Igranic Electric Co. (Cutler Hammer Manufacturing Co.). May 27th.

14,531. "Sparking plugs." W. & W. H. Gold. May 28th.

14,536. "Starting devices for motor-vehicles." A. E. C. and W. Benson. May 28th.

14,541. "Motor-starters, rheostats, &c." L. K. Virr. May 28th.

14,542. "Electrical switch control mechanism for trucks, &c." H. J. Carey. May 28th.

14,543. "Means for suspending bowls, shades, &c., for electric lights, &c." B. Richardson. May 28th.

14,548. "Electric switches for lighting-sets of motor-vehicles." J. Eaton and Efandem Co. May 28th.

14,565. "Electric switches." Horstmann Cars, Ltd., and S. A. Horstmann. May 28th.

14,571. "Electric railway, &c., track systems." N. Prior. May 28th.

14,587. "Sparking plugs." J. Baker, W. C. Bayliss, H. W. Merrill and A. L. Wood. May 28th.

14,590. "Telephone exchange systems." Western Electric Co. May 28th. (United States, July 22nd, 1918.)

14,592. "Variable electric condensers." A. W. Isenthal. May 28th.

14,604. "Short-circuit terminals for magneto-ignition apparatus of internal-combustion engines." Scintilla. May 28th. (Switzerland, May 28th, 1919.)

14,630. "Electric burglar alarms." W. Doms. May 28th. (Germany, April 11th, 1918.)

14,636. "Dynamo-electric machinery." Metropolitan-Vickers Electrical Co. and M. Walker. May 28th.

14,639. "Electric cables and terminals therefor." British Lighting & Ignition Co. and E. O. Turner. May 28th.

14,652. "Induction electricity supply meters." A. Schuster. May 29th. (Germany, August 15th, 1918.)

14,669. "Electro-magnetically operated plate or bar handling skids." D. Colville & Sons and J. J. Inglis. May 29th.

14,672. "Reflection of high-tension alternating currents." Soc. Anon. des Etablissements H. Pilon. May 29th. (France, April 9th, 1919.)

14,679. "Modulation systems for wireless signalling, &c." Radio Communication Co. and J. Scott-Taggart. May 29th.

14,680. "Vacuum tube relay devices, &c., for wireless signalling systems, &c." Radio Communication Co. and J. Scott-Taggart. May 29th.

14,683. "Wireless receiving apparatus." C. K. Chandler. May 29th.

14,687. "Terminals for electric conductors." G. H. Sykes. May 29th.

14,703. "Wireless receiving systems." N. Lea and The Radio Communication Co. May 29th.

Correction.—For the reference under No. 13,185 in our issue of May 28th the following should be substituted: 13,185. "Device for bonding and linking up steel tubing of electrical installations." A. E. Ryeland & C. Ferguson. May 12th.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1918.

18,534. Alternating-current welding transformers. C. J. Holslag. January 14th, 9118. (142,521.)

1919.

46. Electric switches and switch fuses. F. G. Warburton. January 2nd, 1919. (142,523.)

65. Submarine telegraph cables. F. G. Creed. January 2nd, 1919. (142,524.)

2,761. Tools for slotting commutators. J. Gardner and C. Y. Knight. February 4th, 1919. (142,548.)

2,966. Electric heaters or radiators. A. Pritzker. February 6th, 1919. (142,558.)

2,984. Memoranda or writing appliance for use in connection with telephones. J. M. Hattersley. February 7th, 1919. (142,559.)

3,419. Method and system for producing and selectively transmitting harmonics of electric oscillations. Western Electric Co. February 12th, 1919. (142,571.)

3,592. Gas-filled electric lamps. Edison Swan Electric Co. and P. Freedman. February 13th, 1919. (142,574.)

4,168. Rotary current collectors for electric machines. G. di L. Pestarini. February 19th, 1919. (142,578.)

5,387. Ignition devices for use in explosion motors. G. Caliano. March 4th, 1919. (142,593.)

5,766. Sparking plugs for internal-combustion engines. H. F. Holworthy. August 30th, 1919. (142,596.)

7,110. Antennæ for wireless-signalling systems. British Thomson-Houston Co. (General Electric Co.). March 21st, 1919. (142,610.)

8,901. Regulators for electric generators. British Thomson-Houston Co. (General Electric Co.). April 8th, 1919. (142,630.)

9,311. Junction boxes for electric cables. H. B. Smith and Callender's Cable & Construction Co. April 11th, 1919. (142,635.)

9,934. Switches for electric lamps. Clifford Bros. and J. Riddell. April 22nd, 1919. (142,643.)

9,994. Speed-control gear for electric motors, especially applicable for crane motors and the like. Vaughan Crane Co. and J. W. Stanley. April 22nd, 1919. (142,645.)

11,032. Electrical resistance and manufacture of same. G. Turnock. May 3rd, 1919. (Cognate application, 26,935/19.) (142,655.)

12,080. Electric horns. C. H. Offord and W. E. Parker. May 14th, 1919. (142,665.)

12,970. Means for measuring electric currents. M. B. Field. May 23rd, 1919. (142,673.)

13,058. Electric terminal connections. H. S. Cooke. May 24th, 1919. (142,674.)

13,627. Coil-winding machines. Igranic Electric Co. and S. R. Wright. May 29th, 1919. (142,680.)

13,628. Method of and means for applying the insulation of high-tension coils. Igranic Electric Co. and S. R. Wright. May 29th, 1919. (142,681.)

18,941. Sparking plug. D. V. L. Fellowes. July 30th, 1919. (142,716.)

19,378. Electric furnaces. E. F. Collins. September 21st, 1918. (138,026.)

19,459. Incandescent electric lamp sockets or holders. Benjamin Electric, Ltd., E. Fowler and R. A. Ives. August 7th, 1919. (142,717.)

19,599. Electrical apparatus for heating liquids. H. C. Sanders. August 8th, 1919. (142,719.)

23,659. Ceiling-roses and junction-roses for electric light and power installations. J. B. Tannahill. September 25th, 1919. (142,734.)

24,154. Sparking plugs for internal-combustion engines. C. F. Burton. October 3rd, 1919. (142,737.)

25,134. Sparking plugs for internal-combustion engines. G. E. Parker. October 14th, 1919. (142,741.)

26,036. Magneto-electric machines. British Thomson-Houston Co. and A. P. Young. October 23rd, 1919. (142,744.)

28,461. Electric couplings. W. E. Barber and E. Hoyle. November 17th, 1919. (142,754.)

29,532. Spark plugs. Marmon Chicago Co. December 16th, 1918. (136,811.)

32,013. Sparking plug for internal-combustion engines. E. Chasseraux. January 14th, 1919. (137,816.)

The E.T.U.—The *Daily Herald* states that no candidate having secured a clear majority over all the other nominees for the post of extra assistant general secretary of the Electrical Trades Union, a second ballot is to be taken this month on the names of W. M. Citrine and A. H. Stewart.

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THE

ELECTRICAL REVIEW.

VOL. LXXXVI. JUNE 18, 1920. No. 2,221.

ELECTRICAL REVIEW.

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THE I.M.E.A. CONVENTION.

THE convention to be held at Bradford, next week, under the presidency of the city electrical engineer, Mr. Thomas Roles, meets under rather unusual circumstances; its headquarters are at Ilkley, in charming surroundings, but those very charms have made the district so popular that the summer population in normal times taxes its resources to the utmost, so that the influx of some hundreds of additional visitors attending the convention has almost reduced the accommodation available to "Standing Room Only," and has brought home to the residents the reality of the housing problem in its acutest terms. However, Mr. Roles, who during the last few years has acquired an extensive and peculiar experience of dealing with overloads of 100 per cent., or more, can be relied upon to cope with the new peak load thus laid upon his shoulders. We understand that the members' quarters are distributed over a fairly wide area, not only in hotels and boarding houses, but also in private apartments, and that even the latter are at a premium. As the local train service is somewhat indifferent, some inconvenience to members is unavoidable, but we are sure that they will not allow this to detract materially from their enjoyment of the occasion.

Papers on the design of distributing networks, by Mr. C. A. Gillin (Bradford), and power station design, by Mr. I. V. Robinson (of the B.E.A.M.A.), will afford abundant scope for technical discussion, and one on the standardisation of tariffs by Mr. J. W. Beauchamp (of the E.D.A.) will give an opportunity for the Committee members to join in the debate; they will be taken as read, a procedure which we have long advocated, so that the whole time of the meetings will be available for the discussions. The programme of visits, excursions, and receptions will command general approval, and, granted fine weather, the Convention ought to compare favourably with any of its predecessors.

Besides the subjects above mentioned, the municipal engineers and managers will have plenty to discuss, whether *tête-à-tête* or in open meeting. Both the Committee members and the engineers at their sectional meetings will doubtless be interested in the schedules of salaries which have recently been in the public eye, and now the Trade Unions have thrown down a new challenge which, although at the moment restricted to the Greater London area, is bound ultimately to affect the whole country. The Unions' claim is simple and comprehensive; in effect, they demand that non-union labour shall have no place in the electricity supply industry, in the service of either supply authorities or contractors, and they fix a time limit expiring on July 1st for the decision.

This act on the part of the Unions raises two very important questions: first, the operation of the Whitley Council system, and, secondly, the question whether a British citizen is entitled to earn his living without belonging to a Trade Union.

With regard to the former, while it is to be regretted that an agreed decision could not be arrived at in the bosom of the Joint Industrial Council, and that one "side" of the Council should feel called upon to act independently, we do not think the fact indicates the failure of the system. The machine is of very recent construction, and has hardly "found itself" yet; nevertheless, excellent work has already been accomplished by the Whitley scheme, and if it drop a stitch now and then, it does not follow that the scheme is inherently faulty. We believe that as conditions improve,

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and the adjustments and lubrication of the mechanism are perfected, harmony will prevail over discord, and the system will work smoothly. In the meantime, the right to strike being inalienable, the Unions cannot be expected to forgo the use of this weapon to press their views when a deadlock is reached on the Council.

As regards the second question, however, we strongly disapprove of the action of the Unions. The question is in no respect one of urgency, and there was no necessity whatever to resort to the big stick in order to compel an immediate decision. Moreover, we must emphatically protest against the claim implied, that every tradesman must belong to a Trade Union. It is true that the Government policy, as embodied in the Whitley Council scheme, favours the extension of the Trade Union principle, as well as the association of employers, because by no other means is it possible to organise a rational system of representation and a channel for negotiation; but, on the other hand, it leaves to every man the right to decide whether he shall or shall not join a Trade Union, a right which is as inalienable in a free country as the right to strike. We earnestly hope that there will be no yielding on this point; to accept tyranny and call it peace is not the way to industrial salvation, and we strongly commend the subject to the attention of the Convention.

Another item that will arouse debate is the bombshell thrown by the Sheffield Town Council into the electricity supply industry. The Council, overriding the advice of the Electricity Committee and the city electrical engineer, has decided to adopt the same rate of charging for both lighting and power. This is a consummation to which all station managers have long looked forward wistfully—but is the time yet ripe for so drastic a proceeding? No doubt the question will crop up in the discussion on Mr. Beauchamp's paper, and we look forward with interest to the views that will there find expression.

The Transport Position in Paris.

THE situation of the transport undertakings in France, as a consequence of the war and its resulting developments, is not materially different from that in other countries which have been directly involved in the war, particularly in Paris and the Department of the Seine in general. Notwithstanding the increases in fares which have been sanctioned by the responsible authorities, it is impossible for most of the electric railways and tramways to balance expenditure and income owing to the enormous advance in working expenses through the rise in the prices of all kinds of raw and semi-finished materials, augmentations in wages, the introduction of the eight-hour day, and the consequential employment of a larger body of men and other matters. If any profits are earned, the amount is too small to affect the accumulated deficits of previous years. The Metropolitan Railway reports a further deficit for 1919, whilst the inconsiderable profits of the Nord-Sud Railway last year do not prevent the deficit from growing still further, although each is able to pay a small dividend as a result of financial arrangements with the City of Paris. In the case of the tramways in Paris and the Department of the Seine, the companies have been living for a year past under a system of loans, the City of Paris and the Council of the Seine covering the deficits incurred. This method was introduced in order to permit the Municipal Council and the General Council to pursue the question of the purchase of the various tramway networks and their reorganisation in the general interest, particularly with regard to the facilities of communication to be established between Paris and the outskirts. In this connection M. Dausset, President of the Commission des Transports, has just informed his colleagues of the course of the discussions which have taken place with the companies. He states that it appears possible for an agreement to be reached with some of them on the basis of a friendly purchase. It is expected that the systems will be unified under one company, in which the responsible authorities will be jointly interested. At least, this is the impression gathered from the statement attributed to the President of the Commission.

Electrical Training for Women.

WITH the characteristic enterprise of the nation one of the Western agricultural colleges in the United States has announced a course in electrical study for young women, which will teach the repair of household electrical appliances. Amongst the subjects to be taught are the localisation and replacement of blown fuses, the repair of broken appliances and lamp cords, the care and simple repair of washing machines, care and operation of home lighting plant, and other problems that are apt to arise.

This is a subject of much interest, and the innovation is one that is worthy of careful consideration in this country, for with the increasing use of domestic electrical devices, the majority of which are used by the lady of the household, some knowledge of the care and maintenance of the apparatus should be taught her.

Perhaps the E.D.A. and other parties interested have not lost sight of the fact that the adoption of such methods would lead to a better understanding of the possibilities of the various appliances, which, with better treatment, would last longer.

Such a course of study would not only be beneficial to the housewife, but also to the electricity supply authority and the dealer in such appliances; for, with better understanding, more would be sold and more electricity used.

It should not be difficult to formulate some such scheme in this country. An educational campaign would abolish the timidity with which most women regard electricity, and restrain a few of the bolder souls who, by their ignorance, cause so much unjustified censure to fall upon the industry.

Power Developments in U.S.A.

ELSEWHERE in this issue we give particulars of a design for a 300,000-K.V.A. steam-electric generating station which, we believe, may be regarded as embodying the latest American ideas on super-power stations. At the present stage of progress, whatever the future may have in store, the main features of a large power station are fairly stereotyped, and variations must be looked for only in the general arrangement, the selection of known methods and apparatus, steam pressures and temperatures, &c.; nevertheless, there is considerable scope for improvement on current practice, and in several respects the proposed design differs materially from its forerunners. It will be noted that the steam pressure in this case is 350 lb. per sq. in., superheated 350° F., so that the maximum temperature of the steam is about 780° F., near the melting point of zinc. The heated air from the turbo-generators is fed to the boilers, and the economisers are supplemented with pre-heaters, while the jet condensers of the separate "house" turbines are operated with the condensate from the main turbines—a novel scheme. The boilers also present new features, tending towards simplicity, and overhead coal storage is reduced to a minimum.

It is interesting to observe that the generating sets are of 35,000-KW. rating. It is very questionable whether it is advisable, on the score either of economy or expediency, to concentrate much more than this in a single set, even in the largest station.

In the course of a discussion on the development of electric power supply before the American I.E.E., also reported in our pages to-day, it was claimed that the kilowatt-hour could be generated with a consumption of less than 1·5 lb. of good coal with generators of 60,000 to 75,000 KW., and station outputs up to 500,000 KW. were considered, with transmission lines operating at 250,000 volts. Such proposals are exceedingly interesting, and we believe that they afford a true indication of the magnificent prospects that lie before the electrical engineering industry, not only in the United States, but in this country also.

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DISTRIBUTION MAINS FOR NEW HOUSING SCHEMES.

By H. WILSON, Mains Superintendent, Maidstone.

Most mains engineers have during the last year had put before them a block plan of a new estate comprising anything up to two or three hundred houses, and have had to consider the best arrangement of mains to supply these houses with electricity.

This should be to them a problem requiring careful consideration, and at the same time, an opportunity. A problem, because at the least initial cost they have to give the best possible service, not only for immediate needs, but with an eye for possible requirements during the life of the mains which they are laying. It should be an opportunity, because never before have we had, so to speak, a clean slate to start on. Hitherto we have had to make the best of mains "already laid"—and often not laid with a view to ease in maintenance. We have had up to now to deal with houses built in pairs, with often a great uncertainty as to the future development of the roads in which they are erected. We now have to deal with complete estates—with the concentrated accumulation of six years' building. This gives us a much better chance to strike out from the old approved methods, and to profit by the difficulties which we have encountered in the past years.

The demand of the estate in question will probably make it impossible to supply from distributors already in the neighbourhood, and will usually mean a new feeder from the generating station or the nearest sub-station. The nature of the feeder will, of course, depend on the type of generating plant in use at the works, but the suggestions set out below will apply either to a direct or alternating current supply. If the supply undertaking is fortunate enough to have an E.H.T. supply for outlying districts, the feeder will take the form of a 3-core, H.T. feeder finishing up in a static sub-station, which should be as nearly as possible in the centre of the new estate.

Now, assuming that the supply is to be given by means of a 3-phase, 4-wire system, with the consumers connected between one phase and the neutral, a four-conductor main in each street is a clumsy arrangement, and unnecessarily complicated. It is a difficult main to connect service cables to, and, when the houses have been connected in equal numbers between each of the three phases and the neutral, there is no control of the balance of the phases, *i.e.*, of the relative load on each phase. In the early days of the supply, with only lighting in use, this will be quite satisfactory, but with the gradual installation of heating and cooking apparatus in some of the houses, the system will inevitably get out of balance, and there will be no easy means of correcting this.

As an alternative system the laying of a two-conductor distributor along the front of each row of houses has many advantages; moreover, if the main is dipped in and out from house to house, the main and service cables can be combined, and all underground joints and T-boxes can be dispensed with. This calls for a special cut-out on the consumers' premises which replaces the usual T-box on the main and the ordinary two-pole cut-out usually fixed.

A brief consideration of the accompanying diagram—which is of an actual housing scheme now under construction—will be better than a great deal of description.

"S" is a static sub-station from which three feeder cables are taken to feeder boxes A, B, and C, situated in the rectangular bases of lamp columns. The feeder cables are not shown on the diagram, in order to avoid confusion with the distributor cables which are. Each feeder cable consists of a concentric cable with two conductors, the outer being a 0.1 sq. in. conductor connected to the neutral point of the transformer, and the inner being a 0.2 sq. in. conductor supplied from one phase. The copper has been cut down in the neutral conductor, as when the system is in a state of balance this conductor should carry no current, and the neutral conductors are inter-connected at each of the distribu-

The four points marked "L" are 4-way distribution boxes also situated in lamp column bases.

In the case of the 24 houses marked in groups as D, E, F, G, and H, the distributor which is dipped in and out from house to house is a .022 sq. in. twin, paper, lead, armoured cable laid direct. All other distributors consist of 0.05 sq. in. twin cables of similar construction.

Should the distributors become overloaded due to increased load for cooking and heating, it is proposed to extend the feeder cables from the points A, B, and C, to the four distribution boxes marked "L."

The advantages to be claimed for the system here set out may be summarised briefly as follows:—

1. It gives a permanent control of the balance because the area supplied by each phase can be

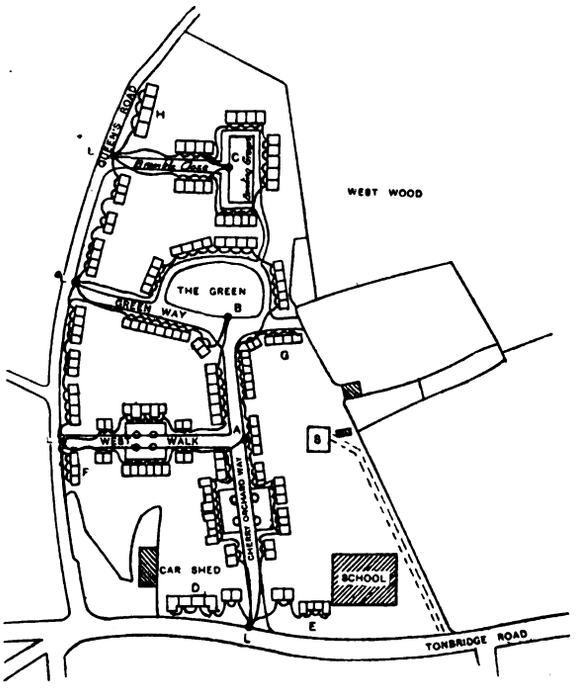

Fig. 1.—Diagram of Distribution System.

altered by adjustment of the links in the lamp column distribution bases or in the houses.

2. It gives a duplicate supply to most of the houses, as by "feeding" from two ways a faulty length of cable between two houses can be disconnected without opening the ground, and can be dispensed with for the time being, without leaving any consumer disconnected.

3. It gives great accessibility to the mains, in the event of a fault developing anywhere on the network. Mains engineers will appreciate the fact that they can get at both ends of a faulty length for testing purposes without opening any ground. It also provides great facilities for rapidly localising any fault which may occur, and for the restoration of the supply. With the advent of electric cooking this will be more important than it has been in purely lighting districts. At the points on the estate where a duplicate supply is not available, that is, where it is impossible to feed from both ends, it is very easy to replace a faulty length with a temporary overhead cable and so restore the supply for the time being, and in this event it is not necessary to open the ground to clear the fault before the supply can be restored to consumers past the point of breakdown.

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4. The system as set out should be fairly immune from breakdowns. It has been the author's experience that faults do not often occur in the middle of lengths of armoured cable laid direct, but usually at points at which the cables have been worked, such as service T-boxes or joints.

5. By the use of armoured cables laid direct, a large proportion of unskilled labour can be used in the installation.

6. It gives the full capacity of the main in each house.

Apart from the question of supply to the new houses, the following points should be kept in mind in the design of the sub-station:—

1. Space should be left for spare H.T. cubicles so that in the future the H.T. supply can be extended further afield with a minimum expense and disturbance of existing arrangements.

The static sub-station which the author has in mind is one of several distribution points on a partly completed H.T. loop main. It is hoped eventually to complete this loop main back to the generating station through other distribution points so as to have a duplicate supply at each point. It would then be possible to cut out any one section of the loop and still supply at all points.

2. Space should be left either for increasing the size of the transformer or for putting in an additional one. The probable increase in the heating and cooking demand in the next few years is a debatable matter, but the least we can do is to allow for a substantial increase for these purposes.

3. Where old mains supplying adjoining districts run anywhere near the new sub-station they should be diverted into it where possible—even if they are direct current mains—as it may be desirable to take them over on to the new supply at some future date. In the author's own case, a three-wire D.C. distributor passes within 200 yards of the new sub-station, and this will probably be taken in and out of the sub-station with a view to changing over to an A.C. supply on account of increasing load and distance from the generating station.

It is suggested that the two D.C. "outers" up the road, and the two "outers" down the road will make four circuits which can be balanced up with the new houses on the 3-phase supply. The 3-phase voltage, one phase to neutral, is 230 volts with 400 volts between phases, while the D.C. voltage is 230 volts outer to neutral, and as the district in question is a residential one without large power consumers, it is hoped to accomplish the change-over without much disturbance other than the changing of the consumers' meters. It should be kept in mind that under modern conditions most power is generated as A.C., and if it can be distributed as such it saves loss both in conversion and distribution.

The cut-out box used in the houses replaces the ordinary cut-out and also the T-box used on the main, and must therefore be of special construction (fig. 2). The first batch of these had to be made during the moulders' strike, and consisted of rectangular boxes 15 in. by 7 in. by 4 in. deep, made of stout sheet iron and treated with a preservative paint. The front of the box is removable, and is made in two sections. The bottom of the box consists of a rectangular hardwood bush grooved on two sides so as to slip into the sheet metal box. This bush can be cut through the middle so that the front half can be slid in after the cables are in position. The bottom section of the metal front, which is 4 in. in height, forms the front of the sealing trough, and is held in position by two set-screws. It is not put in until the work on the cables is completed, so as to give every facility to the cable jointer when opening out the cables. The fittings in the cut-out box consist of two horizontal 1 in. by $\frac{1}{8}$ in. copper strips as shown, the top one being the live conductor, the lower one the neutral. The top bar is set 2 in. further back in the box than the bottom one, so that the conductors coming up to it shall clear the bottom bar. The bars are supported on hard-wood blocks, from which they are insulated by an ordinary meter board insulator and mica washers.

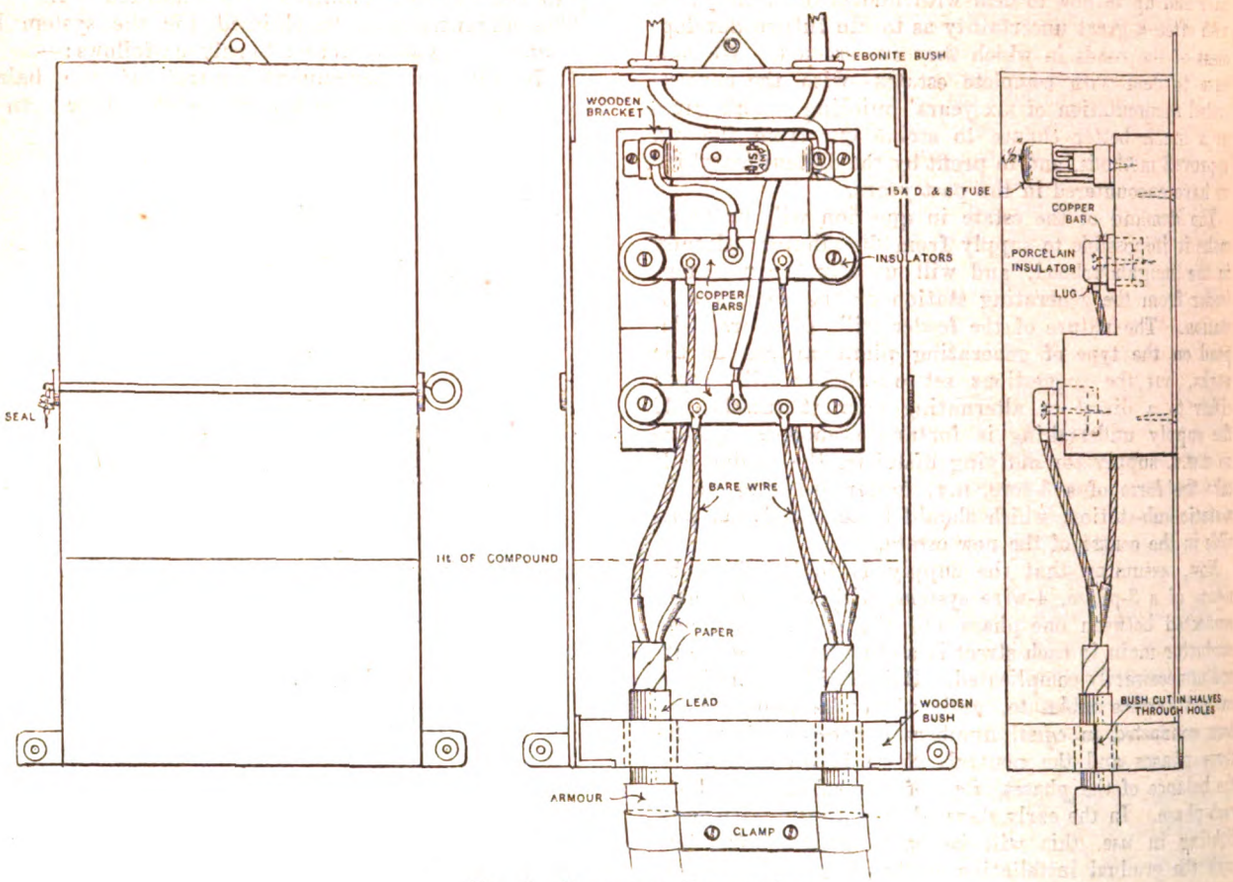

Fig. 2.—Details of Cut-out Box.

Each cut-out will take if necessary three .05 sq. in. twin cables, which permits of any cut-out being used practically as a three-way box. It is proposed to run all street lamp services from the nearest house by means of a .013 two-core paper, lead, armoured cable taken off the bars in the cut-out.

The lamp columns are of the usual type of small

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column except that the bases for 18 in. above the ground are rectangular and are 12 in. by 10 in. The underground portion or root is made as a separate casting, and the column will be lifted on to this and secured by four bolts after the sealing ends and rubber tails have been put on the incoming cables. The bars in the lamp columns will be arranged and supported as in the consumers' cut-outs, and the feeder cables will run with the distributors on to these bars. There will be no fuses other than those on each phase in the sub-station, it being the author's experience that fuses in distribution boxes, unless under constant inspection, have to be set at such a high value to avoid overheating, that they seldom operate satisfactorily when required, and if set only slightly above the working current they are very likely to operate through overload and age, when not required to do so.

All cables will be carefully labelled at the start by means of a stamped zinc label attached to the rubber tails below the bars, and a tracing showing position of all feeders and distributors on the estate will be framed and hung up ready for reference, in the sub-station.

As previously stated, spare ways will be left in all feeder and distribution boxes so as to extend the feeders to the distribution boxes should the future developments require it.

Since writing the above, prices and particulars of a cut-out on the lines indicated for dipping cables in and out, have been received. These prices compare very satisfactorily with the combined cost of an ordinary cut-out and T-box, and the fact that a cut-out of this description will very shortly be on the market for immediate delivery in large quantities, should make the dipping-in system very popular with those responsible for the mains and services to the new housing schemes.

CHARGING ELECTRIC BATTERY HAND LAMPS.

By G. J. DUCKETT.

THE charging of electric battery hand lamps is usually done in a more or less happy-go-lucky way; users of lead-plate sulphuric-acid cells do not appreciate their delicacy, of which there is no gainsaying, but acid cells properly charged and used (that is, not allowed to stand discharged, when sulphation sets in and causes disintegration of the positive plates and swelling of the material, eventually bursting the celluloid case, and resulting in total destruction of the cell) are a most reliable type of electrical apparatus. The writer forsees a great future for the small-capacity electrical storage battery, and therefore a few remarks on the system of charging he has devised may be of some value to those who intend utilising electric lamps in lieu of the old-fashioned gas or oil hand lamps.

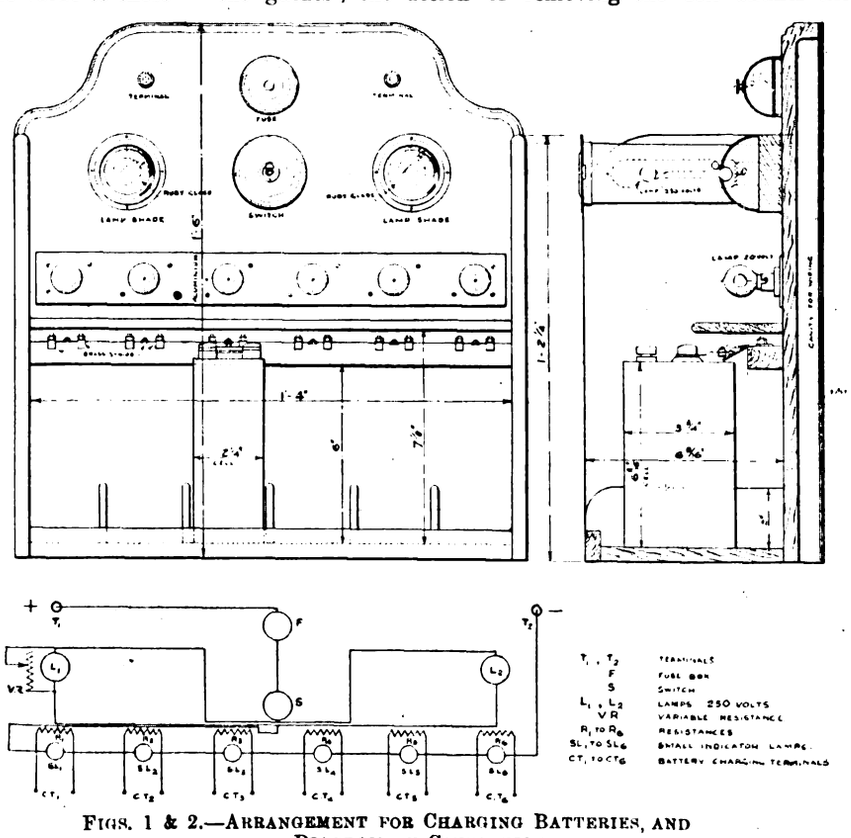
Many people have an unfounded horror of things electrical; owing to lack of instruction, or too great caution, they fight shy of any apparatus which looks electrical. I have borne this point in mind when devising a charging set which is capable of charging any number of cells up to six at one time.

Moreover, one or more cells can be taken off charge without interfering with the remainder, and it is not necessary to switch off the current for the purpose of putting on or taking off a cell, as there is no actual breaking of the circuit, and therefore no fusing of the contacts.

The potential difference between the battery-charging terminals is approximately 2·5 volts when the battery is on charge, but when the battery is taken off charge, the voltage immediately rises to 24, whereas under normal conditions the voltage across the terminals, when the battery has been taken off charge, would be equal to the voltage of the supply mains—in this particular case, 250 volts.

It is common knowledge that the gases given off the plates of accumulators when on charge, have, if combined with a certain amount of air, very explosive properties; therefore, it will be readily seen that if a cell is defective internally, that is, say, if a lug is broken away from the top of the plates, there is a tendency for high-voltage current when charging off 250-volt mains to pass across the gap at the break, and the voltage is sufficient to set up an arc of sufficient intensity to ignite the gases contained within the celluloid case. Such an explosion of the gases is, of course, ruinous to the battery. As I have mentioned before, the voltage across the battery in the arrangement I am describing cannot at any time exceed 24, therefore a break in the cell as above described will not ignite the gases contained within the cell, the voltage being insufficient to cause current to bridge the gap and set up arcing.

The sketch, fig. 1, shows a general view of the charging arrangement, which is capable of charging up six cells at a time, and fig. 2 shows the general wiring diagram. Say, for instance, that No. 4 cell is fully charged and is required, the cell is pulled forward and lifted out of the guides; the action of removing the cell shunts the main current through the 24-volt lamp immediately above the cell compartment, and it lights up, thus indicating that the cell compartment is empty.



FIGS. 1 & 2.—ARRANGEMENT FOR CHARGING BATTERIES, AND DIAGRAM OF CONNECTIONS.

It will now be seen that it is impossible to put a cell on charge inaccurately, and, therefore, it is not necessary to use pole-testing paper, &c., as is customary with the ordinary type of charging apparatus. If a cell is defective (say a broken lug internally), and is put on charge, the

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defect is indicated by the illumination of the 24-volt lamp according to the internal resistance of the battery set up by the fracture in the lug. For instance, if the defect sets up a resistance which raises the battery terminal voltage to 12 or 15 volts, the indicator lamp will glow a dull red, which, of course, draws the operator's attention to the matter, and the battery is put on one side for inspection.

Although there is no necessity to touch any of the live parts of the apparatus, if by chance a pair of battery terminals are bridged across by hand, the potential difference between them is so small that even the slightest shock is very unlikely. Therefore, although at first sight the apparatus appears to consume more current than the ordinary series method, there is very little in it, the actual loss being ·004 unit per charge.

The cost of charging six 2-volt, 25-ampere-hour cells from a 250-volt main is as follows:—

250 volts × 25 ampere-hours = 6,250 watt-hours, or 6·25 units, which, at 2d. per unit, = 1s. ½d., or 2d. per cell, when six are on charge at one time.

The 24-volt indicator lamps and resistance consume 2 amperes at a terminal voltage of 24, therefore their resistance is 24/2 = 12 ohms, but when the cells are on charge the 24 volts are reduced to 2·0 volts, and, therefore, the current then flowing through this circuit is 2/12 = 0·16 ampere, or 0·16 × 2 = 0·32 watt, or for a complete charge it becomes 3·8, say, 4 watt hours, or 4/1,000 × 2 = 0·008d.

The principal claim put forward for this method of charging accumulators is that it is entirely foolproof, and the cells can be charged up by an inexperienced person; there is no technical process to go through, as it is only necessary to put the cells in the compartment if they require charging, and to pull them out of the compartment when fully charged. The best method of ascertaining when the cell is fully charged is to take the density of the electrolyte with the ordinary simple bulb hydrometer.

Fully charged cells should give a reading of 1·250 specific gravity.

THE I.E.E. (SCOTTISH CENTRE) VISIT TO KINLOCHLEVEN.

[BY OUR SPECIAL REPRESENTATIVE.]

On Thursday, June 10th, a party of members of the Institution of Electrical Engineers and their friends left Glasgow for a three days' tour in the Highlands. The excursion was the outcome of an invitation by Mr. W. Murray Morrison, general manager of the British Aluminium Co., to visit their works on Lock Leven.

The revival of interest in Scottish water power, the somewhat mysterious glamour which hangs over the processes of aluminium making, and the pleasant prospects of good company and glorious scenery all combined to lure about sixty members up into the North-West.

Going by the West Highland Railway, the journey led by mountain and loch and across the desolate Moor of Rannoch—where only startled herds of deer broke the empty solitude of the boulder-studded waste; then by tumbling rivers and fresh birchwoods to Fort William at the foot of snow-capped Ben Nevis.

Fort William.

Here the party was marshalled by Mr. William McWhirter for a tour of inspection of the local electricity works.*

The Fort William Electric Light Co.'s plant affords a pioneer example of highland town lighting by means of water power. The head of water is 100 ft., and two Gilbert Gilkes Vortex turbines, each of 100 H.P., drive a pair of General Electric Co.'s D.C. generators at 650 revs. per minute.

The main turbines are situated at Blamafoldoch, 2¾ miles across the hills from Fort William, and the energy, at 560 volts, is conveyed by bare overhead lines to a battery and distribution station in the centre of the town. The town station has, in addition to the battery, a small emergency water turbine and a 40-H.P. Hornsby oil engine, both arranged by belt to drive a battery-charging dynamo, the output of which is 70 amps. at 450 volts.

The standard lighting pressure in the town is 150 volts, and the power pressure is 300 volts. The battery is divided in the centre, with regulating cells at either end, and is charged as a single unit. The town station plant includes a small booster for regulating the pressure of a pair of feeders which go overhead to Corpach—a distance of about four miles.

Mr. McWhirter, while not responsible for the original lay-out of the scheme, has been superintending the supply for the last 20 years. Two typical examples of trouble peculiar to highland installations have been dealt with by him. One of these was frequent interruption by static discharge from the overhead mountain lines. This was effectively stopped by the fittings of non-gap carbon arresters connected to large earth plates.

* Described in the Electrical Review of March 5th, 1897.

The other annoyance was the pitting of the 25-in. steel pipe line at the turbines. The pitting was on the outer surface of the pipe, and was caused by the peaty water in which it lay. It has now been raised on piers to put it above the influence of the corrosive moisture.

The new diamond-cutting factory of Mr. Bernard Oppenheimer was also visited, this being now one of the chief power loads on the town supply. The factory is an offshoot from the larger one established at Brighton, and affords congenial work for disabled soldiers, who are pleasantly housed in the imposing hotel building adjoining. The processes of cutting, grinding, and polishing the stones were watched with interest. The mills and lathes are driven by five G.E.C. motors, having a total output of about 50 H.P.

The vibration caused by the high speed of the polishing disks, together with the need of individual lamps to light each mill, combined at first to produce a high mortality in filaments. It has been found, however, that Ediswan traction type lamps stand up to the severe conditions caused by vibration and constant handling.

Kinlochleven.

The visitors were up early on Friday morning for the 23-mile motor run to the head of Loch Leven. The journey, despite the qualms of those who occupied the seaward seats, was safely accomplished, and at eleven o'clock the party reached the strange town of Kinlochleven, which lies deep between the mountains.

After passing glens and caves, inhabited only by the ghosts of long dead clansmen, and having scanned miles of rocky coast line where not a smoke curl is visible, one experiences a shock on coming upon Kinlochleven, with its wharves and electric locomotives and its shops with wedding cakes advertised for sale. Kinlochleven is a fully equipped town with about 1,500 inhabitants, and while there are churches, schools, and a police office, the dominating feature is the power house with its impressive column of parallel pipes sloping up the hill side.

The power house is a spacious, well-lit, rectangular building having 11 large and two smaller turbine sets. Each set consists of a Pelton wheel turbine and two D.C. generators on one shaft.

The larger or main sets are used each for a battery of furnaces, and the smaller sets are for power, lighting and exciting.

Under the floor and along the length of the power house are a pair of aluminium busbars, which enable any set or group of sets to be coupled to any battery of furnaces.

The main turbines have a guaranteed efficiency of 80 per cent. each, developing 2,900 B.H.P. at a head of 900 ft. and at 300-400 revolutions per minute. They

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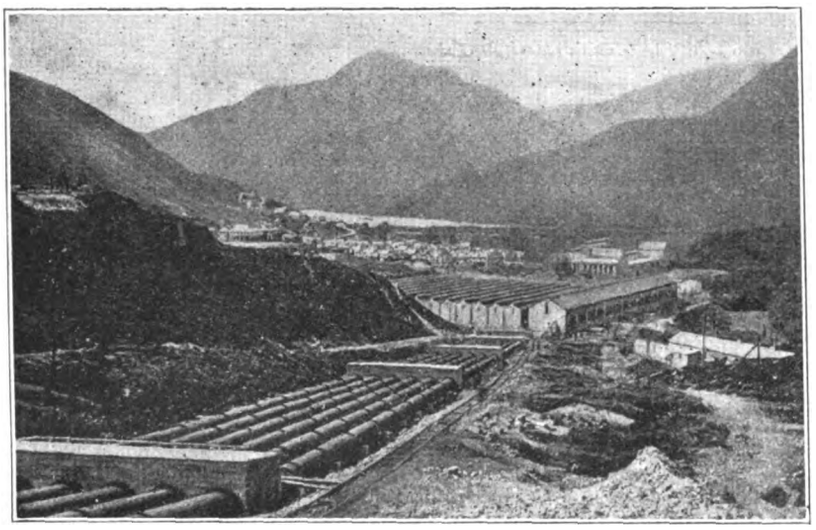
have two water jets, and on the majority of the machines the governors are of the hydraulic type, operating gun-metal spear-head valves. Two of the sets have oil-controlled governing gear; while these are more sensitive, they are also more complicated. The users appear to favour the more robust water governors for furnace work, where very fine voltage regulation is not essential.

The main generators are shunt-wound, without interpoles, and have slot-wound drum armatures. The two generators composing a set are connected in parallel, and the maximum output of each pair is 2,200 KW. at 275 volts D.C.

Electrical regulation is provided to prevent flashing over, which might occur through differences in the currents flowing in the two armatures on one shaft. The field circuits are separate up to their rheostats, but have a common return in which is placed the cut-out. The cut-out is operated by two solenoids. One pressure solenoid breaks the field circuit when the terminal voltage rises to 350, and the current solenoid is connected across the two leads of the same polarity on one pair of dynamos. It is adjusted in relation to the voltage solenoid so that an out-of-balance current short-circuits the field through a discharge resistance.

The two smaller turbine sets are of approximately half the capacity of the main furnace sets. While they also have two D.C. generators on one shaft, these are capable of being used as independent machines, each of different output and voltage. The two larger machines on each set are shunt-wound, and are used for lighting the factories and village and for supplying auxiliary motors, each single generator having a maximum output of 550 KW. at 275 volts. The other two generators are of the compound-wound traction type, having a maximum output of 94 KW. at 550 volts. These are employed to feed the electric locomotives and the cranes on the wharves. The main generators for furnaces, the supplementary sets, and also the locomotives are of Dick-Kerr manufacture. The turbines and their governing gear are by Escher, Wyss & Cie., except the latest addition to the main sets, where the turbine is of Gilbert Gilkes's make.



View of Kinlochleven Aluminium Works.

The extraction of aluminium provides an ideal load for a hydro-electric scheme, and the load at Kinlochleven is, approximately, 20,000 KW. continuously night and day.

The visitors were impressed by the cleanliness, the simplicity, the comparative quietness, and the even temperature of the power house. A peep through a window was permitted at the electric furnaces at work. In addition to the manufacture of aluminium, the company makes its own carbon electrodes in special furnaces. The connections between generators, furnaces, &c., and the overhead pole lines in the yards are of bare aluminium.

The Future of Scottsh Water Power.

After the inspection of the power house, the British Aluminium Co. entertained the party to luncheon at the Tartan Hotel. Mr. E. E. Eccles, the assistant general manager, formally welcomed the Institution representatives, and gave them some idea of the difficulties attending so unique an enterprise as the establishment of a great industrial community in the heart of the highlands. One realised that the present satisfactory position of the company, as well as being a victory over Nature, was also somewhat of a triumph over human nature. He urged on the visitors the need for developing more and more the resources of the Scottish Highlands, and hoped that they would use their influence to conserve the power which was running to waste and so give encouragement to the Highlander to remain among his native mountains.

Mr. W. B. Hird, the chairman of the I.E.E., Scottish Section, in reply, thanked the Aluminium Company and its staff for their welcome, and pointed out that during the last session much attention had been given by the Section to the question of the development of highland water power.

The Resident Manager, Mr. R. P. Tod, furnished some interesting facts as to costs and construction of the works, and mentioned that the factory had run without stoppage for the last 10 years. He announced the arrangements which had been made for the further entertainment and instruction of the company, and, as an incitement to effort, he indicated that a prize had been provided at the dam for the persons who got there first.

The Pipe Track.

The majority of the visitors then set out upon the serious business of the day—the exploration of the pipe track, the conduit, and the reservoir—and for the first part of the ascent many made use of the old road cut through the highlands by General Wade. By means of this road they reached the lower penstock-chamber, which is placed about 1¼ miles from the power-house. The level of the spillweir at this point is 977 ft., and the water here enters six welded steel pipes each of 39 in. diameter. The pipes are anchored to the hillside by massive concrete blocks, and go down to a pair of main bus-pipes to feed the turbines. As the turbine level is 42 ft., the net static head is 935 ft. or 406 lb. per sq. in. Air and scour-valves are fitted to the pipes. Muff joints are used except at anchor blocks, where flanges are employed.

The Conduit.

To the lower penstock-chamber, from which the steel pipes slope steeply down to the power-house, the water is led in a covered concrete box conduit from the reservoir. The conduit is 3½ miles in length, and runs along the southern side of the Leven valley. The conduit slope is only 1 in 1,000. The conduit measures 8 ft. by 8 ft. inside, and normally there is 2 ft. from the surface of the water to the cover of the conduit. The sides of the conduit are reinforced with expanded metal, and the inside floor is faced with a smooth granolithic skin. Expansion joints occur at 64-foot intervals along the straight portions of the wall. These are formed with an asphalt dowel and double bitumen strips. On the cover of the conduit the bitumen joints are replaced by slabs of timber.

The party, considerably thinned out, both as a party and individually, walked along the top of the conduit to the dam, and the course lay over arched gulleys and chasms and under precipitous rocks. On the right towered the mountain side, with here and there an in-

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take pipe from some upper lochan, and on the left far below was the gorge cut by the River Blackwater.

The Dam.

The first sight of the dam is impressive. The upper part of the valley is blocked off by this great wall, measuring 86 ft. high at some parts and with a straight skyline of 3,112 ft. The top of the dam is 1,068 ft. above sea level, and it holds in check a loch reservoir over seven miles long and half a mile wide. The catchment area from which the water is collected is 55 sq. miles, and the reservoir holds more than 20,000 million gallons of water. The average annual rainfall over the catchment area is about 70 in. The dam is bedded everywhere on solid rock. The top thickness is 10 ft., and the upper face is plumb for the first 40 ft., when there is a batter of 1 in 20 to the base. At the base the dam is 60 ft. from back to front at some parts. At the centre of the dam is the valve tower; the valves control three 40-in. diameter pipes. The difference between the levels of these three intake valves and the six pipe valves at the power-house is 993 ft.

Mr. Hird had the energy and the honour to arrive first at the valve tower, and there for a little time he held a reception of the wayfarers as they came straggling up to inspect the tower and its interesting contents.

It was noted that the war had made a considerable demand on the resources of the whole scheme. Advantage has been taken of the presence of a band of German prisoners to connect up Loch Eilde Mor with the reservoir. This has been done by means of concrete pipes and 4 ft. 6 in. bore which were made in Kinlochleven, and stretch for a length of some four miles along the hillside on the opposite side of the valley to that of the main conduit track.

The Finish.

On leaving the dam several took the old bridle path down by the rocky bed of the Blackwater back to the town of Kinlochleven. After dinner those who had not elected to stay the night at Kinlochleven motored back to Fort William.

Saturday forenoon was spent in visiting local beauty spots, in which this district abounds, and while some were left to climb Ben Nevis or go further afield, the tour officially ended with the departure of the noonday train for Glasgow.

The arrangements for this thoroughly enjoyable excursion were chiefly in the hands of the Scottish I.E.E. Hon. Secretary, Mr. Joseph Taylor, and those of Mr. Thomson, of the British Aluminium Co. Perfect weather and the hospitable services of the ladies and the staff at Kinlochleven did much to make the visit a delightful memory.

D. S. M.

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

New Cooking Apparatus.

Among the latest products of the British Electric Transformer Co., Ltd., 50, Oxford Street, W. 1, are the ovens and boiling table illustrated in fig. 1 and the plate heating cupboard shown in fig. 2. The boiling table measures 6 ft. 2 in. by 2 ft. 2 in., and has eight "hot spots"—four with 1-kw. loadings and four having 1.5-kw. loadings—each controlled by a heat regulating switch. The top and legs are of cast iron. Fig. 1 shows four ovens with hot shelves between the two sets, and at the top. The total maximum loading is 1,500 watts controlled by switches designed to put in various combinations of the heating elements. The cupboard (fig. 2) is of oak, and measures 2¼ ft. by 1½ ft. by 2 ft. 10 in. It is divided into two compartments having drop doors fitted with nickel-plated handles and tops—the latter being utilised as hot plates. The interior is lined with aluminium lagged with asbestos. The total maximum loading is 1 kw. Racks to hold 22 plates may be fitted or the cabinet may be used for keeping food warm.

House Lighting Plant.

Messrs. Mark Webber, Ltd., Church Acre Works, Guildford, have sent us particulars of an efficient and economical single cylinder petrol engine suitable for supplying lighting and power to a country house. The "Webber" engine, which is illustrated in fig. 3, possesses many good points, among which may be included the low fuel consumption which is obtained by a number of devices. The piston friction is reduced by the use of a slipper piston, and the crankshaft is mounted on ball-bearings. Forced lubrication of the big end is made by an oscillating plunger pump without the use of pipe work, the oil being delivered through the plunger itself. The camshaft and cams and bearings are contained in a trough which is filled with oil flung out from the big end, and are consequently always immersed. The overflow from this trough feeds the timing gears and governor. The use of very light reciprocating parts eliminates a great deal of vibration. The magneto is operated by a chain drive, and the chain runs in an oil bath. Cooling water is applied direct

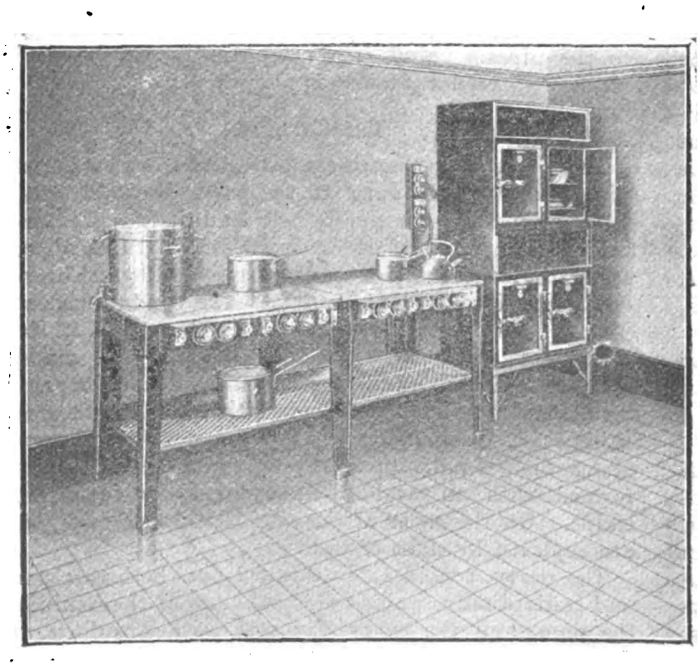

Fig. 1.—Boiling Table and Ovens.

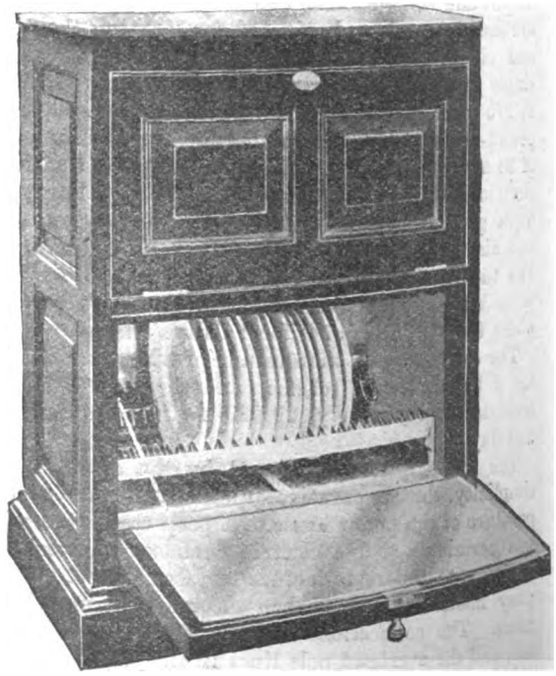

Fig. 2.—Oak Plate-heating Cupboard.

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to valve seats where it is most needed, and all working parts are easy of access. The dynamo can be coupled direct to the shaft of the engine, and fixed on the same bedplate. The fuel consumption of this engine when running on petrol is about .6 pint per B.H.P.-hour, and the lubricating oil required is

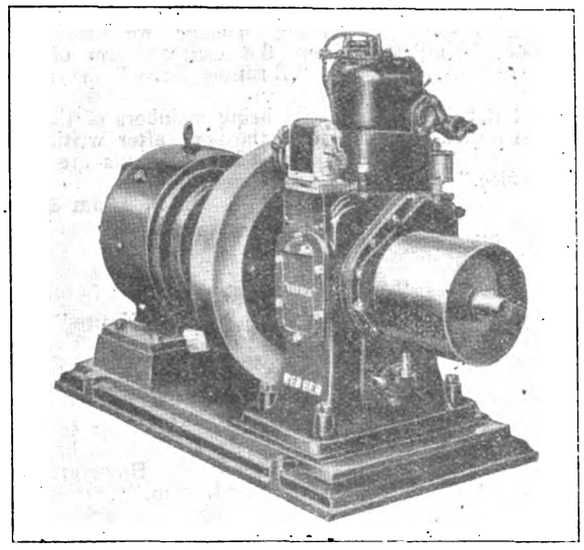

FIG. 3.—THE "WEBBER" ENGINE.

.012 pint per B.H.P.-hour. The size of the lighting sets ranges from 2 to 16 B.H.P., or from 1 to 9 KW. These machines can be adapted to run on gas or paraffin by making the necessary alterations in valves and ignition.

New Wiring Devices.

MR. H. WHITE, A.M.I.E.E., 1, Cumberland Street, Deansgate, Manchester, has sent us details of some new wiring devices he has recently designed. One of these, a "Universal" connector box, is shown diagrammatically in fig. 5. By means of this it is possible to obtain any combination of ways for two or three or four wires while ensuring that no other openings are left in the box. The object is attained by dividing the circumference of the box into sixteen equal parts, slots being cut at 1, 3, 4, 5, 6, 7, 9, 11, 13, 14 and 16 as shown in the diagram. A tight-fitting lid has four openings at

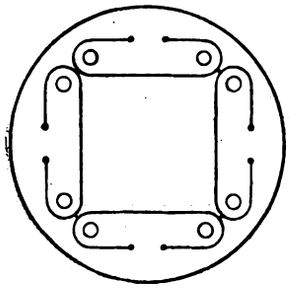

FIG. 4.—BONDING CLAMP.

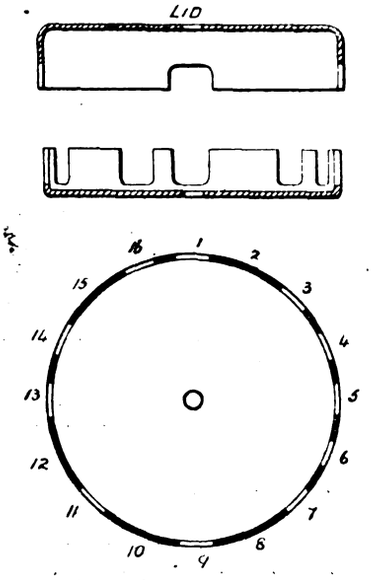

FIG. 5.—"UNIVERSAL" CONNECTOR BOX.

90 deg. By revolving the box it is then possible to obtain any combination desired (4-way, tee, straight through or right angle) only the openings to be used coinciding with the slots in the lid. Another device is shown in fig. 4. This is a circular piece of metal, fitting into the connector box, with four strips for binding over the cables, thus forming an efficient "universal" bonding clamp and ensuring electrical continuity in the sheathing of the wires.

LEGAL.

STOBIE *v.* NEWCASTLE-ON-TYNE ELECTRIC SUPPLY CO.

THE action brought by Mr. Victor Stobie, carrying on business as the Stobie Steel Co. at Dunston-on-Tyne, in the County of Durham, against the Newcastle-on-Tyne Electric Supply Co. came before Mr. Justice Peterson in the Chancery Division upon an adjourned summons on June 8th, and was continued on subsequent days.

Mr. TOMLIN, K.C., appearing for the defendant company (the Electric Supply Co.), said that the summons had been issued to determine a question that had arisen in taking an account directed by a judgment of his Lordship on April 30th last year.* The account ordered was one relating to the profits made by Mr. Stobie in his business, his Lordship having held that under certain agreements the defendants were entitled to share in those profits. The matter went before the Master in Chambers, when Mr. Stobie produced two balance sheets of profit and loss. A question then arose which the Master was not in a position to determine, in consequence of which this summons was issued. It asked for a declaration that new works established by the plaintiff adjacent to the works at Dunston-on-Tyne formed part of the assets of the Stobie Steel Co., and were not the property to which the plaintiff was beneficially entitled, and that the business carried on by the plaintiff at the new works under the title of the Stobie Construction Co. formed part of the business of the Stobie Steel Co. and that accounts be ordered upon the footing of such declaration. Counsel contended that defendants were entitled to a share in the profits of the Stobie Steel Co. under agreements which he read, and said that since his Lordship's judgment Mr. Stobie had adopted the name of Stobie Construction Co. in relation to the new works with a view to excluding the Newcastle Electric Supply Co. from their share of the profits from this undertaking. It appeared that in June 1917, there were for sale certain works adjoining the works of the Stobie Steel Works at Dunston. These were known as the Bradley Williams Works, which were used for the treatment of ore. Mr. Stobie went to the committee with a proposal that these works, which were then in the market, should be purchased. The committee asked Mr. Stobie to get out an estimate for purchasing and equipping them. What Mr. Stobie proposed was to set up there an electric furnace plant for the manufacture of white pig iron. At the next meeting of the committee on June 20th Mr. Stobie reported that he had bought the Bradley Williams Works for £2,000, and that he proposed to instal a furnace for the manufacture of pig iron and after the war to install cogging or rolling plant. Cogging or rolling plant was acquired for converting steel ingots into billets. The Stobie Steel Co. had not at the time on their works any cogging and rolling plant, and they sold their steel in ingots or got it converted into billets by outside firms. The installation of a cogging and rolling plant would therefore be of great service to the Stobie Steel Co. Mr. Stobie's estimate of equipping the Bradley Williams Works with the necessary machinery was £3,000, and the committee agreed that the matter should go forward on these lines.

Mr. UPJOHN, K.C., counsel for the plaintiff, said that the functions of the committee had come to an end at this time, and they had no power to authorise anything.

Mr. TOMLIN said that whether there was a formal authorisation by the committee or whether the committee had any express power to authorise or not there was no doubt that what Mr. Stobie contemplated was submitted by him to the committee for approval. He further contended that the business established at the Bradley Williams Works was part of the Stobie Steel Works, and was administered by one staff, the employés being paid by one official.

The hearing was adjourned.

On resuming on June 9th, Mr. TOMLIN continued his opening for the Electric Supply Co., referring to numerous books, documents and accounts in proof of the business relationship between the parties.

Mr. UPJOHN contended that the two businesses were distinct, and read an affidavit of Mr. Victor Stobie which stated that from 1906 thenceforward he carried on at Sheffield the business of designing and building works and plant such as steel-smelting furnaces and colliery plant manufactured in accordance with several inventions made by him and protected by letters patent. He was also a consultant in metallurgy, and such business he referred to as his construction business. This included the purchase of steel plates and other sections of constructional steel and the cutting, proving and riveting together of such steel to form furnace and other works plant, purchasing motors, transformers and other electrical apparatus. The business carried on under the style of the Stobie Steel Co. mentioned in the agreements in this case was a business entirely different and distinct from his construction business. It consisted of the purchase of steel scrap and ferro-alloys and the melting by means of electricity of such scrap and alloys into a liquid form in a chemically controlled bath and the casting of the liquid steel into the form of ingots to be sold to manufacturers. It did not comprise any constructional work. It was not true that his constructional business was in any way a part or an extension of that carried on under the name of the Stobie Steel Co. It had become

* ELECTRICAL REVIEW, May 9th, 1919.

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very difficult in consequence of the war to get regular supplies of scrap steel, ferro-alloys and other materials for the steel works, and it was necessary to acquire and store a large amount of them. There was not sufficient space at the steel works to store this material, and before he was able to restore his construction business be permitted, as a temporary expedient, the storage of scrap steel in considerable quantities at the new works. In 1918 he commenced to fit up the new works with plant and with his own Stobie electric furnaces. The business carried on there occupied exclusively about three-quarters of the works, and he carried on the construction business there under the style of the Stobie Metallurgic Construction Co. For the purpose of his construction business he had taken over from the steel works goods at the price at which they were sold in the ordinary course of business, the cost of such goods being debited and credited in the books of the two companies. That had also been done when men had been engaged in either business while in the employ of the other. There had been no community of business as between the steel works and the Bradley Williams Works.

Mr. R. P. Sloan, director and manager of the defendant company, gave evidence in support of the defendant's case to the effect that there was ample room on the site of the Stobie Steel Works to store the scrap metal required, and said that to the best of his recollection the Control Committee of the Stobie Steel Co. approved of the purchase of the new works, the object of which was to extend the steel works.

The hearing was continued on June 10th, when further evidence was given to prove that the new works were carried out for the Stobie Steel Co., who had been debited with the charges for materials and labour.

The evidence of other witnesses was taken on June 11th, when the hearing was adjourned until June 16th.

(*To be continued.*)

Morrow *v.* Stepney Corporation.

In the Chancery Division, on June 9th and 10th, Mr. Justice P. O. Lawrence was engaged in hearing an action against the Stepney Corporation to restrain them from causing a nuisance by smoke, &c., from their electric power station at Limehouse.

Mr. Owen Thompson, K.C., and Mr. R. S. Northcote were counsel for the plaintiff, and Mr. Jenkins, K.C., with Mr. J. E. Harman, appeared for the defendants.

The plaintiff carried on the business of a mast, oar, and scull maker in Brightlingsea Place, Limehouse. His premises consisted of a workshop, a dwelling house, and a timber yard, which were opposite to the defendants' power station. His allegation was that the grit and ashes from the works caused him and his family great discomfort, and created an intolerable nuisance, and he asked for an injunction to restrain the Corporation from continuing to discharge grit and ashes from the chimney stack of the works. At the defendants' works there were 13 boilers, nine of which were generally in use, and eight or nine chimney shafts about 80 ft. in height. They consumed about 40,000 tons of coal a year, and they supplied about two square miles with electricity, and had some 3,800 customers for electric light or power.

Mr. Justice P. O. Lawrence, after hearing evidence and the arguments of counsel, in giving judgment, said that, in his opinion, the plaintiff and his witnesses had given their evidence very fairly and without exaggeration, and he (plaintiff) had proved to his satisfaction that the effect of the grit and ashes from the defendants' chimneys deposited upon his premises was to block the gutters and stack pipes on his workshop and to cause the premises to be flooded when it rained. Further, the gritty deposits penetrated the cracks in the timber in his yard with the result that when he worked at the timber the edges of his tools were blunted. Plaintiff also showed that his dwelling house was rendered so uncomfortable by the gritty dust and ashes which fell on the beds and clothing that he was justified in moving to another house. The evidence, said his Lordship, proved conclusively the extent of the deposit, and it satisfied him beyond doubt that the discharge from the chimneys of the defendants' works had rendered the plaintiff's premises less suitable for business and residence. The defendants said that there had been delay in bringing the action. In one sense there had been some delay, but it was to the credit of the plaintiff that he had not taken steps to stop the nuisance until it became intolerable. No exceptional circumstances had been proved by the defendants to induce the Court to exercise its judicial discretion to award damages in lieu of an injunction. The plaintiff was therefore entitled to an injunction which would be suspended for a short period to give the defendants time to abate the nuisance. No special damages had been proved, but he thought he was justified in granting plaintiff £50 as general damages for the discomfort which he had suffered, with the costs of the action.

It was subsequently arranged that the injunction should be suspended until November 12th next.

Buenos Aires Port and City Tramways.

In the Chancery Division, on Monday, Mr. Justice Eve sanctioned a scheme for the reorganisation of this company and an agreement giving effect thereto.

CORRESPONDENCE.

Letters received by us after 5 P.M. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

German Representation.

Judging by the name on the envelope, we also have received one of the letters from the German firm of meter makers referred to in your "Business Notes" in your last issue.

We did not open it, but—not being members of the Newport Corporation—replaced it in the post, after writing over our signature "No letters received from Huns are opened in this office."

E. P. Allam & Co.

London.
June 12th, 1920.

"Situations Vacant."

I feel very grateful to you for the "Special Notice" in this week's Electrical Review re situations vacant, and hope that your kind offer will be accepted by all advertisers of vacant situations. Personally, I have during the last six months replied to no less than 50 advertisements in the Review; one of the applications resulted in an interview, about five employers had the courtesy to inform me that the position had been filled, the rest made no response whatever. However, I still hope to be successful in obtaining a situation.

X.

June 12th, 1920.

We are very interested in your "Appointments Filled" column, which we think is a step in the right direction; but we have a better suggestion to make to solve the difficulty, and that is to recommend that everyone applying for a job should religiously eschew answering advertisements under box numbers; it is little short of an anonymous letter. The writer's policy with letters of that sort is to put them in the waste-paper basket, and he would treat advertisements under box numbers in the same way. Surely we are British enough to be able to trust each other when a berth is advertised, and when an honourable application is made for the same.

For the **Walsall Electrical Co., Ltd.,**
J. Delebecque, *Works Manager.*

Walsall,
June 12th, 1920.

"What is the Contractor Doing?"

Some of the remarks made by your contributor in your issue of June 4th are quite correct, in my opinion. The electrical contractor certainly *does* need to wake up; at the same time the electrical manufacturer has not done all that he could. For instance, take the leading electrical manufacturers' lists of cooking and heating appliances, and you will find in most instances that:—

1. The actual current consumption of the apparatus is carefully left out.

2. There are no details as to the length of time necessary to do the work required.

If these details are not given in the makers' catalogues, they should be prepared to supply the contractor with suitable circular letters in which full details *are* given.

The current consumption should be stated in language easily understood by non-technical persons. Instead of saying 750 watts, why not state that "the current consumption is three-quarters of a unit per hour?"

I am afraid that the average electrical contractor has not the time or patience to prepare suitable circular letters advertising cooking appliances, although the value of these goods is now becoming well known.

With gas at its present high price and low quality, electric cooking should experience a great boom, and I think it is up to the manufacturer to help this forward without relying too much upon the contractor. When the contractor sees that it is worth while, he will do all that is necessary with regard to stocks.

Electra.

June 8th, 1920.

The Chief and the Staff.

In a few days the I.M.E.A. Convention will meet, and it would be well that the members present should take this particular gathering very seriously, for it is certain that there will be much talk and more thought over that very ominous word "Schedule." First, engineers as agents of employers should remember that employés lose public sympathy when *they* fail to stand by any agreement between masters and men! very well, so also will the *employers* lose public sympathy when they fail to carry out a joint agreement between masters and men. Secondly, engineers never have appreciated their own value because they have been too selfish, and in years gone by, having got on a little way themselves, refused to allow their unfortunate juniors to do likewise; they

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neither valued their own brains nor other men's, until now engineers' brains are counted of no value at all in the commercial world. It is perfectly true that you cannot damn another's career without doing damage to your own; nor can one keep a slave without becoming a slave also. Chief engineers are in lots of cases finding this out. Their status is low, wholly because they set out with the object of making their subordinates' status low. The engineer has been a fool, and instead of the elder brother helping the younger, he has trodden on him; now the worm has turned, and the tragedy is that the reformation of status and conditions of labour has come from the lowest rung of the ladder, instead of coming down from the top, as it ought to have done. Now, of course, unless the engineers are still fools they will press the claims of the junior and thus their own status will improve, if they have the influence that is claimed, and all without any effort on their part. If not, then they will have a taste of their own medicine, that is, receive little more than their assistants, as they made their assistants receive little more and often less than the labourers. I should suggest that engineer members talk the matter over very seriously before any such expression as "ridiculous" is used with reference to the schedule of the National Joint Board; pre-war values were neither right nor reasonable. This schedule represents only a small per cent. advance on the real pre-war value, the just value of a man's brain and knowledge. To say that it was then a case of "supply and demand" justifies any extreme demand that employés may now make. Employers made a moral principle which it is not logical for them to alter and whine over because it is against them now. It is a law of nature that if you injure others you injure yourself, and all the talk in the world will not make right for one wrong for the other. If an undertaking cannot stand the charges and make a profit, then the charges must be raised until they do; I have yet to hear of the chief engineer who considered the profits of his undertaking when urging his own claims. There is no justification for a commercial undertaking to pay top price for manual labour and squeeze the technical man on such a plea. The engineer has been cheap, and now is an opportune time if only all will pull together to make the non-technical man understand that the electrical supply engineers consider themselves of some value which has to be paid for; but if we have amongst us at the top men who have no use for any other pronoun besides "I," then harm must be done. At present the technical worker is not prepared to throw in his lot completely with the manual worker, though there is a struggle at present to induce him to do so. I only hope that it will not prove that any member of the I.M.E.A. has it in his mind to be one of the means to bring this about at once, or he may live to reap the bitter fruit of his thoughts. We are all members of one grand profession; some day others will follow you. It depends on you *now* whether you will be honoured as a credit to a noble calling or despised as a hindrance to the attainment of its proper dignity.

A Technical Worker.

June 8th, 1920.

Non-Union Labour and Supply Undertakings.

At a meeting of District Council, Area No. 10 (Greater London), for the electricity supply industry, the question of connecting-up jobs or work done by non-union labour to the supply undertakings mains was discussed at very great length. No agreement was reached on the matter, but the following resolution was passed unanimously by the employés' side:—

"That the trade unions' side of District Council for Area No. 10, for the electricity supply industry, decide that on and after July 1st, instructions will be issued to their members that they are not to connect up any jobs or work done by non-union labour or scab labour in the area covered by this District Council."

In addition, the consent of the various executives of the unions concerned has been asked for, for permission to cease work on July 1st against any or all non-union labour employed in all or every electricity undertaking in the area covered by District Council No. 10.

W. J. Webb,

London District Secretary of the E.T.U. and Secretary for the employés' side of District Council, Area No. 10, for the Electricity Supply Industry.

London,
June 14th, 1920.

Fault Localisation.

Having read with great interest the article in the REVIEW of May 28th on "Cable Fault Localisation," by Mr. Raymond-Barker, also "Kon Denser's" letter in the issue of May 7th, it might interest your correspondents to know that the writer had a similar experience some years ago.

A high-tension, 3-phase, 3-core cable about two miles in length developed an open circuit on one line. Tests for insulation resistance between conductors and also between each line and earth gave no clue, so the writer suggested a capacity test.

A tangent galvanometer was used, and the cable charged from a 500-volt circuit, each line separately. The conductors were discharged through the galvanometer, and deflections of the needle were noted. The faulty line gave half the deflection given by each good line, both of which gave equal throws. The test was then repeated under identical conditions but from the other end of the cable, with the same result as before. Since the cable was uniform throughout its length and the lead sheath continuous and efficiently earthed, it was assumed that the galvanometer deflections would be proportional to the length of the cable. The nearest joint-box to the middle of the cable length was broken down, and it was found that one line had open-circuited at the sleeve joint in this box and the other two were almost separated but still making metallic contact with the other half of the cable. In this case the faulty line was well insulated at the break, the compound having sealed the ends.

J. W. H.

June 7th, 1920.

Composition v. Porcelain Insulators.

In your issue of June 4th, Mr. Geo. V. Twiss, M.I.E.E., writes to find fault with a brochure we have recently issued dealing with "Telenduron" insulators.

Perhaps we have failed to make sufficiently clear that "Telenduron" is manufactured to different specifications to suit the special requirements of different articles. For "Telenduron" as used for telegraph and telephone insulators supplied by us to the G.P.O., we claim:—

1. That it is less brittle than porcelain.
2. That while ordinary commercial porcelain to some extent depends upon its glaze for its insulation, in the case of "Telenduron" the surface finish is of no importance.
3. That its electrical properties as substantiated by N.P.L. reports are ample for all ordinary low-voltage requirements.

For high-voltage transmission we manufacture "Telenduron" to other specifications to suit the special requirements of the consulting electrical engineer.

"Telenduron" is more durable than porcelain. While, like porcelain, it does not incorporate vegetable and animal substances, but is made from "rocks of the earth itself"—to quote Mr. Twiss—it also stands knocking about—which porcelain does not.

per pro **Thomas De La Rue & Co., Ltd.,**
H. C. PARKER, A.M.I.E.E.,
Manager.

Walthamstow,
June 15th, 1920.

COMPOSITION *v.* PORCELAIN INSULATORS.—CORRECTION.—A serious printer's error occurred in the schedule given in the letter of Mr. G. V. Twiss on this subject, in our issue of June 4th. The Schedule should read:—

	Telenduron.	Porcelain.
Flash-over voltage, dry...	40 K.V.	40 K.V.
Puncture voltage ...	25 K.V.	At least 75 K.V.
Absorption	'1 to '3%	Immeasurably small. Certainly below '01%

Recent Magneto Improvements.—Recent improvements in magneto design have much reduced the minimum speed at which the magneto will produce regularly sparks of some given intensity. A certain four-cylinder magneto, for example, will spark regularly across a 5.5 mm. three-point gap at about 60 R.P.M. with the timing lever fully advanced. This type of machine has been found to give good starting on a 3-ton lorry engine, which was always difficult to start with the much larger type of magneto (of older pattern) that it displaced.

This, however, according to Messrs. A. P. Young and H. Warren, *Procs. Inst. of Automobile Engineers*, is not enough; and as an alternative to the complicated and costly electric starter, what is called by Americans an "impulse starter," opens up large possibilities. This device is designed to take the place of the ordinary coupling. It comprises, in essence, two members, one of which is rigidly secured to the magneto-spindle and linked to the other, which is attached to the driving spindle by a stout helical spring. When the crankshaft is slowly rotated the two members will move together until a pawl carried by the member on the magneto spindle is held by a stop fixed to the frame of the magneto. Any further motion of the member on the driving spindle causes the spring to be wound up, during which time the armature remains stationary. After a definite movement of this member the pawl is released, and the armature then suddenly flicks over, producing during its rapid motion an intense spark. This is sufficient to start the engine, which rapidly accelerates. At a very low speed, the pawl is thrown out of action by centrifugal force, and the two members rotate as a single unit. As compared with an electric starting system, this device is naturally much cheaper, and, being a compact and single mechanical unit, it obviously has—other things being equal—enormous advantages from the standpoint of reliability.—*Technical Review.*

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BUSINESS NOTES.

Notice to Readers.—As several correspondents have placed before us particulars of certain business transactions of a disappointing and unsatisfactory character relating to purchases of conduit, it is thought that there may be others who have been similarly inconvenienced. If so, will they communicate with the Editors of the ELECTRICAL REVIEW, 4, Ludgate Hill, E.C. 4.

Siemens Sports' Club.—The directors of Siemens Bros. and Co., Ltd., have presented to the Siemens's Sports Club, formed by the employés of the company at its Woolwich works, a football challenge shield for competition between the various departments. The presentation, which took place on May 28th, was made by two of the directors—the Rt. Hon. Sir William Bull, M.P., and Mr. G. Chauvin, managing director—who at the same time handed over a room for the accommodation of the club until such time as a suitable sports ground can be found. Sir William Bull congratulated the club upon its success in having over 1,300 members already enrolled. The first winner was the Apparatus Machine Shop, which thus heads the list of names to be engraved upon the shield.

The shield, which was designed and made at the Woolwich Works, possesses many unique and emblematic features. It is constructed in fine figured oak, upon which, carved in bas relief, are shown some of the products of the company, viz., overhead telegraph and power lines, an automatic telephone instrument, a searchlight projector and primary cells. The carving also includes a representation of the company's cableship *Faraday*, and of a deep sea grapnel, used for picking up submarine cable at great depths. Above the shield proper is a full size football in wrought copper, beneath which appears the Arms of the Borough of Woolwich. The shield is six feet in height, and is arranged for suspension by means of a suitable length of an actual cable which played no inconsiderable part in the successful defeat of the submarine menace in the late war, and which was manufactured at the Woolwich works.

Lead.—In their report dated June 12th, Messrs. James Forster & Co. give the following information :—

BOARD OF TRADE RETURNS.

	Tons.
The imports for June are given as	14,568
The exports for June are given as	3,317
Left for home absorption	11,251

The latter figure for the seven months November-May (inclusive) is 29,954 tons; against this we venture to give the following figures as a conservative estimate of consumption in the three principal trades, viz :—

	Pre-war. Tons.	This year. Tons.
White lead, red lead, &c.	60,000 ...	35,000
Electric cables and accumulators ...	60,000 ...	60,000
Sheet and pipe lead, &c.	— ...	50,000
		145,000

We have the white lead and sheet lead estimates from authorities in the trade. The second (electrical) is based on the fact that the cable companies report a record trade both in values and quantity.

On these figures (which we are certain are lower than the actual) we have a total consumption of 145,000 tons for the year, against imports available for seven months of 29,954 tons. So far the metal available in the ordinary way for the requirements of consumers has been supplemented by Government war stocks, and in some localities by supplies obtained from the dismantling of chemical plant erected by the Government for war purposes. These adventitious aids have so far tided over a difficult time, but we have to rely on imports, and if our figures for consumption could be cut down by one-half we should still be left with a considerable deficit, unless the coming months show a much larger increase in imports.

Manufacture of Meters in Australia.—According to Press reports just to hand, it was expected that early in July the Small Arms Factory, Lithgow, would commence the manufacture of all kinds of meters, for gas, water, and electricity. "At present there is no firm undertaking this work to any extent in Australia, and the only meters imported are Japanese, which are said to be very inferior in quality. Extreme difficulty is experienced by companies in securing supplies, and the factory management has already received an order from a Sydney firm for 3,000 meters."

Electrical Manufacturing Developments in Australia.—For manufacturing in Melbourne, Berry's Electrical "Magicoal" Fires (Australia), Ltd., has been registered, with authorised capital of £30,000, in 60,000 shares of £1 each. Messrs. H. H. Berry, G. C. Allan, W. Lowe, G. E. Dickenson, and S. G. Pirani constitute the first board. The office of the company is at 60, Queen Street.

Confirmation of the appointment of Mr. G. Weymouth, of G. Weymouth Proprietary, Ltd., Melbourne, and Messrs. J. B. Nicholson and A. A. Stewart as joint managing directors for five years of the English Electric Supply Co. of Australia, Ltd., was to be asked of shareholders in Standard Waygood Hercules, Ltd., Sydney, at a meeting on May 6th. G. Weymouth & Co., Pty., Ltd., lately acquired a large interest in Standard Waygood Hercules Co., Ltd., and the name of the latter is to be changed to English Electric Supply Co. of Australia, Ltd. The Standard Co. has issued its report for the year ended March 31st last, showing a net profit of £46,237, which compares with £16,993 for the previous year. It is proposed to pay a dividend of 10 per cent. per annum and a bonus of 2s. per share. Failing instructions to the contrary, the bonus will be applied towards paying up a new issue of 21,600 shares offered to present shareholders. The Brisbane business has been closed. An outlay of £150,000 is anticipated for extension of works, at which to carry on manufacturing in Australia for the English Electric Supply Co., Ltd.—*Sydney Sun*, April 22nd.

Applications for British Trade Marks.—Appended is a summary of the recent applications for British trade-marks in respect of goods associated with the electrical trades and industries :—

Karnak. No. 400,550. Class 13. Sparking plugs, electrical fittings, &c. Bernard A. Quick, 20, Gladstone Park Gardens, and Arthur R. Kearney, 6, Templars Avenue, Golders Green, London, N. February 9th, 1920.

Instanto. No. 401,272. Class 13. Sparking plugs. Sydney E. Taylor, Frederick O. Ellis, and George E. T. Archer, 307, London Road, Southend-on-Sea. February 27th, 1920.

B.M.T. British Motor Trading Corporation, Ltd. (lettering combined with wheel design). Electrical insulating materials, &c. British Motor Trading Corporation, Ltd., 20-22, King Street, St. James, London, S.W. May 26th, 1919.

Platomac. No. 402,366. Class 13. Sparking plugs. Pickhard, Dobson & Co., Ltd., 536, Claremont Road, Rusholme, Manchester. March 26th, 1920.

Thomson Electric Welding (lettering, combined with design). No. 391,280. Class 18. Electric plant for welding, forging, brazing, and soldering. Thomson Electric Welding Co., 84, State Street, Boston, U.S.A. May 95th, 1919.

Resilia. No. 400,077. Class 8. Electrical measuring instruments. Chas. E. Foster, trading as the Foster Instrument Co., Pixmore Avenue, Letchworth. February 27th, 1920.

New Lamps for Old. The Aladdin Renew Electric Lamp Corporation, Ltd. (lettering combined with design). No. 396,413. Class 13. Incandescent electric lamps (ordinary). The Aladdin Renew Electric Lamp Corporation, Ltd., Grosvenor Mansions, 82, Victoria Street, Westminster, S.W. October 23rd, 1919.

Kayb. No. 399,422. Class 13. Sparking plugs. Thos. Kay, trading as A. Kay & Co., Bolton Brass Works, Blackhorse Street, Bolton.

Reflex. No. 403,686. Class 13. Sparking plugs. The Reflex Ignition Co., 3068 West 106th Street, Cleveland, O., U.S.A. May 3rd, 1920.

Nonsol. No. 401,621. Class 40. Insulating tape principally composed of india-rubber. Connolly Bros. Adhesive Tapes and Insulating Materials Co., 69, St. Stephen Street, Salford, Manchester. March 9th, 1920.

Electrical Installations for Ontario.—H.M. Trade Commissioner at Toronto (Mr. F. W. Field) has informed the Department of Overseas Trade that the Hydroelectric Power Commission of Ontario has issued a notice to electrical manufacturers, jobbers, and dealers in Ontario to the effect that all electrical material, devices, and fittings for use on inside electrical installations in the Province of Ontario, must not be offered for sale until their design and construction has been approved by the Hydroelectric Power Commission of Ontario. (6 Geo. V, Chapter 19, 1916.) Manufacturers whose products are approved and listed by other recognised authorities, and which also meet the requirements of this Commission, may have same placed on the approval list by making application in accordance with Approval Laboratories' Bulletin No. 5, copies of which are on file with the Department of Overseas Trade.—*Board of Trade Journal.*

German Debts : Warning. — The Controller of the Clearing Office (Enemy Debts) desires to warn the public that attempts are being made by German agents or principals to obtain direct settlement or payment of their pre-war debts from their British debtors. By the terms of the Treaty of Peace Order, 1919, it is unlawful for any person to pay or to accept payment of a debt coming within the provisions of Article 296 of the Treaty of Versailles, and communication between the parties interested as debtor or creditor is forbidden. Any person contravening this provision is liable to be proceeded against and punished as if he had been guilty of the offence of trading with the enemy. Severe penalties are similarly imposed by German law on German nationals contravening this provision of the Treaty. Persons or firms to whom overtures have been, or may be, made for settlement of pre-war debts, except through the Clearing Office, are requested to immediately communicate full particulars to the Secretary of the Clearing Office (Enemy Debts), Cornwall House, Stamford Street, London, S.E.1. British nationals who are creditors of German nationals in respect of pre-war debts, and who have not yet notified their claims to the Clearing Office, should do so at once, in view of the fact that the time limit fixed by the Treaty for notification expires on July 10th, 1920. British nationals, to whom official applications have been sent by the Clearing Office for payment of all debts whether above or below £50 admitted to be due to German nationals, should pay these debts forthwith; failure to do so increases the interest chargeable against the debtor and exposes him to the risk of payments of law costs. British claims to the number of 34,802 were on the 15th ultimo notified to the German Clearing Office, and a further large number will be notified during the present month. As soon as the notification of the admission of these claims has been received from the German Clearing Office payment will be made by the Controller without further request by the British creditor.

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Capital of Italian Electrical Companies.—The *Economic Review* reproduces from *L'Economista d'Italia* of May 23rd, the following table showing the amount of capital invested in electrical companies up to October 31st, 1919, according to statistics published by the Electrical Engineers' Association :—

	No. of companies	Capital in L.1,000
Piedmont	31	122,394.5
Lombardy	94	536,811.9
Venetia	24	120,268.0
Liguria	17	168,830.0
Emilia	8	26.7
Tuscany	22	132,494.7
The Marches	12	12,505.0
Umbria	3	1.9
Abruzzi and Molise	8	2,297.0
Campania	30	183,260.05
Puglia	12	8,454.0
Calabria	11	6,266.0
Sardinia	1	120.0
Sicily	9	18,430.7

Rubber-covered Wire: Conditions of Importation into Australia.—Rubber-covered wire imported into Australia must comply with the conditions set out in a proclamation issued in the Commonwealth on April 2nd, 1919. This proclamation, originally notified to operate from July 1st, 1919, was not actually enforced until April 1st, 1920.

We regret that we have not space to spare to print the full proclamation setting forth in detail the conditions and tests that have to be complied with, but these particulars can be obtained by those interested from the office of the official secretary, Australian Commonwealth Offices, Australia House, London, W.C. 2.

Since the issue of the proclamation the Commonwealth authorities have decided to accept compliance with the undermentioned conditions as a satisfactory alternative to compliance with the corresponding conditions specified in the proclamation, viz. :—

1. The insertion of a tape marked as required between the vulcanised tape and outer covering will be accepted in lieu of marking on the tape.

2. The requirements laid down in the British Engineering Standards Association, Report No. 7 of 1919, revised July, 1919, will be accepted for the respective grades of cable.

It is understood that rubber-covered wire purchased from the Disposal Board is being exported to Australia not marked as required by the proclamation. The High Commissioner for Australia has been asked by the Commonwealth Department of Trade and Customs to give publicity to the fact that it is not proposed to exempt such wire from the requirements in question.

Large British Water Turbines for Cauvery River Scheme.—The order has just been placed with Messrs. Boving & Co., Ltd., for four 5,600-H.P. turbines by the Mysore Government for the Cauvery river scheme. It is believed that these will be the largest Francis turbines ever built in this country, though Pelton wheels up to 8,000 H.P. have been built here, five of this size being supplied by Messrs. Boving & Co., Ltd., to the Tasmanian Government. The turbines now ordered by the Government of Mysore will be of the single discharge spiral type for a head of 415 ft., and will run at 500 R.P.M. In addition two Pelton wheels of 450 H.P. are required for driving the exciters. These new units form the first group of the large machines which are to replace the smaller machines now installed, in order to better utilise the power available.

Electrical and Engineering Wage Demands.—The *Manchester Daily Dispatch* states that a ballot is being taken among the 55,000 members of the Electrical Trades Union throughout the United Kingdom to decide whether, if necessary, they shall cease work in order to enforce a demand for a flat rate of half-a-crown an hour. The date for the return of the ballot papers has not yet been fixed, but it is anticipated that there will be a big majority in favour of steps being taken to secure the rate mentioned. Half-a-crown per hour, it is said, would mean an increase of 7d. for the men in the Manchester area, 3d. for those in London, a little over 4d. for those in Liverpool, and as much as 8d. for workers in Scotland and other parts. It is stated that before any notices are handed in the Union will make an offer to negotiate with the Electrical Trades Federation, the employers' body concerned.

The *Birmingham Post* reports that at a private meeting at Edinburgh of employers in the engineering trades the position brought about by the latest demands of the men for increased wages was considered, and it was decided to resist those demands. The men put their claims forward in the form of an ultimatum, giving the employers three weeks to decide. The employers' meeting was private, but it was decided that not another penny should be conceded to the men. The industry is now strained to the utmost to meet the concessions already granted, and when the three weeks have expired the men must either withdraw their demand or all engineering works will be closed down and hundreds of thousands of workers locked out. At the meeting practically every firm of consequence was represented.

State Industries in Germany.—The Exchange Telegraph correspondent at Berlin states that although the German Government has abandoned plans to nationalise whole branches of industry, and has substituted compulsory trusts, the State has of late taken into its hands a considerable number of important producing concerns. From the General Electricity Co. the State has purchased power works near Bitterfeld with a capacity of 100,000 KW., which supplies Berlin City. The State has taken over the brown coal mines in Niederlausitz, and is running the electrically-driven Lauta aluminium works, which also produce artificial nitre. A large number of other power stations have been taken over under the Electricity Law of 1919. The State is also largely engaged in nitre production by the Haber and Frank-Caro processes, and has control of almost the whole aluminium production, which is mainly an outcome of the Government's investment of 300,000,000 marks in 1915. The State has also taken over the important Ilseder smelting works in Hanover.

Wages in German Industries.—The *Wirtschaftliche Rundschau* (May 13th) has an article showing the extraordinary increase in wages in the various German industries in the past few years, from which it appears that the very high wages earned by individual categories during the war became general after the revolution. The result is that Germany's economic life is seriously imperilled, as may be gathered from the following statistics :—

In the Rhine Province and Westphalia the ratio of wages to every ton of crude steel produced rose from Mk. 16, at the beginning of 1914, to Mk. 208 in December, 1919, making a twelfold increase in wages alone. The wage advances in the war industries between July, 1914, and July, 1918, varied from 300 to 400 per cent. The wages of individual categories of workers reached a fabulous height. Apart from cases—by no means rare—in which, for example, a Berlin highly-skilled worker earned Mk. 980, in a 52-hour week, wages of Mk. 200 per week were not unusual; a skilled tinsmith earning less than Mk. 100 per week would have been looked for in vain in Berlin. In addition to the wages, war allowances and other benefits were received by the workers, which cost the undertakings considerable sums of money. After the revolution, the wave of wage-increases rose to an absolutely unprecedented height. According to the *Reichsarbeitsblatt*, the average daily wage of an industrial worker (juveniles included) rose from Mk. 5.18 in March, 1914, to Mk. 13.52 in March, 1919; that of a woman worker from Mk. 2.28 to Mk. 6, *i.e.*, an advance of 261.0 per cent. for the former, and of 263.2 per cent. for the latter.

The increase in the metal-working, engineering, and electrical industries is shown in the following table :—

	Average daily earnings in marks.						
	Mar. 1914.	Mar. 1915.	Mar. 1916.	Mar. 1917.	Mar. 1918.	Mar. 1919.	Inc. p.c.
(*a*) for male workers.							
Metal-working ...	5.54	6.29	7.46	9.88	12.61	14.13	155.1
Engineering ...	5.37	6.39	7.33	8.95	12.10	14.79	175.4
Electrical Industry	4.52	4.99	5.76	9.25	12.06	13.13	190.5
(*b*) for female workers.							
Metal-working ...	2.04	2.22	3.46	4.68	5.88	5.69	178.6
Engineering ...	2.28	2.80	3.65	4.34	5.65	6.31	176.8
Electrical Industry	2.75	3.01	3.91	5.24	6.58	7.96	189.5

—*Economic Review.*

Company Liquidations.—SURREY ELECTRICAL CO., LTD. Winding up voluntarily. Liquidator, Mr. E. W. E. Blandford, 227-8, Gresham House, Old Broad Street, E.C. 2.

KINETIC CO., LTD—A meeting of the creditors was called for June 16th, at 43, Gallowgate, Leicester, on June 16th. Liquidator, Mr. T. Rimington.

TORQUAY TRAMWAYS CONSTRUCTION SYNDICATE, LTD.—A meeting of members is called for July 12th, at 62 and 68, Queen Street, E.C., to hear an account of the winding up from the liquidator.

ALEXANDER DUCKHAM & CO., LTD.—Meeting called for July 19th, at 4, Broad Street Place, E.C., to hear an account of the winding-up from the liquidator, Mr. L. A. Anderson.

W. A. S. BENSON & CO., LTD., London.—This company is winding up voluntarily, with Mr. H. C. Rabbidge, 32, Poultry, E.C., as liquidator. Meeting of creditors, June 28th.

Trade Announcements.—MESSRS. TOFIELD & ROBINSON, LTD., of 165, Edmund Street (and Lionel Street), Birmingham, have recently purchased the Birmingham business of Messrs. Handley & Robinson, Ltd., of the same addresses. They have also acquired offices and stores in London. In addition to being contracting engineers, they hold a stock of A.C. and D.C. motors.

MR. BEN CROSLAND, electrical engineer and contractor, of Bradford Road, and 3, Branch Road, Batley (Yorks.), has been joined in partnership by Mr. H. Bateson, of Bradford, and the business will be conducted under the style of Crosland & Bateson.

MR. J. G. ROYCE, of 37, Victoria Street, Bristol, has been appointed by the Hart Accumulator Co., Ltd., of Stratford, London, as their agent for the sale of the "Hart" storage battery in the south-west district of England (the counties of Gloucester, Somerset, Devon, Cornwall and Dorset).

THE B.E. CO. (OF LONDON AND BIRMINGHAM), LTD., states that it is desirous of appointing agents for many parts of the United Kingdom.

THE BRITISH ELECTRIC TRANSFORMER CO., LTD., of "Tricity" Showrooms, Oxford Street, W.1, has had an additional telephone line installed ("Museum 5880") to cope with increased business.

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The German Transmarine Electricity Co.—The shareholders in the Deutsch-Ueberseeische Elektrizitats Gesellschaft of Berlin have now approved the transfer of the undertaking to a Spanish group. At the recent meeting the chairman mentioned that offers had been received from countries of the Entente to take over the concern, and also from a Swiss group, but the most favourable proposal to the company was that made by the Spanish group of banks. The company realised net profits of 2,115,000 marks in 1919, as compared with 2,372,000 marks in the preceding year, and a dividend at the rate of 6 per cent. has been declared on the preference capital, as in 1918.

Catalogues Wanted.—MESSRS. STEEL MORRISON AND Co., Sprowston Works, Sprowston Road, Forest Gate, E. 7, electrical and general engineers, wish to receive catalogues and lists from electrical manufacturers and dealers.

MESSRS. BURRELL, RUSSELL & Co., 104, Shenley Road, Camberwell, S.E. 5, ask for manufacturers' catalogues of everything electrical suitable for contractors, also shafting.

Dissolution of Partnership.—BAKER & HYMAN, electrical manufacturers, automobile and general engineers, 11 and 13, Portland Crescent, Leeds.—Messrs. W. T. Baker, H. W. Baker, and H. Hyman have dissolved partnership. Messrs. W. T. Baker and H. Hyman will attend to debts and continue the business.

For Sale.—The Disposal Board, Ministry of Munitions, is offering for sale by tender the plant for the production of hydrogen and oxygen by electrolysis, situated at Grand Tuevilly, near Rouen. For full particulars see our advertisement pages to-day.

Manchester Corporation electricity department invites offers for 13,000 pairs of Columbia carbons, and 2,000 pairs Conradty carbons for open-type arc lamps. For particulars see our advertisement pages to-day.

Book Notices.—"Caledon Welfare Magazine." Vol. I, No. 1. (24 pp.) Price 6d. London: Industrial Welfare Society.—A new works journal just issued by the Caledon Shipbuilding Co. The first number includes, among notices of the many social activities of the firm, an article on the ethics of Sportsmanship, by Lieut.-Col. E. A. Berrisford, M.C., President of the Oxford University Boating Club, and a clever cartoon by Mr. Bert Thomas, caricaturing the suggestion that music might be introduced to accompany the more monotonous tasks in industry. There are other contributions on motor cycling, athletics, allotments, the effect of mechanical inventions on the working man and boy life in China, with two pages devoted specially to women. The magazine is well printed on good paper, amply illustrated, and neatly laid out.

"Safety First." The *Journal* of the British Industrial Safety First Association, No. 2. May, 1920. (16 pp.).—A report of the first annual general meeting and the first annual dinner is included in this issue. Other interesting items are notes on "Safety First," from a variety of sources, industrial and otherwise.

"Faraday House *Journal*. Vol. III. No. 6. (Summer Term, 1920). (18 pp.).—This issue includes an interesting and informative paper on "The Electrostatic Capacities of Cylindrical Conductors," by Dr. Alexander Russell (Principal), as well as an account of the annual dinner of the Old Students' Association. Lists of examination results and recent appointments secured by students are given.

Scientific Paper No. 378 of the U.S. Bureau of Standards, "A New Spectropyrheliometer and Measurements of the Component Radiations from the Sun and from a Quartz Mercury Vapour Lamp." Pp. 17. Washington: Government Printing Office. Price 5 cents.—The instrument described consists of a quartz spectrograph and cylindrical condensing lens, placed upon an equatorial mounting. In this manner the ultra-violet absorption in heliostat mirrors is avoided. Notes on the relative components of infra-red, visible and ultra-violet rays from the sun and from a quartz mercury arc lamp, are given.

"Elements of Electrotechnics." By A. P. Young. Pp. viii + 348; 179 figs. London: Sir I. Pitman & Sons. Price 7s. 6d. net.

"Steam Turbines." By J. A. Moyer. Pp. xi + 496; 222 figs. London: Chapman & Hall. Price 21s. net.

Bankruptcy Proceedings.—HORACE HENRY SHAVE (trading as H. H. Roberts), electrician, 228, Sultan Road, Portsmouth.—The public examination of this debtor was held at Portsmouth on June 7th. In answer to the interrogation of Mr. G. S. Hopkins, the Deputy Official Receiver, the debtor said he joined the Navy as a domestic in November, 1906, and left in March, 1908; he rejoined as officers' cook in December, 1913, and finally left in September, 1916, for medical reasons. He then travelled in the sale of enamelled letters, out of which he made a livelihood, until October, 1919, when he commenced trading on his own account as an electrician. He had had some experience in electfical work, having previously been employed in the telephone service. When he commenced on his own account he had no capital beyond £13 5s., the amount of his gratuity on leaving the Service. The six months which he had been in business had barely paid him a living profit, and in October he was obliged to suspend his operations, owing chiefly to the difficulty in getting the necessary tubing. He continued for some time after the knowledge of his insolvency, in the hope that matters would improve. He became aware of his insolvency about five weeks prior to filing his petition. He had kept no books of account of any description, and in applying for work he had underestimated the cost of it, and this had been one of the things which led to his failure. The liabilities amounted to about £85, and the assets were of the net value of £11, leaving a deficiency of £74. The examination was closed.

E. S. ELAM and J. WALTON (Elam, Walton & Co.), electricians, 63, King Edward Street, Kingston-upon-Hull.—Receiving order made June 8th. First meeting June 25th; public examination, July 12th.

GEORGE FREDERICK KIVERON, electrical engineer, Goulders Place, Attercliffe Common, Sheffield, late 38, Shrewsbury Road, Sheffield.—The public examination of this debtor was held on June 10th, at the County Court Hall, Bank Street, Sheffield. According to the statement of affairs submitted, his liabilities amounted to £664, and assets £330. Debtor stated he was Dutch, and came to this country in 1909, and set up business in 1918 after serving in the Army. His stock was supplied on credit, and the business was very successful at first. His business was so successful that at one time he had to employ nine men. Since July last, however, the business had not been so successful, and he had lost money on contracts. He had started books, but as he could not write English very well, he had got mixed up. The examination was adjourned.

Catalogues and Lists.—AUTOMATIC AND ELECTRIC FURNACES, LTD., 281-283, Gray's Inn Road, W.C. 1.—Advance copy of a new catalogue (15 pp.) of "Wild-Barfield" electric furnaces. Owing to the advance in mass production methods, larger sizes have been developed, and furnaces for the hardening of long articles, such as cam-shafts, tools, &c., are being manufactured.

THE BRITISH-THOMSON-HOUSTON CO., LTD., Rugby.—Descriptive List No. 4154 B (32 p.p.), dealing with ironclad oil-break switchgear of many types. Profusely illustrated throughout, and giving ordering instructions.

MESSRS. WERTHEIMER & WHITE, 64, Victoria Street, S.W.1.—Leaflet describing Dawson hardened copper and its various uses.

THE B.E. CO. (OF LONDON AND BIRMINGHAM), LTD., Hendon House, 57, Upper Thames Street, E.C. 4.—Illustrated leaflet giving descriptions and prices of "Hendon" British-made drawn wire lamps.

MESSRS. WATSON & SONS (ELECTRO-MEDICAL), LTD., Sunic House, Parker Street, Kingsway, W.C. 2.—Bulletin 25 S. An illustrated and priced pamphlet (16 pp.) dealing with "Sunic" X-rays tube stands and radiographic couch.

THE ILFORD DRY BATTERY CO., LTD., 83, Wool Exchange, Coleman Street, E.C. 2.—Illustrated leaflet dealing with the "Inert" combined battery and case.

THE GENERAL ELECTRIC CO., LTD., 67, Queen Victoria Street, E.C. 4.—A well-illustrated catalogue (X section, 13th edition, 36 pp.) dealing with switchboards and switchgear, sealing boxes, &c. Fully priced.

The Anti-Dumping Bill.—The Prime Minister cannot at present name a date for the re-introduction of the Anti-Dumping Bill.

Holidays.—MESSRS. A. REYROLLE & CO., LTD., of Hebburn-on-Tyne, notify that their works will be closed from Saturday, June 19th, until Monday morning, June 28th, it being Race Week.

LIGHTING AND POWER NOTES.

Accrington.—YEAR'S WORKING.—A loss of £989 was incurred by the electricity undertaking during the year ended March 31st last. Although the units sold fell from 6,948,390 to 6,705,274, the revenue increased from £45,223 to £57,450.

Athy (Co. Kildare).—ELECTRIC LIGHTING SCHEME.—The estimated cost of the proposed electric lighting scheme for the town is stated at £13,000.

Australia.—TASMANIA.—HYDRO-ELECTRIC SCHEME.—Giving evidence at Queenstown before the Public Works Committee on the matter of the construction of a road to link up Hobart and the West Coast, Mr. Huntly Clark, engineer of the Mount Lyell Co., said that the proposed King River hydro-electric power scheme would be capable of yielding 70,000 H.P. He had the data of four schemes within 10 miles of Queenstown, with a total of 110,000 H.P. The proposed road from Gormanston to Lake St. Clair would be invaluable for the distribution of power to other parts of the State.

MELBOURNE STRIKE.—Owing to a strike of employés at the power stations, the public services have been suspended. It is feared that the strike will become general.

MUNICIPAL UNDERTAKINGS IN N.S.W.—The report of the Local Government Department of the New South Wales Legislature for the year ended June, 1919, shows that 7 out of 14 electricity trading undertakings sold electricity at less than its cost price, the loss ranging from 5·33d. per unit to ·21d. per unit. The largest loss per unit of electricity was incurred by the undertaking at Tenterfield, but as trading operations did not commence until 1917, the result for the year under review cannot be considered as indicating the result which will be obtained when the undertaking has become thoroughly established. Five undertakings show profits varying from 1·29d. per unit in the case of Broken Hill to ·44d. per unit at Goulburn. The particulars of the units of electricity sold by the undertakings at Moss Vale and Penrith were not furnished to the Department. There was, however, a loss in trading at Moss Vale, and a profit at Penrith. All but three of the electricity trading undertakings show a net return on the capital invested. The highest return, viz., 13·21 per cent. on the capital invested, is shown by the undertaking at Broken Hill. The undertaking at Goulburn

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shows a return of 8·46 per cent., that at Tamworth 8·16 per cent., and that at Newcastle 7·69 per cent. on the capital invested. The most striking result is shown by the Newcastle undertaking. It has been converted from an unprofitable to a very profitable concern during recent years. Moreover, this result has been achieved by trading operations only. The ratepayers have not been asked to assist the undertaking by levies in the form of loan rates.

Ballycastle (Co. Antrim).—Public Lighting.—At the last monthly meeting of the Urban Council a communication was read offering the local gasworks for sale. The chairman said that, so far from buying over the gasworks, the town should be lighted by electricity, and several members concurred that when the Council had waited so long it should wait till it could have electric light.

Bangor.—Year's Working.—In his annual report for the year ended March 31st last, the electrical engineer announces a gross profit of £1,058. The Corporation is urged to reopen negotiations with the North Wales Power Co. for a bulk supply, in order to obviate the increases in price which will be necessary if the present plant remains the sole source of supply.

Barrow.—Electricity Supply.—In Committee, the Council decided to defer a recommendation from the Electricity Committee to approve of a resolution "that an adequate supply of electricity is necessary for the industrial development and well-being of this district. In order that this supply may be provided, and the sources of power available in the district may be utilised to the greatest advantage, this Council considers that a Joint Electricity Authority should, with the least possible delay, be constituted for the Furness and South Cumberland District, under the Electricity Supply Act, 1919, and undertakes to co-operate in the formation of such authority. The Council, therefore, requests the Electricity Commissioners to take the necessary steps for determining the area of the district, and for the establishment of a Joint Electricity Authority."

Bootle.—Proposed Extensions.—It was stated at a recent Council meeting that Liverpool was unable to meet the obligation to provide a bulk supply at a moment's notice under the linking up agreement, and it was, therefore, decided to apply for permission to augment the generating plant. Sanction is being sought to a loan of £40,000.

Brighton.—Extension of Area.—The supply area of the Brighton undertaking will, no doubt, be greatly extended in the near future. Hove has already accepted the terms for a bulk supply, and Portslade, Southwick, Shoreham, Newhaven, and Rottingdean, are also considering taking supplies from Brighton.

Burton-on-Trent.—Power Supply.—The Town Council has applied to the Board of Trade for permission to supply electricity to several South Derbyshire manufacturers whose works are outside the area of supply.

Bury St. Edmunds.—Extensions.—In adopting the Electricity Committee's report, the Council decided to apply for sanction to borrow £12,200 to carry out necessary extensions, and to cover expenditure already made in this connection.

Continental.—France.—The Brussels company, which is the concession-holder for the supply of electricity in many localities of the Département du Nord, has applied to the French Government for an increase of the rebate allowed on English coal from 150 to 250 fr. per ton; also for an increase in the tariff charges for gas and electricity allowed in the localities served. The high cost of imported coals causes a loss on the undertaking. Another aspect of the coal question has arisen in connection with the Government's restrictions of the periods of electric lighting. The Mayor of Toulon had applied to the Minister of the Interior for exemption from the restrictions on the ground that the electricity supplied to the city was water-generated. The argument was cogent, and seemed unanswerable; but the Minister replied that the surplus in Toulon resulting from the restrictions would be available in neighbouring localities, and, moreover, no exception could be made in the case of any city, like Toulon, more favourably situated than others.

Spain.—The report of the Sociedad Hidroelectrica Espanola, at the general meeting in March, was mainly concerned with the progress made with the new station at the Dos Aguas Falls, on the Jucar River. This, if no unforeseen hindrances occur, is expected to be completed by the middle of next year, in anticipation of which contracts have been placed for all the hydraulic and electrical plant needed for its working. The output of all the company's undertakings in the past year totalled 130,175,158 kw.-hours, or 14,129,420 more than in the foregoing year. The price of coal, which continued abnormally high, had caused heavy losses in the thermic stations, having amounted to 2,075,000 pesetas, or about 1,300,000 more than in normal years. In hopes of the early inauguration of the Dos Aguas Falls station, demands for power had come in from the whole region of the Levant, the most important industries being represented, and, if success crowned their efforts, as was confidently expected, all the places which constituted their market would be amply served. The profit and loss account showed a profit, including the balance from previous years, of 3,708,804 pesetas, which is distributed as follows:—5 per cent. to reserve, 185,440 pesetas; Council's fees, 7½ per cent., 278,160 pesetas; dividend of 5 per cent. on Coupon No. 11, 1,000,000 pesetas; ditto on Coupon No. 12, 1,000,000 pesetas; dividend tax, 65,740 pesetas; company's Benevolent Fund, 20,000 pesetas, and balance carried forward, 1,159,464 pesetas. This result confirmed the anticipations of the report for 1919, and constituted an assurance for the future. The Electra de Lima (Portugal)—an offshoot of the company—had increased its capital from 4,000,000 to 10,000,000 pesetas, which had been distributed among holders of shares in circulation. With the help of most important industrial concerns, the Hidroelectrica had contributed to the creation of the Sociedad de Electrificacion Industrial, with a capital of 5,000,000 pesetas. The objects of this company were the electric conversion of transport, the study and development of large waterfals, and the manufacture of electrical machinery. Other companies in which the Hidroelectrica has interests are the Union Electrica de Cartagena and the Co-oporativa Electra de Madrid.

Concessions have recently been granted for the establishment of plants to utilise the water power of the Tajo by the Sociedad Hidroelectrica Lobinillas, and of the rivers Bairola, Chisaguer and Cinca, in the Province of Huesa, by the Sociedad Hidroelectrica, Iberica.

Darwen.—Bulk Supply.—The Corporation has decided to arrange for an additional supply of electricity from Blackburn. High-tension mains are to be laid underground from the borough boundary to the electricity works, at an estimated cost of £27,000. It is anticipated that the supply will be available for the coming winter.

Dorchester.—Proposed Municipal Purchase.—The Town Council has decided, in response to a letter from the Electric Light Co., to re-open negotiations for the purchase of the local electricity undertaking. An offer of £8,500 had been made, but this was refused by the company.

Houghton-le-Spring.—House Lighting.—The Urban District Council has decided to approach the Electric Light Co. as to a supply of electricity to the houses being erected by the Council.

India.—Mysore Electrical Scheme.—There are several schemes before the Government for the purpose of still further developing the Cauvery Falls. The immediate needs of the State of Mysore, the cities of Mysore and Bangalore, the Gold Fields of Kolar, &c., are met by the existing 25,000 h.p., but in the near future more power will be needed, and to that end the Government has sanctioned a sixth installation at Sivasamudram. Much of the old plant, which has done good service, is to be scrapped. The new installation will supply the Kolar Gold Fields and Bangalore. In addition to this, the other schemes before the Government include the harnessing of the Shimsha Falls and the Mekadatu Falls. The potentialities of the Shimsha Falls are said to be great. The late Captain Dawes, who lost his life in the survey of the Cauvery, expected to get by pipe line a clear fall of 720 ft., taking the supply 40 miles up river. The scheme would probably cost about 70 lakhs of rupees. The scheme at Mekadatu is much smaller, and would cost about 39 lakhs of rupees. The electrical engineer has given his opinion to the effect that the Falls should be utilised as speedily as possible. It is estimated that when all the schemes have materialised the combined power will represent 100,000 h.p. at the very least. The price of coal in India is now prohibitive, so that a cheap power supply is absolutely necessary.

Kettering.—Loans Sanctioned.—The Electricity Commissioners have sanctioned loans for £9,284 for plant at the Urban District Council's electricity works.

Lincoln.—Year's Working.—The report on the electricity undertaking for the year ended March 31st last, records an increase in revenue of £25,332 and an additional expenditure of £22,202. The net profit for the year was £3,141, which, with the balance brought forward, totals £5,124. £5,000 is to be placed in the depreciation fund.

Extensions.—The ultimate cost of the St. Swithin's extension scheme, which was originally estimated at £250,000, is now stated to be £400,000.

Liverpool.—New Switchgear.—Switchgear in connection with the new generating plant at Lister Drive power station is to be purchased by the Liverpool Corporation at a cost of £6,693.

London.—St. Marylebone.—The Borough Council is applying to the Electricity Commissioners for permission to give a bulk supply to the Hampstead Borough Council, and for sanction to the expenditure of £9,500 for the provision of the necessary cables.

Electricity Consumption.—The London County Council has prepared a return relating to the supply of electricity in and around the County of London. The total number of units sold during the year 1917-18 was, after allowing for intersales, 449,686,063 by the London undertakings, and 167,204,097 by the extra-London undertakings. These figures show increases in the period of four years since 1913-14 of 130,715,453 units, or 41 per cent., and 39,858,827 units, or 31·3 per cent. respectively. The analysis of the 449,686,063 units sold by the London undertakings gives the following results:—Public street lighting, 9,018,088; other lighting, 115,105,312; power, heat, and traction, 318,903,616; and bulk, 6,659,047. It will be seen that power and heat supplies account for 71 per cent. of the total units sold, and that such supplies were nearly three times as great as those for private lighting.

Non-Union Labour.—As announced in our "Correspondence" columns, the Trade Unions represented on the Joint Industrial Council for Electricity Supply, No. 10 (Greater London) Area, have decided to cease work on July 1st if any non-Union labour is employed in any supply undertaking in the district, and from that date will refuse to connect up work done by non-Union labour.

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Malton (Yorks.).—PUBLIC LIGHTING.—The Urban District Council has accepted the tender of the Northern Counties Electric Supply Co., for lighting by 121 50 C.P. lamps for three years, at £580 12s. 6d. per annum.

Manchester.—SALE OF UNDERTAKING.—The Corporation has accepted an offer from the Stockport Corporation for the purchase of the Heaton Norris undertaking. It has also arranged to give a bulk supply to Stockport for a period of 10 years.

BULK SUPPLY.—An application from the Lancashire Power Supply Co. for a supply of electricity from the new power station at Barton, when completed, is under the consideration of the Electricity Committee.

Market Drayton.—PUBLIC LIGHTING.—The Urban District Council has asked the Electric Light Co. to submit an estimate for public lighting, and the conversion of the gas lamps.

Navan (Co. Meath).—LIGHTING SCHEME.—At a special meeting of the Council, on Thursday last, Mr. J. J. Woods, consulting engineer, was in attendance, and submitted three alternative schemes for the lighting of the town. The first was estimated at £12,090, and the generating and distributing costs at 10¼d. per unit, suction gas engines to be the prime movers. The second scheme included the purchase of the local gas company's premises, and generating with town gas. The estimated cost, exclusive of the purchase of the gas works, was £10,215, and the generating and distributing costs, 11·4d. The third scheme was the offer of a local saw mill owner to supply power, the Council installing all the necessary electric plant. The estimated cost was £7,835, and the distributing cost 6·15d. After the various schemes had been explained in detail, the last was adopted, subject to the Council's ability to obtain a satisfactory lease of the land for generator, battery and switchboard-rooms.

Newhaven.—ELECTRICITY SUPPLY.—It is stated that the cost of providing the necessary plant for supplying Seaford and Newhaven from the Eastbourne station would be £25,000, and the Electricity Commissioners consider that it will be more advantageous to supply the towns from Brighton.

Nottingham.—ELECTRICITY SUPPLY.—The Corporation received a letter from the Derbyshire and Notts. Electric Power Co., stating that the company was about to erect a new station on the Trent in accordance with a programme arranged prior to the war, but temporarily suspended. The company intimated its preparedness to enter into an arrangement to supply the Corporation, but the chairman of the Electricity Committee urged the Corporation to reserve the right to supply electricity in the Nottingham area to itself. A motion to postpone consideration of the Electricity Committee's report upon extensions was negatived, and the proposed scheme will be proceeded with.

Portrush.—EXCLUSION FROM AREA.—At a meeting of the Urban District Council a petition was submitted from residents of Dhu Varren protesting against the exclusion of that area from the proposed electrical supply scheme. It was explained, however, at the meeting that if the loan of £15,000 was sufficient, both the old and new areas would be embraced in the scheme, but, if not, Dhu Varren would be provided for in a separate scheme.

Rochdale.—YEAR'S WORKING, &C.—The electricity output for the year ended March 31st, amounted to 15,295,789 units, an increase of 5·4 per cent. on the previous year. The increase in consumers, particularly for lighting has been the greatest recorded, and the result for the year's working shows a surplus of £14,320 18s. 11d., of which the Committee recommends that £5,000 be placed to the relief of the rates, and the remainder allotted to the reserve fund, which now stands at £12,871. The Committee has decided to negotiate for a further bulk supply from the Lancashire Electric Power Co. of 8,000 KW., and to lay new E.H.T. mains to the districts of Firgrove, Balderstone, and Spotland. The application made for sanction to the borrowing of £68,500 has been granted without the necessity of a local inquiry.

Sheffield.—NEW POLICY.—When the question of increased charges was introduced at the recent Council meeting, Mr. J. G. Graves moved the rejection of the report, and put forward a proposal to charge for lighting and power on the same basis. From the subsequent discussion, in the course of which Mr. Graves's proposal was designated as sentimental and unbusinesslike, it would appear that his object was to reduce lighting charges to the same level as power charges, which, it was stated, would cause an annual loss of £51,211. Mr. Graves's contention was that as the same machinery and cables were used for both purposes, the cost to each class of consumer should be the same. The amendment was carried by a vote of 24 to 21.

South Africa.—EXTENSIONS AT PRETORIA.—The Pretoria Town Council has received authorisation from the Government for capital expenditure amounting to £261,000. The bulk of the money will provide for additional electric power stations, consisting of a new generating station at Mitchell Street, equipped with 6,000 KW. of plant, and a 3,000-KW. sub-station at Schoeman Street. The estimated cost is £200,000, inclusive of £15,000 for the construction of a dam on the western town lands to provide water for a new power station, Pretoria iron mines, and other industrial undertakings. To provide for a "make-up" of at least 500,000 gallons per day, an additional expenditure of £25,000 will be necessary on the dam. These proposals are part and parcel of the development of Pretoria West as an industrial centre. —*Board of Trade Journal.*

ELECTRIC LIGHTING SCHEME.—The Standerton Town Council has approved a scheme prepared by Mr. Hodge, the town engineer, which provides for a steam engine and generator for three-phase current at 3,300 volts, 50 cycles, with high-tension cables laid to distributing centres, transformed down to 415 volts for power, and 230 volts for lighting, and for the pumping station a 3,300-volt overhead transmission line. Following are the figures of estimated cost:—Buildings, £2,000; 130-KW. plant, £8,450; water service, £100; distribution, £1,500; transmission line to pumping station, £1,950; electrification of pumping station, £1,650; for contingencies and possible advance in prices, £1,350; total, £17,000.—*Engineering in South Africa.*

Stoke-on-Trent.—ELECTRICITY SUPPLY.—It was stated at a recent Council meeting that consumers in the Fenton district had complained of an inadequate supply of electricity, although a bulk supply was being transmitted to Newcastle. The chairman of the Electricity Committee pointed out that the Electricity Commissioners had ordered this bulk supply as a part of a general scheme, and the Council was bound by a 10 years' agreement.

Stratford-on-Avon.—PURCHASE ABANDONED.—The Town Council has decided to discontinue the negotiations for the purchase of the undertaking of the electricity company. The Council has agreed to the company increasing the charge for electricity up to 1s. per unit.

Sudbury.—ELECTRICITY SUPPLY.—Unanimous approval has been given by the Council to a scheme for the supply of electricity to the town, proposed by the East Anglian Electricity, Ltd. The company intends to erect a 600-H.P. station, and to utilise the old post office as a showroom. Distribution will be effected by low-voltage overhead lines, and it is hoped to be able to supply at cheap rates.

Sunderland.—EXTENSIONS.—The Corporation electricity department has engaged the British Engine, Boiler, and Electrical Insurance Co. to supervise the construction of the new boiler house plant and installation at Sunderland; 3,208 square yards of land have been bought in Farrington Row, at a cost of 10s. per square yard, for the purpose of the extensions.

Trowbridge.—PUBLIC LIGHTING.—The Urban District Council has invited the E.S. Co. to submit a price for public lighting in competition with the gas company.

Walsall.—EXTENSIONS.—The Corporation Electric Supply Committee proposes that, with a view to meeting demands for electricity, extensions of mains and feeders be carried out to supply current to certain premises, at a cost of £1,470; and, further, that application be made to the Electricity Commission for sanction to borrow £15,000 for the purposes of the undertaking, including £12,000 for extensions of mains.

Wimbledon.—LOANS SANCTIONED.—The Town Council has received consent to a loan of £15,000 for mains and services, and £2,100 for transformer sub-stations, and also permission to install two boilers, &c.

Wolverhampton.—NEW PLANT.—The electrical engineer has been authorised to negotiate and arrange for the supply of an additional 500 KW. of converter plant, at a cost not exceeding £3,000, plus 10 per cent. for contingencies.

TRAMWAY AND RAILWAY NOTES.

Accrington.—YEAR'S WORKING.—There was a loss of £295 on the tramway undertaking for the past year. Revenue increased to £50,153 from £41,633, and the working expenses also increased in proportion. The total amount taken from the rates since the system was inaugurated, and not yet repaid, is £4,568.

RENEWAL OF TRACK.—It was stated at a meeting of the Town Council that in three years' time it would be necessary to relay the tramway track at an estimated cost of £60,000 to £70,000. The fares are to be increased 50 per cent.

Bolton.—PROBABLE EXTENSION.—The Tramways Committee here, faced with possible motor-omnibus opposition from Wigan, is considering extending the tramway system to the industrial township of Westhampton.

Bradford.—TRAMWAY LOSSES.—At last week's full City Council meeting it was stated that the tramway undertaking was losing money at the rate of £30,000 a year. It was decided to call a special Committee meeting to deal with the matter, and recommend to the Council what steps should be taken to increase the revenue. It is considered extremely likely that some adjustment of stages will be made whereby 1d. stages, but for shorter distances, can again be introduced.

INSPECTORS' WAGES.—At a recent City Council meeting the weekly wages of tramway inspectors were raised to £5, instead of £4 1fs., as had been previously recommended.

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Burton-on-Trent.—FARE INCREASE.—The proposal of the Public Works and Tramways Committees to increase the fares and make 2d. the new minimum, with the exception of workmen's and children's tickets, has been approved by the Town Council. An amendment in favour of overlapping 1d. stages was defeated.

Continental.—SPAIN.—The Commercial Secretary to H.M. Embassy, Madrid, states that application has been made by the "Banco Espanol de Credito" for authorisation to install a Metropolitan Railway at Bilbao, the estimated cost of which is 13 million pesetas.

The scheme consists of two lines. The first starts from the Square de los Santos Juanes, and passes through a tunnel and in a straight line to the Institute, with an underground station which will link up the Lezama Railway. The line continues to the railway station of Las Arenas, and here another underground station is to be constructed, which will be called Arenal, between the Church of San Nicolas and the Bank of Bilbao; from here, in a straight line, and passing under the River Nervion, the line goes on to the Plaza Circular, where there will be another station, with lifts; it then continues along the Gran Via, with a station at Diputacion, Plaza Eliptica, Park, and San Mamos, and twists to the left, following the Alameda, with two stations, called Alameda and Basurto, and going on to La Casilla, where the first line terminates.

The second concession starts from the Casilla Station, the terminus of the first line, and goes on through the Calle de la Autonomia, with stations at Echaniz, Amezola, and Plaza de Zalalburu; it then passes through the San Francisco quarter, with stations called San Francisco, Miravilla, and Bilbao la Vieja, and, crossing the river over the San Anton Bridge, joins the first line at the station at Achuri.

The lengths of these two lines are respectively 3,158 and 1,949 metres, and the estimated cost respectively is 8,205,679 and 4,554,192 pesetas.

A double line will be constructed of 1-metre gauge, as it has been considered preferable to adopt this kind of line, which allows of the joining up of the Metropolitano with all the narrow-gauge stations of Bilbao, which will then be able to carry goods trains during the night, when the passenger traffic has ceased.

In consequence of the large number of stations projected, situated at distances between 200 and 300 m. apart, all the principal centres of the town will be served, reducing the congestion in the streets, and increasing the rapidity and economy of communication between the different quarters.

Dublin.—WAGE INCREASE.—Negotiations between the Dublin United (Electric) Tramway Co. and their employés have resulted in an increase of 8s. per week for every worker over 18 years of age, youths under 18 to receive 4s. per week, vanmen and parcel checkers 6s., women 4s., and boys 2s. Before this latest arrangement motormen were paid £3 10s. 5d. for a six-day week, and conductors £3 8s. 1d., with extra pay for Sunday work.

Huddersfield.—FARE INCREASE.—The car fares were increased on June 12th. No alteration has been made in the 1½d. and 2d. fares, but the longer distance fares have been advanced by approximately 50 per cent. Children's fares have now a 1d. minimum, as against ½d., with half-fares for other rates. The recent wages award of 10s. per week will cost the Committee £16,000 a year.

In consequence of numerous public requests for more, and later, Sunday evening car facilities, the tramway manager has requested the tramwaymen to work an hour longer on Sunday evenings. A ballot is being taken by the men on the question.

Leeds.—FARE INCREASE.—The increased tramway fares decided upon by the City Council took effect on June 10th. The receipts on that day were £2,451, from 359,381 passengers carried. On the previous Thursday the figures were £2,129 from 363,804 passengers. The returns at present are fluctuating and unreliable as a basis upon which to judge the effect of the increase.

London.—UNDERGROUND FARES.—A Select Committee of the House of Commons has passed the London Electric Railway Companies (Fares) Bill, thereby giving assent to the temporary raising of the maximum scale of fares and charges proposed by the promoters. Clauses were adjusted, and the effect of the Bill, as it now stands, is to give the companies a temporary power to charge a maximum fare at the rate of 1½d. a mile third-class and 3d. a mile first-class. They have also obtained the power to charge a minimum initial fare of 2d. third-class and 4d. first-class, however short a distance the passenger may travel. Workmen's return tickets may be issued at the price of a single ordinary fare.—*Morning Post.*

SHORT STRIKE.—On June 10th the wiremen at the Brimsdown power station ceased work owing to delay in paying increased rates. The matter was settled in a few hours, and a stoppage of the Metropolitan Electric Tramways thereby averted.

New Zealand.—CHRISTCHURCH.—The revenue account of the Christchurch Tramway Board for the year ended March 31st shows a deficiency of £1,237, as against a surplus of £2,741 for the previous year. The earnings were £205,976, operating expenses £145,960, and standing charges £61,253. The position was regarded as satisfactory considering the increases in wages and cost of material and the trouble incurred during the year. The deficiency is the first since the inception of the tramways.—*Auckland Weekly News.*

North-Eastern Railway.—EXPERIMENT.—In order to determine whether it was practicable to employ a third-rail system with a shoe fitting underneath the flange of the rail, the N.E. Railway Co. has been conducting experiments on a specially constructed part of the track between York and Scarborough. The chief point of investigation was the engaging of the shoe with the rail after the passing of a "railless" portion of the track, as it is intended to use this method in conjunction with an overhead trolley system, the latter to be employed in negotiating long crossings, shunting yards, and stations. It is understood that the system proved quite satisfactory in this respect even when high speeds were employed. This is the first trial of the system in this country, although it is being satisfactorily employed on the Central Argentine Railway. The latter system was described in the ELECTRICAL REVIEW of November 1st, 1918 (p. 411).

Nottingham.—YEAR'S WORKING.—The total revenue for the past year's working was £378,948, and the expenditure totalled £294,224. The balance of £84,724 (which fell from £103,988 for the previous year) was distributed as follows:—£24,000 to rate relief, £21,286 to redemption of capital, £18,270 to reserve and renewals funds, £16,168 to interest on loans, and £2,000 to the accidents reserve fund. The total number of passengers carried increased by about 6 millions to 58,749,654, and the total mileage from 3,572,973 to 4,088,570. The total contributed to rate relief by the undertaking since 1902 amounts to £350,000.

South Africa.—JOHANNESBURG.—The tramway strike was settled on May 20th; the men gave way on all points, but the Council promised that an inquiry should be held into the working of the Advisory Committee. The feeling of the community was very strongly indicated against the strikers, and the Citizens' Protection League was able to maintain a voluntary system of motor transport for women workers and aged people. The strikers did not have the support of the other Unions.

EAST LONDON.—The strike of tramway employés is not settled, and the cars are still idle. The latest development is that the Council has given notice to the strikers to send in their uniforms, and has invited applications from men to run the service. These applications have been sufficiently numerous to enable the Council to decide to re-start the service with a fresh staff.

Thornaby.—POWER SUPPLY.—It was reported to the Town Council that in connection with the Teesside tramway arbitration the Joint Committee for Stockton and Thornaby had agreed that the power for this part of the system should be purchased from the Stockton Corporation Electricity Department, the latter undertaking not to make any "undue profit." The Corporation feels, however, that this is not sufficiently explicit, and Stockton has been asked to agree to a definite maximum rate of profit based upon the bank rate.

Tramway Dispute Settled.—The latest claim for higher wages by tramway employés has been settled. A flat rate increase of 9s. will be applied to the London area, and District Industrial Councils are to make awards of from 7s. to 9s. increase in their areas.

West Hartlepool.—YEAR'S WORKING.—There was a gross profit of £6,625 on the working of the tramways during the past year, and a surplus of £863 was carried to reserve.

Wolverhampton.—YEAR'S WORKING.—The gross profit on the tramways for the past year was £21,828, making with profits from the motor-char-à-bancs undertaking a total of £22,204. This has been distributed as follows:—Interest on capital, £4,660; income-tax, £4,214; repayment of loans, £6,564; additions and improvements, £928; and to reserve and renewals fund, £5,838. It is anticipated that £11,000 will be spent on reconstruction during the current period.

CHANGE OF SYSTEM.—The Tramways Committee recently reported to the Corporation upon the question of changing over from the present (Lorain surface-contact) system to overhead trolley working. The proposal was most opportune, as the existing track requires thorough renewal and a double track was already under consideration. The present single track is totally inadequate to meet requirements, and many arguments in favour of the introduction of the double-track overhead system were put forward. The cost of the scheme is estimated at £396,000, made up of the following items:—Overhead equipment, £50,000; 20 miles of track, £320,000; street alterations, £12,000; and special work, £14,000. The sale of old materials is expected to realise £21,000, leaving the estimated net cost at £375,000. The Council has decided to proceed with the change-over by easy stages; the first amount to be spent will be £50,000.

TELEGRAPH AND TELEPHONE NOTES.

Argentina.—WIRELESS CO.—The Compania Transatlantica Radio Telegraphica is reported to have been formed at Buenos Ayres to work the wireless concession granted to the Siemens and Schuckert group on March 15th, 1919. The ordinary shares for 4,500,000 Argentine dollars are intended to pay for the machinery and apparatus awaiting shipment in Germany, whilst the proceeds of the 3,000,000 dollars in preference shares are to defray the cost of erection of the installation and other works

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Direction-Finding Stations.—The following are the wireless direction-finding stations operated by the Royal Navy, under the conditions laid down for the use of these stations by the Mercantile Marine:—Amlwch, Berwick, Carnsore, Flamborough, Larne, Lizard, Peterhead, Rhyl, and Seaview (Malin Head). Rhyl is not fitted with transmitting apparatus, and is controlled by Amlwch. Seaview also has no transmitting apparatus, and is controlled by Malin Head, which keeps watch on 600 metres.—*Manchester Guardian.*

France.—WIRELESS TELEGRAPHS.—It is announced that the French wireless system is to be reorganised, special attention being paid to Colonial communication. Stations are to be erected, or existing stations are to be improved, at Jibuti, Dakar, Martinique, French Guiana, Tahiti, &c. It is also proposed to erect stations at Bordeaux and Lyons for commercial communication with the U.S.A.

India.—NEW CABLE.—It is understood that the fourth cable line which was to be laid between Bombay and Aden is now in working order; according to a mail dispatch it had developed some faults. The cable was laid by the Eastern Telegraph Co.

London.—TELEPHONE SERVICE.—In an article contributed to the *Telegraph and Telephone Journal*, Captain J. G. Hine states that 160 miles of new pole route were constructed in London during the past 12 months, bringing the total mileage of pole route to 2,780, and the open wire mileage to over 60,000. (A considerable amount of the open wire acquired from the National Telephone Co. has been replaced by underground wire.) Fifty miles of single pipe were laid, bringing the total to 3,625. Over 45,000 miles of underground wires were laid, bringing the total to over one million miles. Over 20,000 new lines were brought into use, and over 30,000 telephone stations connected with these lines.

AUTOMATIC TELEPHONES.—Mr. Illingworth (P.M.G.), in the House of Commons, said: The provision of a system of automatic telephone exchanges for so large an area as London presents peculiar difficulties. It is proposed to install one automatic exchange as soon as possible, and I hope the experience thus obtained may make it possible to frame a complete scheme. The existing exchanges would be replaced gradually, and it would be some years before an automatic system for the whole of London could be completed.—*Daily Telegraph.*

Strike of Wireless Operators.—The failure of the Marconi Co. to deal with a wages claim made on behalf of operators by the Association of Wireless Telegraphists led to a general strike, which commenced at 11.30 a.m. on June 15th. The Association states that the claim was made last September; but the Marconi Co., in a notice issued in reply, says that the request was not actually received until May 17th, and confirmed in writing five days later, and the matter has been placed in the hands of the Association of Engineering Employers. The claim is for a scale of pay rising from 48s. per week for the first year to 120s. in the ninth year, an eight-hour day, and the continuance of "war-risk bonus" as long as it applies to other seafarers. Upwards of 4,000 operators are affected, some of them being employed by Siemens Bros. and the Radio Communication Co.

Telephone Improvements.—Replying to a deputation which waited upon him at the General Post Office, on the defects of the telephone service, especially in districts swept by strong winds and severe storms, the Postmaster-General said the department was already engaged in a large extension of underground telephone lines in various parts of Lancashire and Yorkshire, which it was hoped would go far to obviate the trouble. Increased facilities were also being provided by the laying of new wires between Oldham, Manchester, Huddersfield, Liverpool, and other centres.—*Daily Telegraph.*

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the ELECTRICAL REVIEW in which the "Official Notice" appeared.)

OPEN.

Australia.—SYDNEY.—August 4th. N.S.W. Government Railways and Tramways. Two 1,000-KW. sub-station units. Chief Electrical Engineer, 61, Hunter Street, Sydney.

August 3rd. Department of Public Works. Turbines and generators for the Barren Jack hydro-electric development scheme. Department of Public Works, Sydney.

N.S.W.—Postmaster-General's Department. August 2nd and 5th. Aluminium sheet, brass rod, &c., scheduled 769; platinum wire, gold and silver wire, scheduled 768. (June 11th.)

WESTERN AUSTRALIA.—Postmaster-General's Department. August 3rd. 326 accumulators, schedule 668. (June 11th.)

Belgium.—June 22nd. Municipal authorities of Wevelghem. Tenders for two sub-transformer stations for converting three-phase, A.C. Particulars can be obtained from M. Goffin, 113, Avenue Albert, Brussels, and tenders are to be sent to La Salle Communale, Wevelghem.

June 26th. Municipal authorities of Voroux-Goreux (Province of Liége). Tenders for the concession for the electric lighting of the town.

Bedford.—June 21st. Electricity Department. One 2-ton locomotive jib crane, with grab and track rails, steam and other pipework. (June 4th.)

Canterbury.—June 22nd. Electricity Department. 1,210 yards '25 sq. in. × '25 sq. in. × '125 sq. in. L.T. triple-concentric paper-insulated cable. (June 11th.)

Carlisle.—June 25th. Electricity Department. One 3,000-KW. turbo-alternator and condensing plant. (May 28th.)

Colne.—Electricity Department. Steam and water piping. (June 11th.)

Dartford.—June 26th. Electricity undertaking. Rotary converter, transformers, switchgear, &c., L.T. twin cable-feeder, pillar and feeder-panel. (June 11th.)

Dundee.—June 24th. Electricity Department. Steam feed and water piping, two turbine-driven feed pumps. (June 11th.)

Edinburgh.—June 19th. Electricity Supply Department. E.H.T. and L.T. switchgear, &c., for Portobello station. (May 21st.)

Glasgow.—July 6th. Tramways Department. One 10,000-KW. steam turbo-alternator, with condensing plant. (See this issue.)

Liverpool.—June 21st. Board of Guardians. Electrical supplies (three months) for the township of Toxteth Park. R. Albert James, Clerk to Guardians, 15, High Park Street.

Manchester.—June 25th. Electricity Committee. Twelve months' supply electricity meters, time switches, potential and current transformers, motor-starting switches, C.C. and A.C. motors. (June 11th.)

New Zealand.—AUCKLAND.—September 1st. Harbour Board. For the supply of electric capstans and spares. Messrs. W. & A. McArthur, Ltd., 18-19, Silk Street, Cripplegate, London.

Newport.—June 26th. Electricity Department. Turbo-alternating plant, surface-condensing plant, boilers, economisers, draught plant, steel flue and stack, &c. (June 4th.)

Nuneaton.—June 30th. Electricity Department. 1,000-KW., D.C., geared turbo alternator, surface-condensing plant and pipework. (June 4th.)

Salford.—June 21st. Electricity Committee. H.P. steel steam pipes and separator, and steel exhaust steam pipes and supports. Borough Electrical Engineer, Electricity Works.

Southampton.—July 3rd. Electricity Department. E.H.T. and H.T. switchgear and D.C. control panel. (June 4th.)

Swindon.—June 26th. Electricity Department. 2,000 yards 3-in. four-way stoneware conduits, light steel poles for overhead lines. (June 11th.)

Warrington.—June 29th. Electricity Department. Truck type ash elevator and hopper. (June 11th.)

July 13th. Electricity and Tramways Committee. Two 6,000-KW. turbo-alternators. (See this issue.)

CLOSED.

Bedford.—The Education Committee has appointed H. Bacchus, Ltd., as electricians for six months.

Clacton-on-Sea.—Urban District Council:—

English Electric Co.—Diesel engine, £7,040: generator, £1,714.

Doncaster.—Mr. R. B. Isle has secured the contract for the electric light installation at St. Andrew's Church.

Dundee.—The Tramways Committee has placed an order with an American firm for 1,000 tons of rails, at £24 6s. per ton, thereby hoping to save £4,000. The City Engineer was unable to obtain a lower estimate than £28 7s. 5d. per ton, including carriage, from a Middlesbrough firm.

India.—Messrs. Boving & Co. have received an order from the Mysore Government for four 5,600-H.P. turbines for the Cauvery River Scheme. Further reference to this contract appears in our "Business Notices" to-day.

London.—SHOREDITCH.—Electricity Committee.

5,000-KW. turbo-alternator, with condensing plant:—	Price.	Efficiency at full load-lb. of steam per KW.-hour.	Delivery.
Met.-Vickers Elecl. Co., Ltd. (recom.)	**£39,995**	**13·13**	**56 weeks.**
C. A. Parsons & Co.	43,000	13·6	64 "
British Thomson-Houston Co., Ltd. ..	39,980	13·7	52 "

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The remaining offers, owing to low efficiency or high price, were not considered. 13 tenders were received, 10 from British firms, two from Swiss firms and one from Sweden.

BOILER PLANT.

	Price.	Efficiency.	Delivery.
Clarke, Chapman & Co.	£18,196	80/81%	—
" "	18,105	—	—
" "	17,740	—	—
Baldwin Loco. Co. of America	18,500 about	not stated	about 8 mths.
Babcock & Wilcox, Ltd.	16,620	82%	11 months.
" " (land type)	15,960	80%	11 months.
Stirling Boiler Co., Ltd.	**16,550** (recom.)	**82%**	**10** months.
" " (land type)	15,850	—	10 months.

The Committee recommends the acceptance of the tender of the Stirling Boiler Co., Ltd., for one marine-type water-tube boiler, with chain-grate stoker, superheater, economiser, steel chimney, &c., at £16,550.

Sunderland.—Electricity Committee. Accepted :—

New Switchgear Construction Co., Ltd —E.H.T. switchgear.
Ferguson, Pailin & Co., Ltd.—L.T. links.
W. G. Farrow & Co.—Box frames and covers.
James Allan.—Box frames and covers.

Wolverhampton.—Corporation. Accepted :—

Six E.H.T. crucibles, £2,260.—Ferguson, Pailin & Co., Ltd.
Transformer oil filter, £178.—G. Lister.
One 500-KW. rotary-converter set, £3,210.—Met.-Vickers Electrical Co., Ltd.

FORTHCOMING EVENTS.

Battl Wallahs' Society.—Monday, June 21st. At the Holborn Restaurant. Luncheon (Mr. Guy Campbell will tell of his recent trip to the United States of America).

Institution of Electrical Engineers (Wireless Section).—Wednesday, June 23rd. At 6 p.m. At the Institution of Mechanical Engineers. Paper on "The Development of Thermionic Valves for Naval Uses," by Mr. B. S. Gossling.

Physical Society.—Friday, June 25th. At 5 p.m. At the Imperial College of Science, South Kensington, S.W. Ordinary meeting.

Incorporated Municipal Electrical Association.—Annual convention at Bradford and Ilkley. June 21st to 25th.

NOTES.

Appointments Vacant.—Chief instructor in electrical installation and maintenance work, for the Bradford Technical College (£250) (training of disabled sailors and soldiers); chief telegraph inspector (Rs. 350 per month), for the Burma Railways Co., Ltd.; car-shed foreman for the London County Council tramways; assistant (£300 to £400) on the staff of the Institution of Electrical Engineers; evening lecturers in electrical engineering (Grades II and III), evening assistant lecturer (in one or all of the following: fitting and machinery, machine drawing, machine design, and practical mathematics), evening instructor in metal-plate work, Grade II evening assistant demonstrator in electrical engineering (labour) for the Goldsmiths' College, New Cross; technical assistant (Grade I) electrical branch (£300 + war bonus), ditto Grade II (£250 + war bonus), ditto Grade III (£200 + war bonus) for the London County Council tramways department; engineering draughtsman (£220 + £192), two ditto (£180 + £171) for Metropolitan Asylums Board; telegraph mechanicians (£440), for the Government of the Gold Coast Posts and Telegraph Department. For particulars see our advertisement pages to-day.

Hydro-electric Engineering.—Recently, at the request of Major C. E. Inglis, Professor of Engineering at Cambridge University, Mr. Douglas Spencer, of Messrs. Armstrong's Hydro-Electric Section, read a paper before the Cambridge engineering students on the subject of hydro-electrics and the British engineer, and at the close of the paper a selection of 12 candidates was made to undertake a journey to Norway to see Norwegian power plants, with a view eventually to a selection being made from their number to undergo a course of training in practical manufacture and construction in Norway.—*Financial Times.*

Birmingham Electrical Golfing Society.—The next competition will be held on the Castle Bromwich Course on Monday afternoon, June 21st, when the Electrical Trades Challenge Cup will be played for. There will be other prizes. The annual subscription is 7s. 6d., covering three meetings. Applications for membership should be addressed to Mr. W. A. Millinger (Hon. Sec.), 9, Livery Street, Birmingham.

Electrically-Propelled Ships.—The new U.S. battle cruisers *Saratoga* and *United States*, the keels of which have just been laid, will, says the daily Press, be equipped with a main battery of eight 18-in. guns. The vessels will be 850 ft. long, and of 43,500 tons displacement, with engines of 180,000 H.P., developing a speed of 33·25 knots. Four other battle cruisers, the *Constitution*, *Constellation*, *Lexington*, and *Ranger*, will mount main batteries each of eight 16-in. guns. All these ships are to be equipped to burn oil fuel, and are to be electrically driven.

A Corona Voltmeter.—An interesting paper in the May, 1920, issue of the American I.E.E. *Journal* describes an improved form of corona voltmeter. Precision measurements of crest values of high alternating voltage taken in the high-tension circuit are compared with the indications of the corona voltmeter. The law of corona has been determined to a higher degree of accuracy, and a modification in the form of the law as heretofore accepted is revealed. As based on the precision voltage measurements, the corona voltmeter is proposed as a natural secondary standard of high voltages. Its advantages as a standard, and its practical operation, are described.

Nickel-Plating of Aluminium and Aluminium Alloys.—Messrs. Guillet & Gasnier, in a paper read recently before the French Academy of Sciences, described some tests they had carried out to determine the possibility of obtaining satisfactory deposits of nickel on aluminium and its alloys. Another French worker had already obtained partial success by first scouring the metal in a solution of hydrochloric acid, but the resultant deposit was very uneven. The method of the two writers mentioned above consists in, first of all, sand-blasting the metal to be treated, the pressure of blast being 500 grams per sq. cm., and the sand just passing through a screen of 0·2 mm. mesh. This was followed by nickel-plating to a depth of some 6/100ths mm. The duration of the operation is half-an-hour, and the mean current-density 0·8 ampere per sq. dm. After this the nickel surface is copper-plated to a depth of 0·02 mm. for two hours, with a current density of 1 ampere per sq. dm., the surface obtained being carefully polished. The copper surface is then coated with nickel to a depth of 0·05 mm., the operation lasting for one hour, and the current-density being 0·5 ampere per sq. dm. Finally, the nickel-plated surface is polished. When this procedure is followed, the mechanical tests are satisfactory. The following were applied :—Penetration test for cracking; bending through an angle of 120°; burnishing. The chemical test consisted in subjecting the nickel-plated surface to a 15 per cent. solution of NaOH at a temperature of 100° C., and under these conditions the nickel-plating was found to be intact. The copper solution used in the tests in question consisted of 150 grams of copper sulphate, and 20 grams of sulphuric acid, with water to make up to 1 litre. The nickel bath was formed of 150 grams of double sulphate of nickel and ammonium and 50 grams of water, to make up to 1 litre.

Educational.—MANCHESTER COLLEGE OF TECHNOLOGY.—According to *The Times*, an important decision affecting the College of Technology has been taken. The college is a municipal establishment which has become the Faculty of Technology in the University of Manchester. Its degree courses have become more and more popular, and the college has attracted students from a wide area. It has, however, been urged that the development of the higher instruction of the college has been detrimental to the interests of young Manchester students not intending to take a degree course. The Education Committee has decided to recommend the City Council not to admit more than 80 new degree students at the Michaelmas term. There would be room, it is officially stated, for 240. According to one view, the question is whether the institution is to remain a college of University status, or fall to the rank of a technical school. The other view is that bright working youths of Manchester are losing the chance of technological instruction qualifying them for their trades, in order that the sons of the well-to do from the whole of the North of England may obtain degrees, partly at the expense of Manchester's ratepayers.

Celebration of Demobilisation.—Last Saturday afternoon the Manchester Corporation Electricity (Installation) Department celebrated the demobilising of the ex-Service members of the staff. A char-à-banc tour was arranged into "Peakland," and tea was taken at Buxton.

Inquiries.—Makers of the Morse push-button for marine signalling, Whyte & Thomson patent; motors using the mark R. D. M. Co.; and ironclad switchgear marked "W.W.," are asked for.

INSTITUTION NOTES.

Diesel Engine Users' Association.—The subject of connecting-rod bolts was further discussed at the last meeting of the Association. Mr. J. L. Chaloner thought that a definite period might be fixed, after which a connecting rod bolt should be subjected to a careful examination by means of suitable measuring marks, and that it should then be left to the discretion of the chief engineer whether the bolt was to be renewed.

Mr. Geoffrey Porter referred to the desirability of calculating bolt sections on the basis of the elastic limit rather than on that of the ultimate stress.

Mr. G. W. F. Horner submitted a sketch of an arrangement he had made use of in carrying out a series of tensile tests with loading conditions similar to those set up in the bolts under discussion, and a series of diagrams giving the results of the tests. He said that heat treatment of steel bolts should be carried out by experienced persons, as it was very easy to obtain a high elastic limit and ultimate stress with a very low percentage elongation, and these were undesirable conditions. With regard to the packing

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pieces between the halves of the big-end bearings, it was advisable to use one uniform thick piece rather than a few thin pieces.

In a communication, Mr. Charles Day gave the results of investigations which had been carried out at Stockport for some time past with regard to connecting-rod bolts. He said that the material should be heat-treated in the bar; the bar being of uniform section, internal strains were avoided, whereas when bolts were heat-treated there was a danger of such internal strains occurring at the bottom of the threads, and at any other parts where changes of section occurred. Mr. Day condemned the practice of drilling only one pin hole through a bolt in connection with the use of castellated nuts. The castellations should be as numerous as the diameter would permit, and several holes should be put through the bolt. With regard to renewal of bolts, he thought that any general recommendation was illogical. Certain bolts might work with safety for many years, whereas other bolts failed after a very short time, the failure being due to the bolts having been subjected to improper conditions. He described a method of marking bolts so as to permit of accurate measurements being taken which would show at any time if they had been stretched or twisted. Whenever a bolt had been materially stretched or twisted it should be rejected and replaced by a new one.

The President (Mr. Charles Gould) announced that at the following meeting of the Association, Mr. A. Abbott, of the Department of Scientific and Industrial Research, would address the members on the general scheme of the Research Association for Liquid Fuels.

The Tramways and Light Railways Association.—The twelfth annual congress of the Association is to be held in the Council Chamber, Caxton Hall, S.W. 1, on July 2nd, at 2.30 p.m.

Institute of Metals.—A lecture on "Recent Progress in Thermo-electricity" was delivered by Prof. C. A. F. Benedicks, Ph.D., of Stockholm University, before the Institute on June 10th.

Prof. Benedicks first gave a short summary of his theoretical views upon the metallic conduction of electricity, which explained many matters not made clear by the former electron theory. A consequence of this new theory was that one had to conclude that even in a single homogeneous metal thermoelectric currents did occur; hitherto such currents were believed to be produced only when two different metals were present. Prof. Benedicks gave a concise demonstration of the most important experimental evidence of the truth of this conclusion, utilising for this purpose various metals.

In liquid mercury it had been possible for him definitely to prove the existence of thermoelectric currents, thus disproving the negative results of previous workers. A consequence of what the lecturer termed his "homogeneous thermoelectric effect" was that there must exist the reverse effect, the "homogeneous electrothermic effect," including as a special case the well-known Thomson effect. The reality of this effect was duly made clear. A specially interesting demonstration was of a new rotating thermoelectric apparatus, made entirely of copper, and rotating in a magnetic field, the driving force originating solely from unequal heating (by means of a tiny gas jet) of thin strips of copper.

The point at which the new knowledge brought forward by Prof. Benedicks might have some practical interest lay in the possibility of reducing the thermal conductivity of metals by insulated sub-division into fine wires without impairing the electrical conductivity. The demonstrations were carried out with the aid of a galvanometer provided by the Cambridge & Paul Instrument Co.

Liverpool Wireless Association.—A meeting of the Association was held on June 9th. As many members are now joining who have had no previous experience in wireless telegraphy, considerable time was devoted to coaching and assisting the "raw recruits," and it is intended at each meeting to set apart a certain portion of time for dealing with the very elementary stages of wireless for the benefit of new members, in order to make the subject attractive and popular to both old members and beginners. New members are cordially invited, and should apply to Mr. S. Frith, hon. secretary, 6, Cambridge Road, Crosby, Liverpool.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Major PHILIP DAWSON, M.Inst.C.E., M.I.M.E., M.I.E.E., upon whom, as stated in our last issue, the King has conferred the honour of knighthood in recognition of his services rendered as a member of the Disposals Board of the Ministry of Munitions, has been a member of that Board practically since its inception. Sir Philip is a man of boundless energy and enthusiasm, and his public activities are manifold. To electrical men he is best known by reason of his standing as an expert on electric traction matters, with which he has been practically and intimately connected ever since electric tramway and railway work really began to develop in the British Isles. His reputation is world-wide through his authorship of many well-known text-books dealing with electric traction and power supply. He is a partner in the consulting engineering firm of Messrs. Kincaid, Waller, Manville & Dawson, of Westminster, who are intimately connected with dock, harbour, electric traction, and power developments in Great Britain, South and North America, India, and Australia. The new knight, who may be relied upon to worthily carry so high a distinction, is, of course, well known as consulting electrical engineer to the L.B. & S.C. Railway Co., and is responsible for its electrification. He is also responsible for that of the Great Eastern Railway Co. He is further a member of the Railway Electrification Advisory Committee of the Ministry of Transport, and was appointed by the President of the Board of Trade as a member of the Water Power Resources Committee. In 1919 he was created Chevallier de l'Ordre de Leopold by King Albert for technical services rendered in Belgium during the war. He is Vice-President of the Belgian Royal Commission appointed by the Belgian Government to investigate and report on the electrification of the Belgian State railways and on the unification of Belgian electric power supply; President of the Association des Ingenieurs Electriciens of the Institut Electrotechnique Montefiore, Liége. Among many local and general activities we note that Sir Philip is one of the members of the L.C.C. for West Lewisham, and is on the Housing, Highways, and Electricity Committees.

Mr. E. MORGAN, of Dewsbury, has been appointed technical and engineering assistant to the Wolverhampton electrical engineer, at a salary (including bonus) of £500 per annum, increasing to £550 after twelve months' satisfactory service.

Wakefield Electricity Committee recommends that Mr. H. G. FRASER be appointed acting city electrical engineer for twelve months, at a salary of £550 per annum.

Mr. S. M. G. TEAL has been appointed deputy chief engineer to the Calcutta Electricity Supply Corporation.

The marriage took place, on June 11th, at the Cathedral Church of St. Mary, Glasgow, of Major H. R. TUPPEN, M.C., A.M.I.E.E., of Tanners Manor, Horeham Road, near Eastbourne, and Miss Elizabeth Rhind, younger daughter of the late Mr. Andrew Rhind, C.M.E., Bengal-Nagpur Railway, India.

Taunton T.C. has fixed the salary of the electrical engineer (Mr. HOWARD) at £450, plus the civil service scale of bonus, making a total of £660 a year, instead of his present salary of £520.

Mr. W. T. TALLENT-BATEMAN, who about a year ago was appointed works manager to Messrs. Dorman & Smith, Ltd., of Manchester, manufacturers of switchgear and accessories, has recently joined the board of directors, at the same time retaining his position of works manager. Mr. Bateman was formerly chief switchgear engineer to the British Westinghouse Co.

Mr. F. L. WARD, station superintendent with the W.D. Central Power Station, Aldershot Command, has resigned his position to take up an appointment in Africa.

Mr. HARRY S. ELLIS, who recently resigned the position of borough electrical engineer at Southampton under circumstances with which our readers are familiar, is joining his brother, Mr. Arthur Ellis, of Cardiff, who is in practice as a consulting engineer. The business addresses of both gentlemen are: 9, Park Place, Cardiff (head office), and 103, Cannon Street, London, E.C. Mr. Arthur Ellis's business, which has already developed to a very considerable extent, embraces electricity supply, tramways and transport work, and Parliamentary matters. Mr. Harry Ellis has been connected with the profession for twenty years or so. Prior to going to Southampton, a year ago, he held important appointments at South Shields, Bradford and Cardiff, where he was identified with electrical and mechanical engineering in shipyards, textile mills, public supply and engineering undertakings. He is a M.I.E.E. and M.I.Mech.E., and was for some years a member of the committee of the Newcastle Section of the I.E.E.

The Albert Medal of the Royal Society of Arts for 1920 has been awarded to Mr. A. A. MICHELSON, For.Memb.R.S., Professor of Physics in the University of Chicago, whose optical inventions have rendered possible the reproduction of accurate metric standards, and have provided the means of carrying out measurements with a minute precision hitherto unobtainable.

Obituary.—MR. J. W. PAYTER.—Australian papers just to hand record the death in April of Mr. J. W. Payter, who died at his home at Toorak, at the age of 87 years. The deceased received the first cable message which reached Australia. He retired from the State Public Service 27 years ago. He spent 38 years in the service of the telegraph department, and had reached the position of co-manager at the time of his retirement. At the time of the Boer war he was conducting experiments in wireless telegraphy.

MR. J. T. CROWE.—We regret to record the death from pneumonia, after a very short illness, of Mr. John Tudor Crowe. Mr. Crowe, who passed away on Friday last at his residence at Crouch End, London, was 66 years of age. He was staff manager of the Eastern Telegraph Co., and was well known in the electrical industry.

MR. H. A. JONES.—The death has occurred, as the result of an accident, of Mr. Herbert Alexander Jones, electrical engineer, of St. Kilda, Queen's Road, Buckhurst Hill, Essex. Mr. Jones, who was 49 years of age, was cycling home from the West Essex golf links, when he collided with a motor car, and he died on June 7th from the injuries he sustained.

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NEW COMPANIES REGISTERED.

H. W. Smith & Co. (1920), Ltd. (168,161).—Private company. Registered June 10th. Capital, £60,000 in £1 shares (50,000 cum. pref.). To take over the business of electrical wire and cable manufacturers carried on by H. W. Smith & Co., Ltd., at Lydbrook, Glos. The subscribers (each with one share) are: H. W. Hill, 74, Grantham Road, Stockwell, S.W.9, clerk; E. Newton, 3a, Marysville Terrace, Colney Hatch Lane, N.11, solicitor. The subscribers are to appoint the first directors. Registered office: Lydbrook, Glos.

A. H. Hunt, Ltd. 168,116).—Private company. Registered June 9th. Capital, £40,000 in £1 shares. To carry on the business of gas, electrical, and mechanical engineers, electricians, automobile and motor car engineers, &c. The first directors are: A. H. Hunt (permanent director and chairman), Court Green, Court Hill, Banstead; C. H. Hunt, Court Green, Court Hill, Banstead. Qualification, 5 shares. Registered office: H. A. H. Works: Tunstall Road, Croydon.

Newcastle Electrical & Motor Accessories, Ltd. (168,103).—Private company. Registered June 8th. Capital, £5,000 in £1 shares. To carry on business as indicated by the title. The first directors are: W. E. B. Dove, 45, Woodlands Terrace, Darlington, electrical engineer; J. Cowper, 19, Dean Street, Newcastle-on-Tyne; T. Sloan, 103, Shrotridge Terrace, Newcastle-on-Tyne. Solicitor: A. M. Tait, 46, Grainger Street, Newcastle-on-Tyne. Manager: G. G. Gorrill. Registered office: 39, High Bridge, Newcastle-on-Tyne.

New Italian Art Association, Ltd. (168,003).—Private company. Registered June 4th. Capital, £15,000 in 10,000 10 per cent. cumulative preference shares of £1 each and 100,000 ordinary shares of 1s. each. To take over the Italian Art Association, Ltd., and to carry on the business of importers and exporters of and dealers in works of art, and in particular marble, alabaster, and other materials used in the manufacture of electrical fittings, &c. The first directors are: Sir Alan Hutchings, K.B.E., 0, Grosvenor Street, W.1; Lieut.-Col. the Hon. E. Thesiger, D.S.O., 16, Prince of Wales Terrace, W.8; Major-Gen. P. E. F. Hobbs, C.B., C.M.G., Barnaboy, Farnborough Park, Hants.; G. H. Gascoigne, Moray House, Adelaide Road, Surbiton; Capt. the Baron George Marochetti, M.V.O., O.B.E., 60, South Audley Street, W.; Lieut.-Col. F. Lucas, O.B.E., 26, Stanhope Gardens, S.W.7. Secretary: P. H. Goodwin. Solicitors: Kenneth Brown & Co., Lennox House, Norfolk Street, W.C.

A.R. Engineering Co. (Southampton), Ltd. (167,986).—Private company. Registered June 4th. Capital, £1,000 in 5s. shares. To carry on the business of engineers, electricians, &c. The subscribers (each with one share) are: J. B. Webb, 1, Telford Avenue, S.W.2 (director of Anglo-Russian Engineering Co., Ltd., and the Anglo-Russian Engineering Co., Birmingham, Ltd.); H. J. Veitch, 56, Moorgate Street, E.C.2, chartered accountant. The first directors are: J. B. Webb (chairman), H. Walker, and A. E. Webb. Registered office: 126, High Street, Southampton.

Hartford Engineering Co., Ltd. (168,085).—Private company. Registered June 8th. Capital, £5,000 in £1 shares. To take over the business of the Hartford Engineering Co., now carried on under the proprietorship of the Southport Electrical Supply Co., Ltd. The subscribers (each with one share) are: W. Sharrock, 17, Dunkirk Road, Birkdale, engineer; G. Pendleton, 19, Bridge Street, Southport, confectioner. The first directors are to be appointed by the subscribers. Registered office: Pine Grove, Southport.

Bukwood Engineering Co., Ltd. (168,084).—Private company. Registered June 8th. Capital, £1,000 in £1 shares. To carry on the business of tool makers, general and electrical engineers, &c., to adopt an agreement with G. St. J. Wood, W. J. Butler, and H. S. Kemshead. The first directors are: G. St. J. Wood, 29, Gunterstone Road, West Kensington, W., electrical engineer; H. S. Kemshead, 70, Cranley Gardens, Palmers Green, N.13, engineer; W. J. Butler, 17, Wayland Avenue, Hackney. Registered office: 31a, St. Jude Street, Stoke Newington, N.16.

Durelco, Ltd. (167,994).—Registered June 4th. Capital, £300,000 in £1 shares. To acquire all or the majority of the shares in, and the undertakings of Duram, Ltd., Cryselco, Ltd., and Metal Manufacturers, Ltd., carrying on business in England, and to carry on the business of manufacturers of drawn wire and electric lamps, and all articles made of molybdenum and other metal, &c. The first directors are: W. L. T. Arkwright, J.P., 4, Wilbraham Mansions, Sloane Street, S.W.; the Earl of Kintore, 10, Park Place, St. James's, S.W.; P. H. G. Powell-Cotton, Quex Place, Birchington; Capt. E. G. S. Churchill, D.L., J.P., Northwick Park, Blockley, Worcs.; G. G. Craig, 10, New Square, Lincoln's Inn, W.C.; W. W. Worthington, J.P., Maple Hayes, Lichfield; J. C. Moulden, 19, Carew Road, Northwood, Middlesex. Qualification, £500. Remuneration (except managing directors) £400 each per annum (£100 extra for the chairman) and 5 per cent. of the net profits divided between them. Solicitors: Speechly, Mumford and Craig, 10, New Square, Lincoln's Inn, W.C. Registered office: Thanet House, 231-2, Strand, W.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Penrith Electric Supply Co., Ltd.—Deposit on May 12th, 1920, of deeds of land in Friar Street, Penrith, to secure all moneys due or to become due from company to Lloyds Bank, not exceeding £2,500.

Richmond Light Manufacturing Co., Ltd.—Debentures dated May 14th, 1920, to secure £2,500 charged on the company's undertaking and property, present and future, including uncalled capital. Holder: A. K. Fordham, 90, Cannon Street, E.C.

Switchgear & Cowans, Ltd.—Issue on June 1st, 1920, of £3,000 debentures, part of a series.

CITY NOTES.

Siemens Brothers & Co., Ltd.

The report for 1919, which was submitted at the annual meeting on June 8th, stated that the result of operations, despite the dislocation caused by the change over from war to civil work, was quite satisfactory. Valuable contracts, notably for submarine telegraph cables, were secured, and output was well maintained. The Stafford works of Siemens Brothers Dynamo Works, Ltd. (of which all the capital is held by this company), had been sold to the English Electric Co., Ltd., and an agreement had been entered into between the English Electric Co. and this company whereby each company would confine its manufactures and trade to particular lines of electrical plant, and would have the support and assistance of the other company in obtaining orders for such business. The cottage property at Stafford, standing among this company's assets at £53,344, had been included in the sale at that figure. The agreement for sale was entered into in November, 1919, but the property had only been legally conveyed in this year, so that the values in the balance sheet in respect of it remained undisturbed at December 31st last. The Dynamo Co. would continue its existence for the purpose of completing its contracts for dynamos and motors, and for carrying on its other electrical business. The profit for the year was £211,209, plus £244,567 brought forward, making £455,776; 10 per cent. dividend for the year requires £100,000; there is written off from the discount on the sale of debenture stock £25,000, put to reserve £15,000, and carried forward to 1920 (subject to excess profits duty for 1918 and 1919) £315,776. Lieut.-General Sir Hubert Gough has been elected to the board.

In the course of his speech at the annual meeting, Mr. G. Mure Ritchie said that the balance sheet showed the company to be in a generally healthy condition. The net profit was £211,209, compared with £229,647 for 1918. All sections of the business had contributed towards the profit, which represented an average of 10 per cent. on the total capital employed in the business and about 8 per cent. on the turnover. The dividends and appropriations would absorb altogether £140,000, leaving a sum of £71,209 out of the year's profits from which to pay the excess profits duty to which the company might be assessable for 1919. Adding to that the balance of £244,567 from 1918 there was an amount of £315,776 to carry forward. In regard to the sale of the Stafford works of the company, the transaction arose out of lengthy negotiations with the English Electric Co., Ltd. That company was engaged in the manufacture of machinery for lighting and power purposes, whilst Siemens Brothers' manufactures at their principal works at Woolwich mainly consisted of telegraph and telephone plant, and electrical cables. A similar class of work to that undertaken by the factories of the English Electric Co. was carried on at Stafford by Siemens Brothers Dynamo Works, but inasmuch as modern developments in electrical power plant steadily tended in the direction of the manufacture of larger and even larger units, it became obvious to the directors that that branch of the company's business, while superbly well equipped up to a certain point, would require, if it was to continue profitable in the future, to receive extensive additions both to the works and to the staff. Under existing conditions it would have taken several weeks to build and equip new workshops and train new men for the work, and the expenditure would have been very great, involving the issue of further capital. They had made a friendly business arrangement with the English Electric Co. for mutual support. The Stafford works were sold at a valuation made by Mr. Michael Faraday on behalf of the company, and the valuation showed a substantial balance over the book figures. Dealing with the manufacturing work of the company, the chairman said that owing to the diversion for nearly five years of cable manufacture to war purposes, the demand since the conclusion of peace for submarine telegraph and telephone cables was very large, and substantial contracts had been completed, or were still in hand, for both those classes of cable for various Governments and cable companies, among which might be named the Danish and Norwegian Governments, for whom they had made special types of inductance-loaded submarine cables of a larger capacity than any hitherto made, and for the manufacture of which the plant was specially designed and erected. For electric light and power cables the demand was great and was still growing, and their manufacturing facilities had been employed to the utmost. That had also occurred in the case of the output required of them for the development of the telephone service of the Post Office, for whom they had made and laid cables in a large number of towns in the Northern and Scottish districts. That contract had further given considerable employment outside the factory, as it had necessitated the opening up of the thoroughfares, the laying of conduits and pipes, and the installation of telephone cables in no less than 50 towns. Like all other industries they had had special difficulties to face arising from the ferment in the labour world, affecting, on the one hand, the adequate and prompt supply of their raw material which they required in very large quantities, and on the other, the preparation of tenders covering manufacture extending over lengthy periods in a way satisfactory to their shareholders and fair to their customers. They might claim that those difficulties had been met and conquered, and as far as lay in their power their relations with their own employés were maintained on a friendly and satisfactory footing through the assistance afforded to their various committees, charities, sports club, &c. Their cable ship "Faraday" after repairing the Direct United States Co.'s cable in the summer, was employed during the autumn and winter carrying freight, but was now back again on her regular work of cable laying. In reviewing the business transacted by the cable sales department during the past year, it could reasonably be said that the result of the trading might be considered very satisfactory, and the turnover of the department for the year had exceeded that of any pre-war year, not only in value but also in regard to

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the quantity and output. Among the orders secured during the year, one of particular interest was the contract for the supply and erection of the cables for the electrification of the Great Western Railway from Shepherds Bush to Ealing. They had also been successful in obtaining several large orders from abroad for extra high tension cables. A very considerable increase had taken place in the sale of cable accessories and joint boxes, particularly in the latter, and although that shop was considerably enlarged during the year it was still kept fully occupied. Several large contracts had been entered into with corporations and municipalities for their requirements in those goods. The trading in rubber insulated wires and cables showed an increase over any pre-war year both in value and mileage, and the sales were steadily improving. Special attention might be drawn to their "Stannos" wires, which were now in great demand all over the kingdom, and another of their manufactures which called for special mention was ebonite. The quality of their ebonite had now attained a reputation second to none, and the demand far exceeded the supply. Steps were being taken to meet the situation, and they hoped in the near future to be in a position to satisfy the requirements of all their clients. The battery business had been fully maintained. The connection which they enjoyed prior to the war had in the majority of cases been re-established, and the demand for their batteries was increasing. The construction of overhead lines for telegraph and power purposes had been revived, and there was every sign of considerable business, especially in the construction of power transmission lines. In the early part of 1919 they had to face the task of diverting their efforts from the supply of war material to the supply of those goods for the manufacture of which their works were originally laid out, and in that they met with the same difficulties as other companies. Raw material was hard to get and it was often of inferior quality, and output was diminished by the general compulsory reduction in working hours. However, in spite of all those difficulties, and of the long delivery times which they necessitated, the demand for their products was so great as to rapidly fill their order book. Their business in telegraph apparatus had revived satisfactorily, and continued as before to be almost exclusively for export, their chief customers being foreign Governments or railway administrations. Their business in wireless telegraph installations took a considerable step forward during the year, and continued to develop satisfactorily. The Post Office had placed considerable orders for telephone exchanges, of which they had secured a fair share, having booked no less than three public exchanges during the year. In conclusion, he referred to the fact that arrangements had recently been made which would ensure the manufacturing output of their lamps being doubled in the near future. The increased cost of labour and raw materials had, he said, reduced the net profits in comparison with the turnover made by the lamp department last year to less than half of that realised during the preceding year. That fact should appease the minds of any who, through the sketchy accounts concerning the report of the Standing Committee on Trusts, which recently appeared in the daily Press, might have formed the opinion that the company was profiteering in lamps.

Lord Queenborough seconded the motion, which was adopted without discussion.

Electrical Construction Co., Ltd.

Presiding at the annual meeting, on June 10th, Mr. James Gray, the managing director, said the balance of profit and loss account showed a small reduction on that of last year. Having regard, however, to the fact that during the two previous years the works had been operating up to their full capacity, there could hardly fail to be some set-back in profits this year, due to reduced hours of labour and the restrictions prevailing as to overtime, &c. The extensions of the works did not add appreciably to the output during the year, and the moulders' strike caused great disorganisation. The effects of this strike were still felt, but would, it was hoped, soon be overcome; and a larger turnover than ever was anticipated, though it must be kept in view that labour conditions would tend to modify the effect of the extensions which had been carried out. Comparing the past two years, the gross profits from manufacturing and contracting in 1919-20 were £121,764, and in 1918-19 £121,364, the increase being £400. The net profit decreased from £68,680 in 1918-19 to £66,169 in 1919-20. These figures showed that though the gross profit was practically the same in each of the two years, the net profit last year was £2,561 less than in the preceding year. This was accounted for by an increase of £4,992 in general charges, though there was a set-off of £1,183 reduction in debenture interest and maintenance of plant and machinery, and also of £898 additional dividends and interest and transfer fees. Having regard to all the conditions, the results were quite satisfactory. The net profits were £66,169, and the sum brought forward (after payment of £20,000 excess profits duty for the year ended March 31st, 1919) was £18,669, making a total of £84,839. Referring to various items in the balance sheet, Mr. Gray explained that the reference to proceeds of sale of leasehold property at Millwall, £5,398, concerned premises which were formerly sublet to the Electrical Power Storage Co., but had since 1916 been in occupation of a shipping company, which had made an offer to purchase, and this had been accepted. "Additions to plant and buildings, £44,883," included the extension of the works to which reference had already been made. It consisted of three bays, measuring in the aggregate 330 ft. by 110 ft. The beneficial use of these was not obtained as early as anticipated, but the whole of the switchgear department had now been transferred to the new shops and a greatly increased output from that department would be possible. When the shops had been completed they would be second to none in the country in lay-out and equipment, both of which were vital to cheap production. The item shares in allied companies had been reduced considerably, advantage having been taken of favourable offers to purchase. The company was not a holding company, and the proceeds of the sale could be more profitably employed in its own business. The shares realised a surplus over their book value, and this was applied in reducing investments to market value. On the liability side, the ordinary capital had been increased by the issue made in April, 1919; the debentures had been reduced by £8,000. The general reserve, with the present allocation, would stand at £100,000, equal to one-third of the ordinary share capital. The floating assets exceeded the floating liabilities by £326,913; a most satisfactory position. With regard to the payment of excess profits tax, when the war broke out the manufacturing electrical industry was emerging from a long period of depression caused by strenuous and unfair foreign competition, and the excess profits duty had, therefore, weighed heavily upon the industry in consequence of low pre-war standards. In the case of their own company, the sums paid in excess profits duty and munition levies since their incention, had exceeded the dividends to the ordinary shareholders after deducting income tax. It would be difficult to find words more forcible than those used by the Chancellor of the Exchequer last year in favour of abolishing the duty, but to the surprise of the community he had not only decided to continue it, but to increase it from 40 to 60 per cent. Every reasonable person acknowledged that the money had to be found, and was willing to pay his share, but he objected to an unfair distribution of the burden. Excess profits duty was imposed in a time of stress and served its purpose, but to continue it was a direct encouragement to extravagance, and it would not conduce to increased production, which was vital to the rehabilitation of the country's finances. The labour outlook was still uncertain, but their relations with their own men were quite satisfactory, and provided there was no dislocation by strikes or otherwise, they might look forward with complete confidence to the results of the new financial year. The speaker referred to the valuable services rendered by the staff and workmen during the year.

The report was seconded by Sir Henry Mance, and unanimously adopted.

Altrincham Electric Supply, Ltd.

During 1919 109 new installations were connected, making the number of actual consumers 1,940. After providing for debenture interest, &c., the profit was £6,913, plus £284 brought forward. After paying the preference dividend, and putting £500 to depreciation, a dividend of 7½ per cent. per annum is to be paid on the ordinary shares for the half year ended December, and a dividend of 5s. per share for the year on the deferred shares. £517 is to be carried forward. The revenue for the year was somewhat disappointing, as the price that the company was able to charge for current for domestic purposes was not commensurate with the increased cost of labour and coal, and during the first half-year the operation of the Household Fuel and Lighting Order adversely affected the revenue.

The recovery of industrial activity in the area has been unexpectedly slow, and this, in addition to affecting the revenue from existing consumers of electrical power, has delayed the completion of new factories being erected in the district, and to which the company are already supplying a certain amount of power. When the fresh capital was issued in July, 1919, it was anticipated that the major part of it would be required at an early date in payments for the extensions to plant. It has not yet, however, been possible to obtain delivery of the major portion of this, including a 2,000-kw. turbo alternator. A large proportion of the new capital has therefore been practically unproductive, and has been invested for the time being in 5½ per cent. Treasury Bills, and the anticipated increased profit for the past year has, for this reason, not been realised. The Broadheath district is continuing to find favour as a manufacturing centre, and, unless unfortunate set backs occur, the directors look forward to satisfactory results for the current year's working.

Delhi Electric Tramways & Lighting Co., Ltd.—For 1919 the gross receipts of the tramway undertaking were £15,092, and those of the electric supply undertaking £32,498; increases of 1¾ per cent. and 13 per cent. respectively. The tramway revenue was affected by the disturbances which occurred in Delhi in April, 1919. The combined undertakings show a net revenue of £20,430, as compared with £18,010 in 1918. After providing for general expenditure, debenture interest, depreciation, putting £2,500 to renewals reserve, and writing £5,000 off preliminary expenses, 7 per cent., less income tax, is paid on the preferred and participating shares, and 1s. 4½d. per share, less tax, on the ordinary shares, and £1,362 is to be carried forward. Additions to plant amount to £3,073. Further plant, equipment, and mains required to meet the growing demands have been ordered, and the question of providing for future developments is receiving careful consideration.

Manila Electric Railroad & Lighting Corporation.—Dividend of 1½ per cent. on the common stock for the quarter ending June.

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United Electric Tramways of Monte Video, Ltd.—The report for the year ended March 31st, 1920, states that the credit balance for the year to October, 1919 (the fiscal year of the Uruguayan company), after providing for administration expenses and debenture interest is £86,344, plus £10,669 brought forward. £4,981 is applied to redemption of debenture stock; £2,500 to redemption of preference and ordinary share capital; £30,000 to renewals and contingencies; 6 per cent., less tax, is paid on the cumulative preference shares in respect of the year to September 30th, 1918, and 6 per cent. is recommended on the same shares for the half-year to March, 1919, and for the year to March, 1920; carried forward £7,032. The operation of the tramway system showed gross receipts at an exchange of $4.7 to the £ of £443,694, an increase of £63,394. The operating expenses were increased by £29,823, leaving a net increase of £33,571. Passengers carried 54,883,919, an increase of 6,955,313. Car miles run 7,756,634, an increase of 718,207. The decrease in cost of fuel has been less than was hoped for a year ago, while expenditure on repairs, maintenance, and wages has continued to advance.

Calcutta Electric Tramways, Ltd.—Presiding at the annual meeting in London, on Monday last, Sir Henry Kimber, Bart., said that the capital outlay of the year, £9,671, was small as compared with the increased revenue earned. The traffic receipts increased by £39,581 on a mileage run increase of 21 per cent. The passengers carried increased by nearly 7 millions to 50 millions. They were now considering the question of overhauling the power house with a view to providing more up-to-date machinery or other facilities to meet the growing traffic. In regard to the prospects for the current year, the traffic receipts continued to improve, the increase to date being over 1¼ lakhs. In order to meet the growing morning and evening traffic they had ordered eight motor 'buses, which they hoped to have ready to start a service during the latter half of the year. The costs of running were, of course, much higher than those of the tramway service, but the experiment would be closely watched with a view to the extension of the service if it was warranted by results.

Prospectuses.—*A. Reyrolle & Co., Ltd.*—The prospectus has been advertised for the issue at par of 160,000 £1 ordinary shares in this well-known company of switchgear manufacturers. The demand for the company's product since the war has exceeded all previous records, both in quantity and value. The works at present cover five acres, and the employés number nearly 1,000. The proceeds of the present issue will be devoted to completing the extensions and providing working capital. Very full particulars were given in our advertising pages last week.

The lists will be closed on Saturday, June 19th, but applications received by post on Monday, June 21st, will receive consideration.

W. Canning & Co., Ltd.—The list is to close to-morrow, Saturday, in an issue of 200,000 ordinary shares of £1 each at par, in this company, which has been formed to acquire the old-established business of W. Canning & Co., of Birmingham and London, electro-platers' engineers, manufacturers of electro-plating plant and materials, &c. The issue will provide additional capital in respect of premises purchased in London, for extensions to meet increasing trade, and to enable the practice of carrying large stocks to be extended. Particulars of the registration appeared in our last issue (page 757).

Marconi's Wireless Telegraph Co., Ltd.—The report for 1919 shows that the credit balance of profit and loss account amounted to £1.220.740. The total distribution on the old ordinary shares is 25 per cent. for the year, on the preference 22 per cent., and a bonus of 5s. per share, without reduction of income tax, is to be paid on the old ordinary shares and on the preference shares.

Kalgoorlie Electric Power & Lighting Corporation, Ltd.—For 1919 there is a decreased profit. It fell from £10,622 in 1918 to £5.451 mainly on account of the closing down of the principal mines by reason of labour troubles. Since the strike ended early this year the returns have shown an improvement.

Lewes & District Electric Supply Co., Ltd.—Total revenue £5,013; working expenses £3,856; balance to net revenue £1.156. After meeting debenture interest, &c., and adding £868 brought forward, £600 is put to renewals fund, and £837 is carried forward.

Stock Exchange Notices.—The Committee has specially allowed dealings in the following under temporary regulation 4 (3):—

Mather & Platt, Ltd.—450,000 ordinary shares of £1 each, fully paid, Nos. 600,001 to 1,050,000.

La Plata Electric Tramways Co., Ltd.—After meeting debenture interest the net profit is £3,024, plus £7,628 brought forward. Both sums are to be carried forward.

Globe Telegraph & Trust Co., Ltd.—Dividend of 14s. per share on the ordinary shares, making 10 per cent. total for the year.

Lancashire Power Construction Co., Ltd.—Dividend at the rate of 6 per cent. per annum for 1919 on the ordinary shares.

Ruston & Hornsbys, Ltd.—Dividend on the ordinary shares at the rate of 5 per cent. per annum. To credit of employés' aid account, £1,000; £41,175 to depreciation on buildings, plant, and machinery; carried forward £37,240.

Companies to be struck off the Register.—The following is to be struck off the register within three months unless cause is shown to the contrary:—

Autoelectric Transmission, Ltd.

Coventry Chain Co., Ltd.—Interim dividend of 6 per cent. per annum, less tax, on the preference and ordinary shares for the half-year.

Howard & Bullough, Ltd.—Final dividend on the ordinary shares, making 10 per cent. for the year. £57,207 carried forward.

James Keith & Blackman Co., Ltd.—Dividend on ordinary shares for year ended March, 1920, at the rate of 20 per cent. per annum, free of tax. To reserve £13,780; forward £18,559.

C. A. Vandervell & Co., Ltd.—Dividend of 10 per cent. per annum, less tax, for the quarter ended June 30th on 10 per cent. preferred ordinary shares.

Provincial Tramways Co., Ltd.—Interim dividend of 8d. per ordinary share.

STOCKS AND SHARES.

Tuesday Evening.

The Stock Exchange is troubled with a good deal of selling from somewhat mysterious sources. Apparently the liquidation emanates from Paris, but it is so persistent and so heavy that suspicion arises as to whether some, at any rate, of the sales are inspired near home. The outlook in regard to money is unchanged, though there does seem to be some awakening on the part of the Government to the fact that trade will be much better served by cheaper money than it can be by the Bank Rate rising. Consequently, optimism is already beginning to talk about a fall, instead of a rise, in the Bank Rate, though the position is still sufficiently unsettled and obscure to cause hesitation on the part of investment or speculative enterprise.

There is a breath of improvement in the issues of the Underground Electric Railways Company, on the assumption that the company is bound to be allowed to put up its fares before very long, and that when this is done, the enormous volume of traffic handled will begin to make itself felt. As soon as profits do come into the picture, they should be on the substantial scale, and the speculative investor is prophesying a return, sooner or later, to the days when the Underground Company paid 6 per cent. on its income notes. For the next half-year, or the next few half-years, it may be safely conjectured that these Notes will receive considerably less than their proper dividend, but the price, in anticipation of the fare-raising being conceded, has hardened to 59½, while the shares at 1⅛ are ⅛ higher. The shilling shares, on the other hand, are easier at 4s. 6d.

The talk of serious financial trouble in Paris has caused Brazil Tractions to recede to 49. Other Brazilian issues are also dull and heavy, apparently in consequence of the delay which has occurred in allowing Brazilian companies to raise their freight rates. The strength of Anglo-Argentine Tramways is scarcely maintained, the first preference losing 2s. 6d. of the recent advance, but British Columbia deferred at 49½ and the preferred at 50½ are 4 and 2 points higher respectively. Mexican issues are no better. Indeed the tendency is for them to slide back, with the exception of Mexico Tramways 6 per cent. bonds, which have gained 2. The Calcutta Tramways raises its dividend from 8½ per cent. to 10 per cent., free of tax, and the price is firm at 7⅞. The report is an excellent one. Bombay Electric Tramways preference at 13 are 5s. lower.

Of the new cable shares, Westerns are 4¾, Globes 4¼, Eastern Extensions 4 and Eastern Telegraphs 9s. 6d., with a fair amount of business doing in them all. Amongst the senior stocks, Eastern ordinary has given way to 147½, a fall of 3 points, and Eastern Extensions at 14¼ are 10s. lower, though Westerns remain at 15½. The principal excitement in this market, however, has been another rise in Marconis, the price putting on 3-16 to 3⅛. The company's report is exceedingly good. The dividend is made up to 25 per cent. for the year on the ordinary shares, and these, together with the preference, receive in addition a bonus of 5s. per share paid free of tax. The market has been strong for some two or three weeks past, and the price has come up from 3 to 3⅛ with scarcely a break. The new shares, which rank equally with the old as soon as the latter have received the dividends just declared, stand at 3⅛, the same price as the preference shares, which are to receive 22 per cent., and the bonus just mentioned. Canadian Marconis are 10s. 3d. and Marines 38s. 9d., the latter showing a distinct disinclination to respond to the recent good report. No particular heed is paid in the Stock Exchange market to the strike of Marconi operators.

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It may be well to point out that the calculation of the yield on Marconi shares, in our tabular list, takes no account of the 5s. bonus. The return is worked out on the 25 per cent. dividend only.

Amongst the manufacturing shares, Callenders have attracted a little attention and a rise of 1-16, in consequence of the new issue, while the report shows up well. It is interesting to notice the available balance during the past four years from 1916 onwards, and the annual figures are: £311,444, £207,491, £232,978, £262,803. For 1913, the year before the war, Callender's had £170,000 to dispose of, and the dividend then was 15 per cent., the same as it is in respect of the year just ended, the latter, of course, including the new shares distributed by way of bonus some time ago. Castner-Kellners are weak at 3¼ ex dividend. Babcocks at 2⅝ xd show little change, allowing for the deduction. Henleys have risen ½ to ⅞. Siemens at 26s. show recovery of the 1s. dividend, while Telegraph Constructions are £1 lower at 21½ owing to monetary conditions.

Electricity Supply shares are unchanged, from Bromptons to Westminsters. Nobody is taking any interest in them. The strike which has plunged Melbourne into nightly darkness failed to influence the price of Melbourne Electric Supply shares. The rubber share market is quiet to dull, with the price of the commodity once more a trifle below 2s. per lb. Armament shares are weak, Vickers and Armstrongs both giving way on provincial sales. In these, as in many other of the Stock Exchange industrial departments, business is slow; prospective buyers profess that they prefer to wait and see whether the 60 per cent. E.P.D. will remain, or whether the continuance of vigorous attacks may force its partial abandonment even at this twenty-fifth hour.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1918.	Dividend 1919.	Price June 15, 1920.	Rise or fall.	Yield p.c.
HOME ELECTRICITY COMPANIES.					
Brompton Ordinary	8	12	6⅜	—	£9 8 2
Charing Cross Ordinary	4	7	9⅜	—	9 6 8
do. do. do 4½ Pref.	4½	4½	9⅜	—	8 8 8
Chelsea	8	4	2½	—	8 0 0
City of London	8	10	1¼	—	8 17 10
do. do. 6 per cent. Pref.	6	6	17/-	—	7 1 2
County of London	7	8	8¼	—	9 17 0
do do. 6 per cent. Pref.	6	6	8½	—	7 5 5
Kensington Ordinary	6	7	4¼	—	7 15 6
London Electric	Nil	2½	1½	—	6 0 0
do. do. 6 per cent. Pref.	6	6	8	—	10 0 0
Metropolitan	5	6	9¼	—	10 8 8
do. 4½ per cent. Pref.	4½	4½	2¼	—	8 0 0
St. James' and Pall Mall	10	12	6⅝	—	8 16 10
South London	5	6	2⅝	—	9 12 0
South Metropolitan Pref.	7	7	18/9	—	7 0 0
Westminster Ordinary	8	10	5	—	10 0 0
TELEGRAPHS AND TELEPHONES.					
Anglo-Am. Tel. Pref.	6	6	77½	—	*7 14 10
do. Def.	88/6	1½	18	—	8 6 8
Chile Telephone	8	6	6½	—	*4 18 2
Cuba Sub. Ord.	7	7	9½	—	*7 7 4
Eastern Extension	8	10	14¼	— ¼	*6 18 0
Eastern Tel. Ord.	8	10	1.7½	—8	*6 15 7
Globe Tel. and T. Ord.	8	10	15¼	—	*6 7 0
do. do. Pref.	6	6	8½	—	7 1 2
Great Northern Tel.	22	—	21½	—	9 15 6
Indo-European	18	10	25	—	7 2 10
Marconi	25	25	33	+ ⅝	6 18 0
Oriental Telephone Ord.	10	12	2⅝ xd	—	*4 18 4
United R. Plate Tel.	8	8	7½	—	*5 6 8
West India and Panama	1/8	Nil	⅜	—	Nil
Western Telegraph	8	10	15½	—	*6 9 0
HOME RAILS.					
Central London Ord. Assented	4	4	44½	—	8 19 9
Metropolitan	1	1½	19½	—	6 8 2
do. District	Nil	Nil	15	—	Nil
Underground Electric Ordinary	Nil	Nil	1¾	+ ⅛	Nil
do. do. "A"	Nil	Nil	4/6	— 6d.	Nil
do. do. Income	5	4	59½	+ 1	6 14 6
FOREIGN TRAMS, &c.					
Anglo-Arg. Trams. First Pref.	Nil	5½	3⅜	— ⅛	8 3 0
do. do. 2nd Pref.	Nil	Nil	⅛	—	—
do. do. 5 Deb.	5	5	60	+ ½	8 6 8
Brazil Tractions	Nil	—	49	— 2	—
Bombay Electric Pref.	6	6	13	⅛	4 10 3
British Columbia Elec. Rly. Pfds.	5	5	57½	—	8 13 10
do. do. Preferrred	2½	5	50½	+ 2	9 10 6
do. do. Deferred	Nil	8	49½	+ 4	6 1 8
do. do. Deb.	4½	4½	52½	—	8 2 0
Mexico Trams 5 per cent. Bonds	Nil	Nil	28½	—	Nil
do. 6 per cent. Bonds	Nil	Nil	22½	+ 2	Nil
Mexican Light Common	Nil	Nil	12⅛	—	Nil
do. Pref.	Nil	Nil	19½	— 2	Nil
do. 1st Bonds	Nil	Nil	42½	—	—
MANUFACTURING COMPANIES.					
Babcock & Wilcox	15	15	22xd	—	*5 14 4
British Aluminium Ord.	10	10	1⅝	—	9 8 2
British Insulated Ord.	12½	15	1⅝	—	8 2 8
Callenders	25	15	1⅛	+ 1/16	9 12 0
,, 6½ Pref.	6½	6½	18/9	—	6 18 6
Castner Kellner	20	17	3¼xd	— ½	5 4 7
Crompton Ord.	10	—	22/-	—	9 1 10
Edison-Swan, "A"	10	—	1⅞	—	8 8 0
do. do. 5 per cent. Deb.	5	5	79½	—	6 5 9
Electric Construction	10	—	21/-	—	9 10 6
Gen. Elec. Prof.	6½	6½	18/6	—	7 0 5
do. Ord.	10	—	32/6	—	*6 8 0
Henley	25	15	1¼	+ ⅛	8 0 9
do. 4½ Pref.	4½	4½	8½	—	6 18 6
India-Rubber	10	—	1⅜	—	*7 11 0
Met.-Vickers Pref.	—	8	2⅝	—	6 18 6
Siemens Ord.	10	10	26/- xd	+ 1/-	*7 13 10
Telegraph Con.	90	90	21½	— 1	*5 11 8

* Dividends paid free of Income Tax.

MARKET QUOTATIONS.

IT should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Tuesday, June 15th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Oxalic	per lb.	2/10	...
a Ammoniac Sal	per ton	£100	...
a Ammonia, Muriate (large crystal)	,,	£92	...
a Bisulphide of Carbon	,,	...	...
a Borax	,,	£42	...
a Copper Sulphate	,,	£48	...
a Potash, Chlorate	per lb.	1/-	...
a ,, Perchlorate	,,	1/8	...
a Shellac	per cwt.	£31 10s.	80/- inc.
a Sulphate of Magnesia	per ton	£18	...
a Sulphur, Sublimed Flowers	,,	£28	...
a ,, Lump	,,	£25	...
a Soda, Chlorate	per lb.	6d.	...
a ,, Crystals	per ton	£12	...
a Sodium Bichromate, casks	per lb.	...	...
METALS, &c.			
g Babbitt's Metal Ingots	per ton	£118 to £345	
c Brass (rolled metal 2" to 12" basis)	per lb.	1/4	¼d. inc.
c ,, Tubes (solid drawn)	,,	1/5½ to 1/6	...
c ,, Wire, basis	,,	1/3½	¼d. inc.
c Copper Tubes (solid drawn)	,,	1/8½	...
g ,, Bars (best selected)	per ton	£161	...
g ,, Sheet	,,	£161	...
g ,, Rod	,,	£161	...
d ,, (Electrolytic) Bars	,,	£110	£1 inc.
d ,, ,, Sheets	,,	£156	...
d ,, ,, Wire Rods	,,	£125	£1 inc.
d ,, ,, H.C. Wire	per lb.	1/4	...
f Ebonite Rod	,,	3/-	...
f ,, Sheet	,,	2/6	...
n German Silver Wire	,,	3/-	...
h Gutta-percha, fine	,,	13/-	...
h India-rubber, Para fine	,,	2/1½	...
i Iron Pig (Cleveland Warrants)	per ton	Nom.	...
l ,, Wire, galv. No. 8, P.O. qual.	,,	£50	£2 inc.
g Lead, English Pig	,,	£35	£5 10s. dec.
g Mercury	per bot.	£21 to £21 10s.	£3 10s. inc.
e Mica (in original cases) small	per lb.	6d. to 4/6	...
e ,, ,, ,, medium	,,	5/- to 10/-	...
e ,, ,, ,, large	,,	12/6 to 25/- & up	...
g Phosphor Bronze, plain castings	,,	1/6 to 1/1	...
g ,, ,, rolled bars and rods	,,	2/2 to 2/6	...
g ,, ,, rolled strip & sheet	,,	2/3 to 2/9	...
g Silicium Bronze Wire	per lb.	1/11½	...
r Steel, Magnet, in bars	,,	1/8	...
g Tin, Block (English)	per ton	£234 to £239	£3 dec.
n ,, Wire, Nos. 1 to 16	per lb.	4/9	...
White Anti-friction Metals	per ton	£90 to £345	...

Quotations supplied by—

a G. Boor & Co.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespears.
h Edward Till & Co.
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
r W. F. Dennis & Co.

A "Meteorite Mystery."—On Wednesday, May 26th, there was an excetionally heavy thunderstorm at Chiswick, which was recorded in the Press under such headings as "Meteorite Mystery at Chiswick.—Strange Occurrence in Great Storm.—Fireball Seen to Fall," and was followed by a visit of "two eminent scientists" from the British Museum and Meteorological Office, to investigate. They doubted the meteoric cause of a hole in the ground that was found after the storm, but were said to be puzzled. The affair went the round of the Press—the terms "meteorite, fireball, thunderbolt" being applied.

Mr. Walter Betts, of Chiswick, informs us that visiting the scene at a convent on the Friday following the storm, he found a gardener filling in the hole. Close to the hole was a cemented path joined at right angles by a similar path from a paved courtyard, forming a sort of funnel with the outlet towards the hole. As from each direction there was a slight fall towards the corner where the hole was made, this spot would be the first soft and cultivated ground to be submerged by the direct downfall of rain thus collected. The roof-gutters overhanging the cemented paths would be overflowing, and two gutters meeting at the angle of the building just opposite the hole would form a pointed "jug-spout" from which the water would be projected on to the soft ground from a height of 18 or 20 ft. With such combined forces the soft soil would inevitably be washed out or down any subterranean hollow, such as an old drain. And so the hole can be accounted for. It was, in a double sense, a "wash-out." As to the "thunderbolt" itself, just before the great flash, a particularly dense cloud, at a low altitude, was approaching from the south-east. It probably passed over the convent, then, some 400 yards beyond, was discharged all at once with one tremendous flash and almost simultaneous clap. Mr. Betts's house, about three-quarters of a mile from the convent, was considerably shaken, and there was a torrential downpour of rain. After this abated, although the heavy rain continued for some time, there was not much lightning.

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WHERE AMERICA LAGS BEHIND.

[COMMUNICATED.]

We are so used to having it dinned into our ears that America is the home of every electrical virtue, and has originated every worth-while improvement and development, that it may not be an easy task to make people believe that at least one of her feet is formed of unsubstantial clay, or (to employ a more appropriate simile), of bituminous compound.

In some ways America is ahead of this country electrically. The natural wealth, large population, and the important fact that a very big proportion of American buildings have been erected during the last 30 years, are sufficient to account for the wider use of electrical service on the other side of the herring pond. Electrically, America has not had to contend, as we have here, with a strongly entrenched and admirably organised gas industry, which has piped every town in the country, and has established a sort of dingy but sacred tradition in ninety-nine houses out of every hundred.

Apart, however, from the question of extent of use, America lags, in many ways, behind English practice. Particularly is this so in what may be called the refinements of electric lighting—the little contrivances which mean so much in the way of convenience and adaptability. With regard to switches, for example, America is apparently only just realising the superiority of the tumbler switch for ordinary domestic use. At least, one must infer this from recent advertising in American papers, calling attention to a new form of switch, which can be turned on with the elbow if the hands are otherwise engaged.

In small houses and apartments, and probably in some large ones, wall switches do not seem to be used at all. Instead, the fittings are equipped with pendant switches which have to be found and operated in the dark. This has led some clever person to place on the market phosphorescent pins or tabs which can be attached to the switches. It is extraordinary that, in a country which is supposed to be teeming with genius, such alarming stupidity should be exhibited in the use of electric lighting; that its outstanding advantage of easy control should go almost unregarded. No doubt it is a little cheaper to dispense with wall switches, but cheapness is certainly not the ruling motive of American industry; indeed, the general tendency is to spend a great deal of money in order to save a little time or work. As evidence of this, one has only to consider the enormous sales of electric washing machines at an average cost of about £40. The only probable explanation of America's deficiency in wall switches is that people have simply not realised the, one would have supposed, evident advantages of being able to control the light at the entrance rather than at the end of an adventurous and frequently damaging passage half-way across the room.

In the matter of wall plugs, too, the American user of electric light is unfortunately situated. At present there is a sort of crusade in progress, advocating the installation of what are called "base-board outlets." Reading the advertisements and booklets issued in support of this propaganda, one is forced to the conclusion that, in the average American household, small cooking appliances, fans, portable lamps, &c., are generally connected to the lampholders of ceiling fittings. As these lampholders are always of the Edison screw type, one can imagine the disproportionate amount of trouble involved in connecting up, say, a hot-plate or hair-drier which is only wanted for a few minutes.

One visualises the average American house as being replete with every conceivable sort of electrical appliance, from a washing machine to an electric chair for the removal of superfluous kittens; and, if all these devices are connected to lampholders, our trans-Atlantic cousins must pass their lives amidst trailing clouds of flexible cord, using their lamps only on those rare occasions when the holders are not otherwise occupied.

With relief one notes that, as in the case of the switch, English practice is just beginning to find favour, and that a two-pin wall plug has recently been evolved. This, if generally used, will probably save a lot of time hitherto wasted in screwing home the absurd contraption at present employed. Unhappily, the American designer, although he had sufficient intelligence to see somewhat belatedly the advantages of the two-pin idea, seems to have made rather a bad job of the actual manufacture. Instead of providing substantial split pins, as in the English variety, he went in for thin brass strips which are bound to crumple up should one miss the holes at the first plunge.

America prides herself on her progress in the development of electric lighting fittings, and certainly in this respect her complacency is not altogether unjustified. Even in this department, however, she seems to have overlooked some of the small conveniences to which we in this country are accustomed. The counter-weight pendant, for example, is almost unknown in America; yet for certain purposes it is extraordinarily useful. It seems that the insurance companies are supposed to have some objection on the score of fire risk; but, as a matter of fact, this risk is practically non-existent. At any rate, the counter-weight is considered, and indeed has proved itself, to be entirely safe in this country.

It is possible that the Americans possess certain lighting conveniences of which we are as yet ignorant, but nothing they have could neutralise our advantage in the matter of intelligent switch design and location, and the free use of wall-plugs.

Apart from the lack of certain devices in America, there is also observable a degree of crudity and bad workmanship in electrical accessories which would be quite inconceivable in this country. Of course, many wiring accessories used in England are poorly made, but, in comparison with the fragility and unsound construction of the American varieties, they seem to be almost perfect. The threads of English lampholders, switches, &c., for instance, are often a source of irritation and delay, owing to insufficient tapering, but at least they *are* threaded and, once assembled, will remain so indefinitely. In the States, however, many devices, such as pendant switches, are made to fit together like a cigarette case or blacking tin. That is to say, there is no thread, the parts being kept together by the coincidence of a niche and a projection. Such a method of securing (save the mark!) the cover of an electrical device is simply abhorrent to the English mind.

To sum up, it may be said that America has advanced a great deal more than we have in the variety of its electrical applications, and in the degree of electrical saturation achieved in the larger towns. But no single wiring device has been perfected; while such matters as the design and convenient arrangement of switches and wall-plugs have been almost entirely ignored. The home of the multi-millionaire may be an Aladdin's cave of electrical delight, but the ordinary middle-class homes in America, although they may contain many heating and cleaning appliances rarely seen in this country, are a long way behind their English "opposite numbers" in respect of some of the elementary conveniences and refinements of electric lighting. In America, lighting seems to be a cheap and hastily arranged means of inducing the consumer to use an electric washing machine. In England, electric lighting is an end, and a very excellent end, in itself; although we must not, for that reason, allow ourselves to overlook the economic necessity of persuading the people of this favoured isle to use electricity for other purposes.

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THE DESIGN OF A SUPER-POWER STATION.*

By H. GOODWIN, Junr., and A. R. SMITH, of the General Electric Co., U.S.A.

THE general tendency towards the consolidation of existing power plants and transmission systems and the probability of the construction of super-power lines will undoubtedly result in the erection of large generating stations which can be operated at practically full load throughout the year. Whether such plants be located near coal mines where fuel is reasonably cheap or in localities where the transportation cost of fuel is considerable, the fact that the load factor is high will justify the construction of a most economical plant.

Apart from the economy of fuel based entirely on its present value per ton, consideration must be given to its possible value many years hence. Another fact that is often lost sight of is that the more coal consumed per kilowatt-hour the greater must be the capacity of boilers, stokers, and coal and ash handling facilities; and the greater the steam consumption the larger the piping, condensers and water tunnels. In brief, the cost of much of the apparatus that is necessary only for economic reasons may be largely offset by the reduction in cost of the essential apparatus because of the reduced demands on it.

The design herein described was developed for a particular condition where some of the fundamental considerations were: High fuel cost, moderately good load factor, extreme river floods, and high voltage underground distribution. This design is of recent origin, and has therefore not been fully developed; consequently some of the apparatus shown, particularly the boilers, economisers and pre-heaters, are proposed designs.

The more unusual features of the design are:—

High steam pressure, 350 lb.
High superheat, 350 deg. F.
Independent power supply for station auxiliaries.
Air pre-heaters for stokers.
All auxiliaries electrically driven.
Minimum overhead coal storage.
Simplicity of boiler-room building.
Outdoor switchgear for 66,000-volt distribution.
Means of cleaning circulating water tunnels and possible utilisation of circulating pumps in case of flood.

The ratings of the principal pieces of apparatus are:—

Seven main generators of 35,000 KW., 0.8 p-f., 43,750 K.V.A. capacity at 13,200 volts, 3-phase, driven by steam turbines.

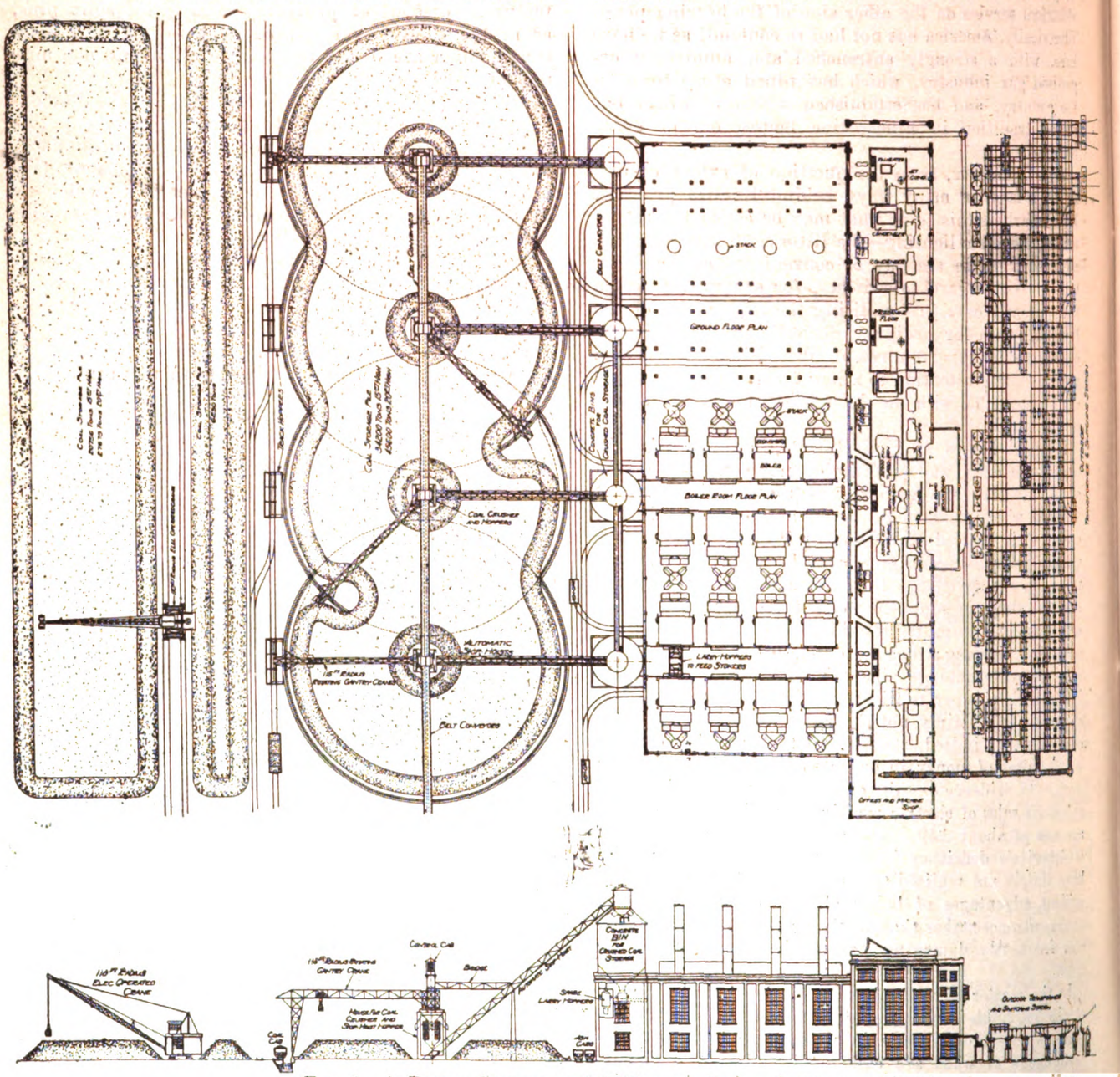

FIG. 1.—A POWER STATION OF 245,000 KW. PLAN AND ELEVATION.

Seven 45,000-K.V.A. transformer banks for stepping from generator voltage to 66,000 volts, each bank composed of three 15,000-K.V.A. single-phase units. One generator and one transformer bank are designated as reserve capacity.

Ten underground and two overhead feeders, all at 66,000 volts. The underground feeders will each be composed of three single-conductor underground lead-covered cables and will have an individual capacity of 45,000 K.V.A. The overhead feeder capacity is approximately 10,000 K.V.A. each.

The coal-handling equipment has been designed with the idea that the bulk of the coal will be unloaded from barges by means of travelling crane towers at the dock and transported by two belt conveyors directly to the four receiving hoppers and crushers. Fig. 1 shows the construction. There

* From the *General Electric Review*, May, 1920. Abstract.

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are no travelling trippers, as all belts are dead-ended. From the receiving hopper the coal is delivered directly to the outside storage or through a crusher and skip hoist to the overhead outside bins. These overhead bins are connected by an emergency belt conveyor so that in case of failure of a skip hoist, a crusher, or any part of a receiving hopper tower, the crushed coal can be transported from the adjacent overhead bin.

The intention is that one operator located in a control cab above each receiving hopper will operate the revolving gantry crane, the crusher, the skip hoist, &c. Another operator will be located on each electrically operated larry to transport and weigh the coal from the overhead bins to each boiler. The emergency coal storage handled by the locomotive travelling crane will be operated only when the excess coal is being stored or reclaimed.

It will be observed that the revolving gantry crane reclaims the coal from the circular storage without moving the bridge; thus, this method is very rapid when reclaiming coal, although in distributing the coal the bridge will have to be moved slightly from time to time, but to minimise this movement outside shoots are shown on the four sides of each receiving hopper tower. The revolving gantry cranes overlap so that coal can be transferred from one pile to another. The design shown can be partially built and extended from time to time without interfering with operation, or without changing existing structures.

high price of fuel than by the high load factor. Where the load is uniform the stokers must have a greater relative combustion area.

With the use of economisers and preheaters, induced-draught fans will be necessary because of the increased draught loss and the low temperature of gas entering the stacks. These fans might be of the ordinary plate type, or possibly of the multi-vane type, because the temperature is low and the pressure comparatively high. However, the induction type of stack employing high-pressure blowers may be substituted.

Both the induced-draught fans and the stoker blowers are in duplicate for each boiler, although each would be of only half the maximum capacity required per boiler.

Wrought tube economisers of the same construction as the boilers, that is, with headers inclined with relation to the tubes, are proposed. The economisers will be practically the same width as the boilers; thus, there will be no change in the sectional area of the flue connecting the boiler and the economisers. The economisers will be cleaned with steam soot blowers instead of scrapers, and it is anticipated that there will be no moist soot deposit because the water entering the economisers will first be heated to 150 deg. or 160 deg. with exhaust steam, thus bringing the temperature well above the dew point of the gases.

Special attention is called to the natural thermo-siphon flow of water in both the vertical tubes and the headers,

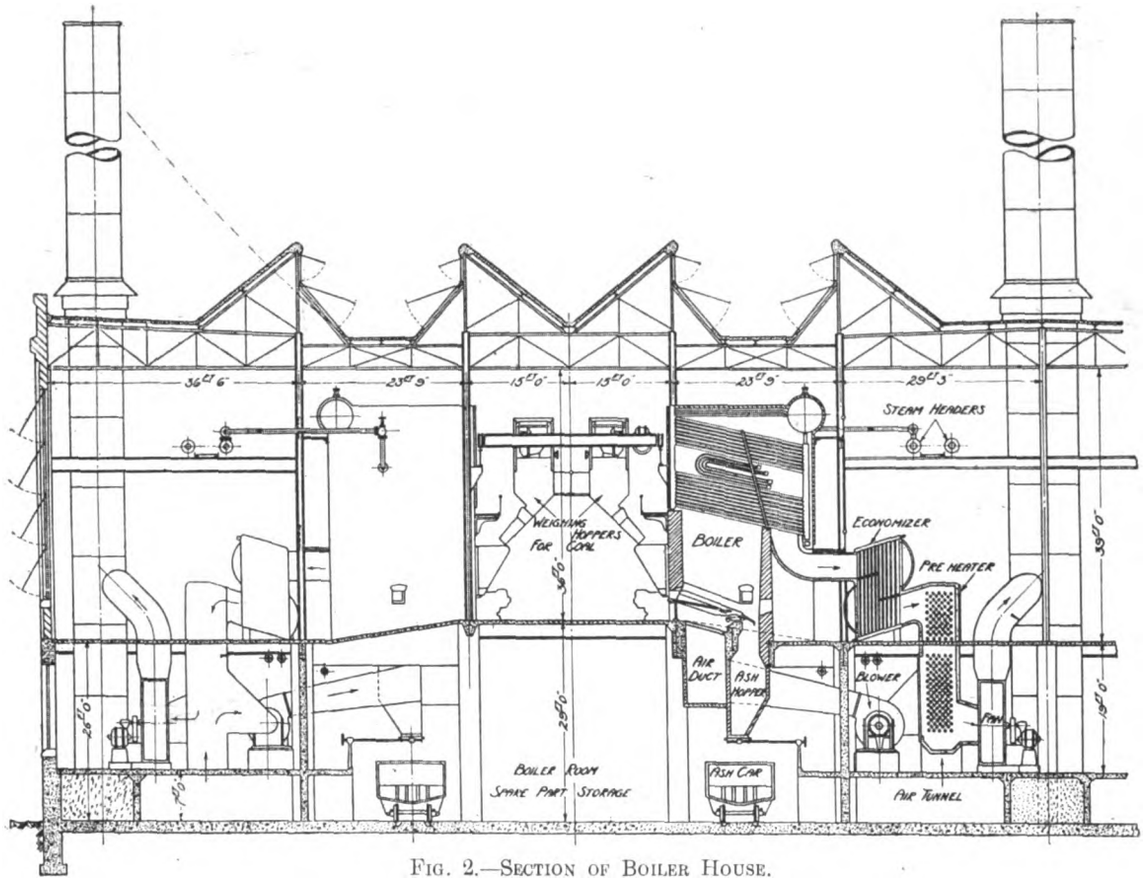

Fig. 2.—Section of Boiler House.

It is proposed to dispense with all kinds of ash conveyors, which are at best troublesome. The ash hopper under each boiler will be of such capacity as to contain 12 or 24 hours' storage so that ashes need be removed only once or twice during the day. The ash hoppers will empty directly into standard railroad cars, which will be hauled by a storage battery locomotive.

The boilers (shown in figs. 2 and 3) will have a rating of some 1,600 H.P. or 16,000 sq. ft. of heating surface. The proposed separation of the two banks of tubes with the superheater between is suggested for two reasons: First, to permit using a two-pass boiler and keep the economisers on the main floor, which means a greater number of tubes in height; second, to get a high amount of superheat without an excessive amount of superheat surface. The baffling of this boiler is simple. All of the heating surface should be effective, as there are no idle pockets, and the draught loss, because of the two passes instead of three, will probably be less in spite of the fact that the boilers may be several rows of tubes higher than the usual standard.

Four boilers per turbine are shown, but as there will be one spare turbine, there will naturally be four spare boilers, and some steam may have to be transmitted through the interconnecting steam header.

The "extra long" underfeed stoker has been shown, as the grate area must be commensurate with the increased heating surface resulting from a very high boiler. In this case the demand for economy was prompted more by the

and the counter-current flow of the gases and the water in the economisers; also, to the convenience of piping the feed water from the headers in the basement through the economisers to the boiler drums.

To avoid internal corrosion of the wrought steel economiser tubes, it is proposed to eliminate as completely as possible all air from the feed water, either in the condenser or between that and the economisers.

The air from each turbo-generator is discharged into a duct leading from the generator room to the end of the boiler house. This is shown clearly in fig. 3. The tunnel is shown in section in fig. 2. The far end of this duct, being open to the atmosphere, gives a free discharge for the generators in case no blowers are in operation, and any air required for the boilers over and above that supplied by the generator will be taken in at this end. From this main duct the air passes through the heating tubes in each preheater, the preheater being divided into two units per boiler to make a more practical design. With this arrangement the boilers nearest to the turbine room will burn the heated air discharged from the generators, whereas the boilers at the far end will burn the air from outside.

Preheaters have not been in general use in stationary plants, although they have been applied for many years on board ship. If the cost of coal is at all high, they can undoubtedly be made to show a good return on the investment.

On account of the high pressure and high superheat involved, it is proposed to simplify the steam piping as much

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as possible. There are no steam headers in the general sense of the word, but there is a transfer header for equalising pressures and transferring steam between boiler rooms. The omission of all steam-driven auxiliaries except the house or auxiliary turbines, of which there is one for every two main units, greatly simplifies the steam piping, and materially reduces the cost of the plant.

should be arranged so that either one can be taken out of service for cleaning or for repairs. This statement applies most forcibly to the intake tunnels, which invariably fill up with sand or silt. Sluice gates have therefore been shown connecting between the intake tunnels and a centre chamber. There is one centre chamber for each main turbo-generator; thus, any one or all the circulating pumps can get suction

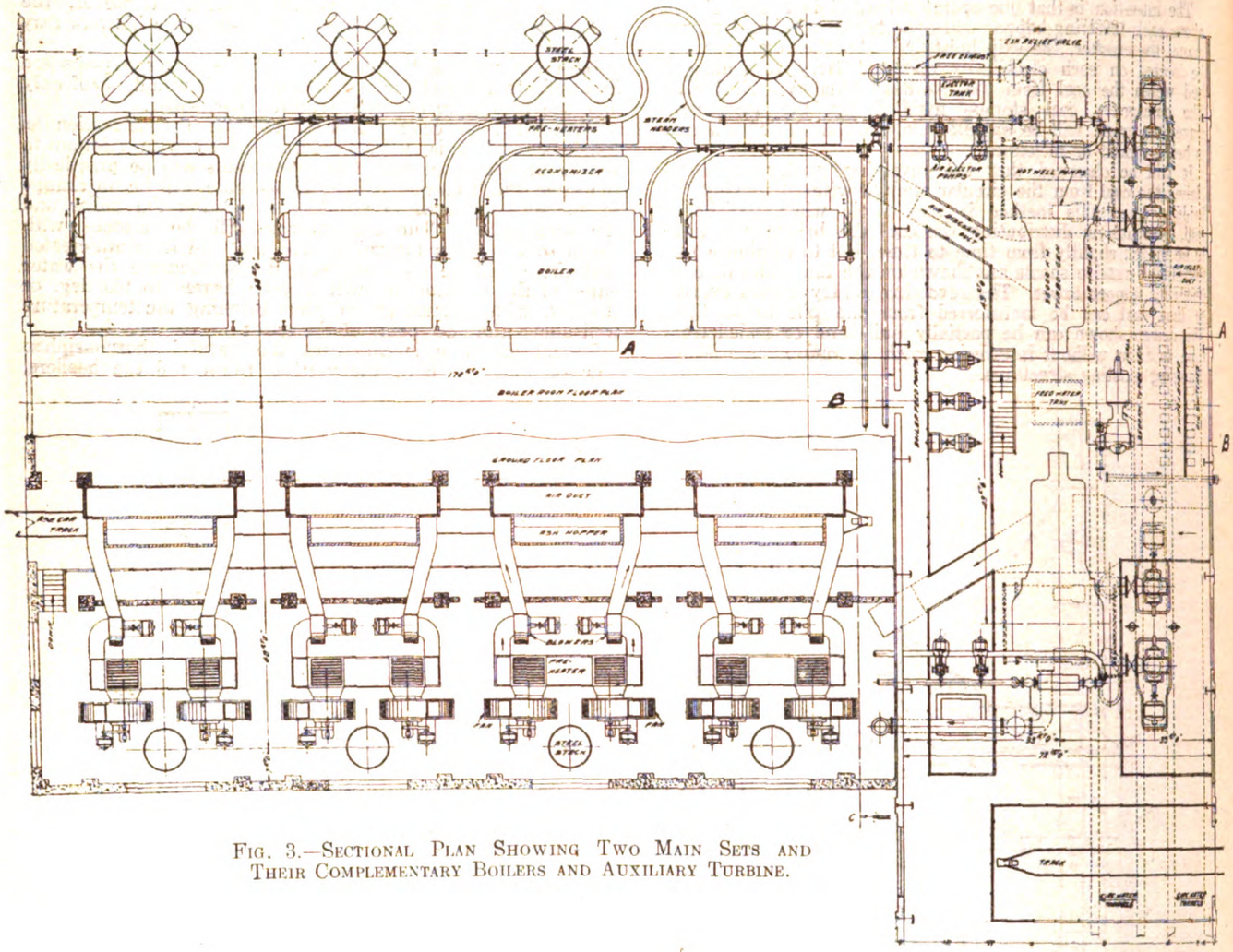

Fig. 3.—Sectional Plan Showing Two Main Sets and Their Complementary Boilers and Auxiliary Turbine.

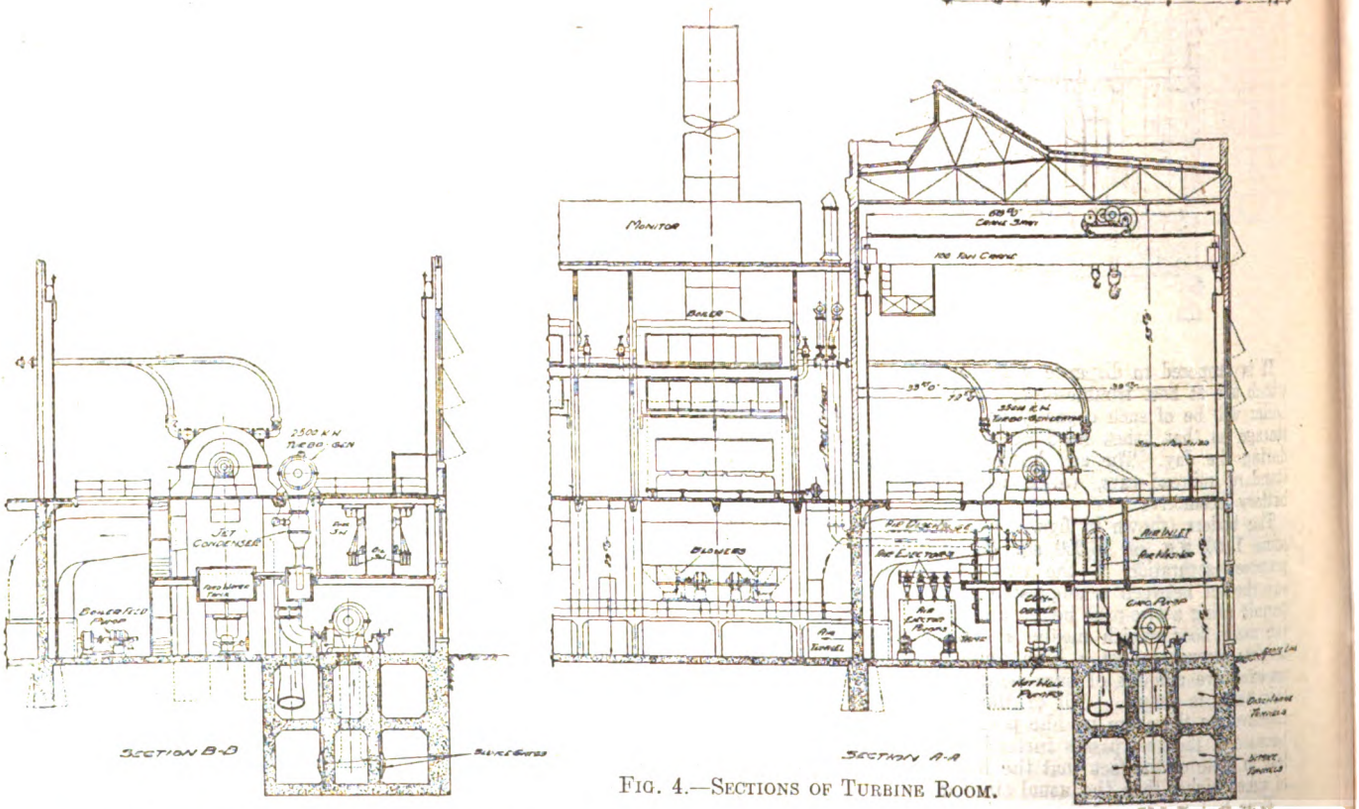

Fig. 4.—Sections of Turbine Room.

There is a group of feed pumps for each boiler room. The piping, therefore, can be segregated in a most advantageous manner and the sizes of the pipes kept very small.

Fig. 4 shows a cross section of the turbine room, and below this the circulating-water tunnels. On account of the large size of these tunnels it appeared best to divide them into two parts. With two intake and two discharge tunnels they from either tunnel. In the event of a flood with the water entering the power station basement, any one or all of the circulating pumps could pump this drainage by simply closing the sluice gates on both sides of any or all of these centre chambers.

The discharge tunnels are connected together to reduce the head loss.

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The very high steam temperature involved with 320 deg. F. superheat at 325 lb. gauge at the turbines practically precludes the use of any small steam-driven auxiliaries, such as boiler feed pumps, &c. Since the water in the boilers would be evaporated to a dangerous level in a very few minutes, were the boiler feed shut off, a most reliable source of power must be provided for the supply of boiler-feed water. Power for driving the feed pumps is not considered sufficiently reliable when supplied from the main bus-bars.

In order to provide a very reliable supply of power to drive all essential station auxiliaries electrically, it is proposed to use one 2,500-KW.. auxiliary or house turbine for each pair of main turbines. Each house turbine will be provided with a low jet condenser which will normally produce about 15 inches of vacuum. The circulating water for this condenser is the condensate from the main units.

The auxiliary power and therefore the load on the house turbo-generator will not be proportional to the load on the main units; consequently, with a fluctuating quantity of circulating water the vacuum will tend to vary through a wide range. It is therefore intended that the house alternator be paralleled with the main bus so that a portion of the auxiliary load can be shifted automatically or manually from the house alternator to the main alternators to maintain a constant vacuum under all conditions. This electrical interconnection would be so made that a drop in potential or a lowering of the frequency, due to disturbances on the main system, would automatically disconnect the two and keep the auxiliaries connected to the house alternators.

In order to provide for a constant flow of water through the condenser of the house turbine, some of the water may be recirculated. In other words, if a condenser is designed for a quantity of water equivalent to ¾ load on two main units and only one main unit is in operation, the circulating pump for the house turbine condenser will recirculate half of the water. This condenser obviously serves as a feed-water heater. The tank shown just in front of the condenser (fig. 4) is a storage or surge tank for the boiler feed supply. This performs an important function, because it is impossible to feed the boilers at the same rate as the condensate is being returned from the main condensers. This surge tank therefore equalises the discrepancy and prevents overflowing of hot distilled water and the use of excessive cold, raw, or treated water.

The main condensers are of ordinary standard design, each being supplied with two circulating pumps, two hot-well pumps, and two air pumps. The hot-well pumps are each of full capacity. The others are of half the maximum capacity. It is expected that with a reasonably tight condenser system only one air pump will have to be operated at a time, and in case of very cold water one circulating pump will be sufficient. One circulating pump may give 60 per cent. to 70 per cent. of the capacity of two pumps, due to the reduction in condenser and pipe friction resulting from the reduced flow of water.

The condensers will be mounted on springs to take care of expansion and to avoid the introduction of an expensive and undesirable expansion joint between the turbine and the condenser.

All of the power supply for the less essential auxiliaries, such as cranes, coal lorries, conveyors, lighting, miscellaneous pumps, &c., will be from transformers connected to the main bus and supplied through a switchboard located in the first gallery. All the essential auxiliaries, such as condenser pumps, feed pumps, blowers, &c., will be controlled from switchboards located on the main turbine room floor at each auxiliary turbine. The operator at the switchboard will have immediate control of all the turbine-room auxiliaries within his vision and the control of the supply of power to all of the boiler-room auxiliaries supplying that particular section of the turbine room; thus, there will be four switchboard operators on the turbine room floor in addition to the main switchboard operators in the galleries.

(To be continued.)

British Canals.—The Development Department of the Sheffield Corporation is pursuing its programme of canal development, and is now making representations to the Ministry of Transport for the improvement of the canal system linking Sheffield with the Humber ports. The interest of Rotherham, Doncaster, Mexborough, and Thorne traders has been secured, and it is hoped that the necessary pressure may be placed upon the Government to secure the carrying out of the scheme. The proposal put forward is that the Sheffield and South Yorkshire Navigation shall be acquired by the Government or another public authority and that the canals which link the South Yorkshire industrial area through the Trent and Ouse with the Humber shall be widened and deepened to enable boats drawing 7 ft. of water and having a capacity of 110 tons to be used without the need of transhipment. The estimated cost of the improvement scheme is £1,750,000, and to this has to be added the purchase price for the Sheffield and South Yorkshire Navigation Co.'s Waterways.—*The Times.*

ECONOMICAL SUPPLY OF ELECTRIC POWER IN THE UNITED STATES.

A SUPER-POWER ZONE.

THE proposal that a super-power zone be created in the U.S.A. in a section of the North-East Atlantic seaboard, calls for the electrification of the railways and industries in this congested district, and for the installation of comparatively few large generating stations to economically supply the necessary electric power. This plan, and some of the engineering problems it involves, were presented at the mid-winter convention of the American I.E.E., held at New York in February last, in the form of a symposium, by ten of the leading consulting, designing, and power-plant engineers, and discussed by a number of others. The following details of the scheme are abstracted from *Power*. Mr. W. S. Murray briefly outlined the plan as providing a means by which a present estimated plant capacity of 17,000,000 H.P., divided into 10,000,000 for industrial purposes and 7,000,000 for the railroads, in a region 450 miles long, between Boston and Washington and extending inland from the coast 150 miles, now operated with a load factor not exceeding 15 per cent., could be lifted to a load factor greater than 50 per cent., and a means by which one ton of coal would do the work of two, and the railroads within the above zone and those carrying coal into that zone would be relieved of transporting one-half of the amount required for power and lighting purposes. The value of machine capacity from a utilisation standpoint would be increased from threefold to fourfold, and coal resources for the purpose named would be conserved twofold. This means that a present plant capacity of 17,000,000 H.P. can be replaced by one not greater than 5,500,000 H.P., and that not less than 30,000,000 tons of coal per annum can be saved, which at $5 per ton will represent $150,000,000 per year.

"Besides the foregoing savings, two great departments of economy will be created; one applying both to the railroads and industries, in the reduced cost of maintenance of machinery, and the other applying to the railroads alone in the reduction of train miles. It is estimated that these latter economies will effect a saving of another $150,000,000 annually, thus making a saving of $300,000,000. The foregoing are the direct savings as estimated from data collected from actual past operation o fthe specific order contemplated to be put into force in the zone under consideration.

"This plan offers immediate relief from the present intolerable congestion of our railroads by automatically increasing rail capacity without increasing track mileage, and reducing power equipment to a minimum; the present cargo space now required for industrial coal will be cut in half; train equipment in all classes will have its service practically doubled, and the present steam-power equipment, replaced by electrical equipment, can be transferred to other divisions where it is so vitally needed."

Mr. W. L. R. Emmet pointed out that "the best steam-turbine station equipment, operating under favourable conditions, can deliver a H.P.-hour in the form of electricity with an expenditure of one pound of coal, where four pounds are required to deliver a H.P.-hour to the draw bar of a good locomotive. While the comparison of efficiency between the large power station and the smaller engine or turbine equipment used in small stations and isolated plant is less striking than that with the locomotives, it is nevertheless highly unfavourable to the small plant."

Mr. J. F. Johnson expressed the opinion that "Reliability would have to be the first aim of the designer. Generating stations of some 200,000- to 300,000-KW. capacity, employing generating units of some 60,000- to 75,000-KW. capacity, each operated on steam conditions of 300-lb. pressure, 200 deg. F. superheat, and 29 in. vacuum referred to a barometer of 30 in., would involve no difficulties of design, construction, or operation, and from such stations a steam consumption rate of 10 lb. or less per KW.-hour and a total station rate of less than 1.5 lb. of good quality coal per KW.-hour output should be obtained."

Mr. H. G. Reist said: "So many generators of from 30,000 to 50,000 K.V.A. are at present in operation, giving satisfactory service, that there need be no hesitancy in considering generators as large as those now in use or larger. The potential of these generators should be within the limits of our experience; that is, not above 18,200 volts, and preferably lower, if this does not cause inconvenience in the lines leading from the generators to the step-up transformers. The losses may be expected to be less than 2 per cent. of the output of the machine. On account of the great capacity of the lines in such a large system, there may be some advantages in the use of induction generators. Roughly, the size of induction generators would probably be from 25 to 30 per cent. larger than a synchronous generator and the cost of the machine in proportion."

Mr. F. D. Newbury's point of view was that "the generating element in the proposed system does not involve anything new or untried. Any probable station could be designed with steam or electric generating units of a size now available. Suppose we assume a station of 300,000 to 500,000 KW. total capacity. We have available single-shaft generating units up to 40,000 KW. with generators of 50,000-K.V.A. capacity. The preferred speed for such units would be 1,200 R.P.M., 60 cycles. Eight to twelve such units would give the assumed

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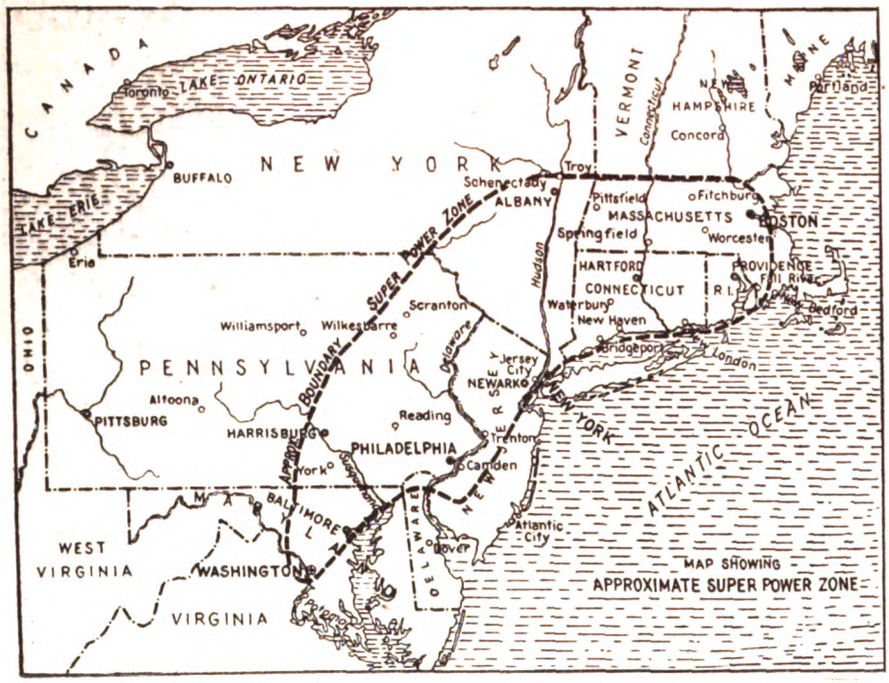
total station capacity. There have been developed and built triple-shaft compound units of 60,000 KW. Five to eight such units would constitute as large a station as has been suggested. All the generating units referred to are actually conservative in size, and by no means represent the largest unit of the speed in question that could be designed."

From a consideration of data available on railway operation, Mr. W. B. Potter draws the conclusions that "of the whole mileage included in the zone, a not very large proportion has been electrified. The traffic within the zone now handled by steam locomotives, if handled electrically, would require an average output of less than 750,000 KW., and if produced entirely by coal-burning electric power stations, would reduce the coal requirements for transportation purposes from 21,000,000 to 7,000,000 tons annually. As a certain proportion of electric power would be produced from hydraulic power stations, this coal requirement would be reduced in proportion as advantage is taken of hydraulic operations. The reduction in cost of maintaining the motive power units would be a large amount, which, estimated from the locomotive mileage, would be of the order of $15,000,000 or more annually.

Mr. Philip Torchio discussed the relative values of water versus steam-power development, and said: "The Western States, Mountain, and Pacific, have resources in both coal and water to meet indefinitely all the heat and power required from either source of supply, the potential water powers alone being large enough to supply over six times all the heat and power requirements in 1915. The other States, with corresponding heat and power requirements forty times greater than the Western States, have actually smaller resources in coal and potential water power, the latter capable of supplying only 8 per cent. of their total heat and



MAP SHOWING THE PROPOSED SUPER-POWER ZONE.

power requirements. It follows, then, that these States must indefinitely, as far as present human knowledge can foresee, depend upon the use of coal to supply the great bulk of these needs. These States, comparatively so deficient in water powers, consumed in 1915 528,000,000 tons of coal, about one-half for generating power and one-half for generating heat. They obtained an average efficiency from coal of 5 per cent. for the power and 50 per cent. for the heat."

In a comparison of the cost of steam power plant and hydroelectric developments, Mr. Torchio pointed out that the former cost about one-third to one-quarter that of the latter, consequently one dollar invested in steam plant would make available several times more power for industries than a dollar invested in hydroelectric plant. The author urged development of water powers especially in connection with electrochemical and metal refining processes using immense amounts of power continuously, where the net cost of hydro-electric power may be considerably less than steam power.

Mr. Percy H. Thomas assumed a transmission line extending from Lawrence, Mass., to Washington, D.C., operating at 250,000 volts, with tap lines running to the various sources of power and large centres of power consumption, and showed that it was within the scope of present engineering practice to construct and operate such a system. (See ELEC. REV., Sept. 19th, 1919, p. 371.)

Mr. J. W. Lieb called attention to the fact that an adequate power supply was one of the most important economical problems before the nation at the present time. The engineer should view the problem with a broad national outlook, and not make the mistake of the railroads by a battle over the different systems. The speaker referred to the question of both voltage and frequency making the problem involved, and illustrated this point by experience during the war, when New Jersey was short of power, and in New York City 100,000 H.P. was available, but could not be connected with New Jersey's power system on account of a difference of 2½ cycles between the two systems; this difference, however, no longer existed, since the New York Edison Co. had recently changed the frequency of its system from 62½ cycles to 60 cycles. Mr. Lieb laid great stress on the necessity of continuity of service, and said that in a community like New York City, the seriousness of interrupted service, even for a short time, would be impossible to exaggerate.

REVIEWS.

Wireless Transmission of Photographs. By MARCUS J. MARTIN. Second edition, revised and enlarged, 1919. 143 pages. London: Wireless Press, Ltd. Price 5s. net.

This book should prove of interest to two classes of readers. To the serious worker engaged in endeavouring to produce a commercially efficient method for the transmission of photographs by wireless telegraphy it gives an up-to-date account of the work which has already been done in this field, and suggests the lines along which progress might most profitably be made. On the other hand, to the amateur, who is, perhaps, not sufficiently trained in mathematics and physics to carry out quantitative experiments with wireless gear, and who finds, after he has constructed his ordinary wireless apparatus and used it for a little while, that his interest in the subject has begun to flag, it offers a new field in which his inventive talents and mechanical ingenuity can have full play, and of which he will be long in exhausting the possibilities.

The book is divided into five chapters, to which are added three appendices.

In the introductory chapter a brief account is given of the work which has already been done in the transmission of photographs over land-lines and cables, and of the difficulties which are met with due to the retarding effect of the capacity of the line. The second chapter deals with transmitting apparatus, and the third with receiving apparatus used for sending photographs by wireless telegraphy.

The problem of driving the transmitting and receiving gear in synchronism with one another is discussed in the fourth chapter, while in the fifth chapter a description is given of the "Telephograph," a system for the transmission of photographs by wireless telegraphy devised by the author. In addition, this chapter contains some useful information on the Nernst lamp, and on photographic films.

Appendix A deals with the construction and action of the selenium cell. In appendix B detailed instructions are given for the preparation of the photographs on metal plates, by which the actual transmission is controlled, and in appendix C a brief outline is given of the theory of the action of lenses as used in photography.

We notice, on page 57, when describing the receiving apparatus, in which the final reproduction of the image is brought about by means of a Bain chemical recorder, that the author expresses surprise that the point of the iron stylus used as the electrode shows signs of wear after it has been in use for some time. He remarks that "no explanation of this peculiarity on the part of the stylus can be given, as there is nothing very corrosive in the solution used, and the pressure of the stylus upon the paper is so slight as to be almost negligible." We do not think that any of our readers with a knowledge of the elementary facts of electrolysis will share in the author's wonderment at the wearing away of the stylus!

There is very little else in the book which we have to criticise. The printing is good, the descriptions of the various pieces of apparatus and the diagrams are clear, and anyone with a small workshop at his disposal should be able to make most of the apparatus required to carry out experiments in this fascinating branch of wireless telegraphy.

Graphical and Mechanical Computation. By JOSEPH LIPKA, Ph.D. London: Chapman & Hall, Ltd. Price 18s. 6d.

This book describes how to draw up alignment charts (also called nomographic charts or abaci) of all types, and should be of use to engineers and designers whose work entails the solution of equations or formulæ such as Hazen's for the

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velocity of water flowing in pipes, $u = c\,\mu^{0.63}\,(h/l)^{0.54}$, where u = the velocity, μ = hydraulic mean depth, h = height, l=length, h/l=slope of pipe; c is a constant depending on the material of the pipe. To calculate u numerically, c, μ, and h/l being given, is laborious. If a nomographic chart is drawn, the values of any two quantities can be read off at once when the other quantities are given.

The author explains how various types of chart, *i.e.*, plain, Z V, &c., can be drawn. Twenty-nine detailed charts are given, such as those for giving deflection of beams, adiabatic expansion of gases, flow of water according to various formulæ, discharge of gases through an orifice, H.P. transmitted by belting, &c. Chapter I deals with scales, ordinary slide rules, log—log rules, circular slide rules, &c. Chapter II deals with log paper and solution of equations by co-ordinate paper; some of the methods of solution and types of graph are seldom used or mentioned in the English technical Press. Chapters III, IV and V deal with nomographic charts; this forms the most important portion of the book.

The well-known chart for finding the combined resistance of two or more parallel resistance paths is given on pages 41 and 104.

To assist engineers in drawing up charts, two sheets of transparent paper, one with uniform scaling and with square root scaling and one with log scaling are enclosed in the book. These types of scaling can thus easily be marked off on lines less than 25 cm. long, and charts can be quickly made. On page 107 the author explains the derivation of charts with curved lines, representing formulæ such as $Q=3.33\ (B-0.2h)\ h^{3/2}$ where Q=quantity of water, B=width of weir, h=head of water. Many examples are worked out, and many exercises are given for students to practise upon.

Chapter VI describes the deduction of empirical formulæ to represent observed data, and the determination of suitable constants either by selection of particular points, or by averages or by the method of least squares. The figures showing typical parabolas, hyperbolas, exponential curves, and $y=x\ (a+bx)$ curves, may be of use in suggesting a solution to engineers who are not familiar with the aspect of such curves, when they are trying to find the law of a curve to represent a set of physical observations.

On page 152 *ff*, the derivation of constants in equations of the form $y = a + bx + c\,e^{dx}$, and $y=a\,e^{dx} + c\,e^{dx}$, is described exhaustively.

At the end of Chapter VI are 47 examples, observed values of data from various engineering tests are quoted (along with the type of law underlying them in some cases). The student has to deduce the numerical values of the constants for himself. These exercises will be valuable for students. Chapter VII deals with the derivation of numerical coefficients of periodic curves by means of Fourier's series. References are given to other papers and books on the subject and to mechanical harmonic analysers, two of which are described in fair detail.

Chapter VIII deals with interpolation, by graphical estimation, by the use of successive differentiation and then by Newton's interpolation formula, and Lagrange's formula.

Chapter IX deals with numerical integration and differentiation, and mentions various mechanisms for performing such work. This subject is more widely known than the alignment charts dealt with in the earlier portions of the book, but should be of considerable use for reference when dealing graphically with the results of tests and observations.

It might have been convenient if in addition to footnotes, references to books had been collected in one place; the index though fairly complete, might have a few additional entries giving directly the reference to charts, viz., "water flow," or "flow of water," pages 58, 109, &c., instead of only being referred to under "Charts."—A. B. EASON.

Education and Training for the Electrical and Allied Engineering Industries. Pp. 64. 1920. London: Edwin Arnold. Price 3s. 6d. net.

This little book is the Report of the Education Committee of the British Electrical and Allied Manufacturers' Association, which was appointed during the war by the Council of the Association with directions to consider the whole subject of technical education in the electrical and allied industries, and to suggest a uniform system. The committee consisted of ten representatives of various sections of these industries, of whom the chairman was Mr. A. P. M. Fleming, C.B.E., who has for several years shepherded the apprentices of what is now the Metropolitan-Vickers Electrical Co., Ltd.

The work occupied a little less than two years, and when it is considered that nearly every manufacturing firm of importance has devoted a great deal of thought to this important question, and that many have taken action, necessarily independent, on the lines which appeared best to themselves, it will be agreed that the co-ordination of this "immense amount of unrelated work" (to use the words of the preface), and its presentation to the public in permanent form, has been accomplished in a remarkably short space of time.

The individuals who are intended to be brought within the scope of the scheme are classified into: (1) Trade apprentices; (2) engineering apprentices; (3) student apprentices; and (4) research apprentices. These are to be trained respectively to become: (1) Skilled workmen, foremen, &c.; (2) members of engineering, commercial, erecting, drafting, testing, or other staffs; (3) senior officers of the same staffs; and (4) members of the research staff.

The several classes of apprentice are to be drawn from different classes of educational establishment, ranging from the primary school to the university, and at various ages between 14 and 22 years. The research apprentices would be selected from the student apprentices, and given a post-graduate research course.

The importance of careful selection is duly emphasised, and the organisation of games, so that team-work in after life may not be unfamiliar, is recommended. It is pointed out that practical training is a vital necessity in every case.

The situation as regards scholarships is surveyed, and recommendations are made that more should be founded. This is in agreement with the policy we have for many years advocated, and we feel that if the industry in general, and the British industry in particular, is to make the strides which in the whole world's interest it ought to make, it is an essential condition that in no case shall talent be withheld or diverted by reason of the lack of pecuniary support for its development.

The committee has arrived at a somewhat strange conclusion in paragraph 65, page 43: "Hitherto the scholarship system in Great Britain has been directed almost exclusively towards encouraging students to enter the so-called learned professions —law, medicine, teaching, and the Church. Scholarships founded in recent years for the express purpose of encouraging those engaged in industry to obtain technical training have frequently merely provided recruits for the staffs of technical institutions and universities." No doubt evidence was brought before the committee which appeared to justify this view, but there are very many individuals engaged in industry who owe their technical training entirely to the facilities provided by scholarships. It is, of course, only to be expected that the older branches of learning should be more adequately provided for in this respect, but we think it highly probable that the technical engineers engaged in industry who are scholarship men outnumber considerably the whole of the technical teachers of the country. The proportion of scholarship-trained teachers is doubtless higher than the proportion of scholarship-trained engineers, but this does not prove the accuracy of the committee's conclusion, and we should like to see more of the facts—if any—on which it was based.

With the recommendations for a uniform system we are in cordial agreement, and the B.E.A.M.A. is to be congratulated on having produced a report which, if acted upon, will exercise a great influence on the future of our industry.

Principles of Radiotelegraphy. By C. M. JANSKY. London: Hill Publishing Co. Price 8s. 6d. net.

This is a well-compiled work of some 236 pages and 179 illustrations in eleven chapters. The general get up is in accordance with the usual high standard of the McGraw-Hill Co. The opening chapters deal with elementary electric and magnetic principles, tersely but quite effectively. The subject of electric waves is reached in Chapter V, and is dealt with in a way that is calculated to appeal well to students. The method of explanation of waves as pulses thrown along electric strain lines in a field of force is, however, open to some criticism, and perhaps rather dangerous to students. The strength of an electric field is, in general, proportional to the inverse cube of the distance from the charge, whilst wave intensity is only as the inverse square. Wave energy travels to distances and reaches positions from which the electric lines are completely cut off. Wave motion along the electric lines is therefore not a good explanation. Elementary alternating current theory is dealt with in Chapter VI, and the remaining chapters deal with subjects which may be properly regarded as immediately concerning radiotelegraphy. The distinguishing characteristics of different methods and systems of wireless telegraphy are fairly well treated, but expressions occur occasionally which require modification. For instance, on page 182, the energy radiated *per second* from an antenna is said to be 14.3 KW. The final chapter deals satisfactorily with the vacuum tube as a receiver and amplifier, though the author seems to be rather over imbued with the electron theory of electric currents without adequate grounds.—J.E.T.

Iron Losses in A.C. Fields.—It is not always possible to eliminate all iron parts from high-frequency apparatus. The losses in iron exposed to such fields have been examined, according to the German Physical Society, by producing the field in a coil into the field of which iron parts could be brought. The coil and iron parts were immersed in a calorimeter for the determination of the losses. It was found that placing a sheet of iron of 315 mm. diameter and 2.6 mm. thickness in front of one end of the coil 16 mm. from the end of the coil increased the effective resistance of the coil to 2.3 times its value without the iron, and the insertion of an iron tube of 3 cm. diameter and 2.6 mm. thickness into the interior of the coil increased the effective resistance seven-fold. The coating of the sheet of iron with a deposit of 0.3 mm. of copper, or 0.1 mm. of zinc eliminated the additional losses completely.—*Technical Review.*

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EXPORTS AND IMPORTS OF ELECTRICAL GOODS FOR MAY, 1920.

The May returns of electrical business show considerably increased values in the export section, as compared with the previous month, and an increase of, roughly, £50,000 on the March total of £1,102,781.

The electrical exports for May reached the total value of £1,150,234, as compared with £940,014 for April, an increase of £210,220. This excellent result is largely accounted for by the increase in insulated wire exports of £147,000; telephone and telegraph cable and apparatus, £40,000; and electrical goods, £35,000; while batteries, meters, and lamp exports reached higher values than in April, machinery exports fell off in value to the extent of about £40,000.

The electrical imports for the month were valued at £193,255, as compared with £189,597 for April, decreases occurring in batteries, machinery, and telegraph and telephone imports, but in other directions increased values obtained.

The re-exports for May at £18,699 show a slight increase on the previous month's total of £15,494.

The total weight of electrical machinery exported during the month amounted to 697 tons, as compared with 1,102 tons in April, and 809 tons in May, 1919, and 2,347 tons in May, 1913.

VALUES OF ELECTRICAL EXPORTS AND IMPORTS FOR MAY, 1920.

	Exports.	Imports.	Re-exports.
Electrical goods and apparatus (unenumerated)	£162,583	£61,092	£8,507
Insulated wire	413,350	17,705	1,572
Glow lamps	20,511	6,169	308
Arc lamps and parts	2,620	1,224	230
Batteries...	48,514	3,273	22
Meters	44,170	5,048	328
Carbons	10,687	8,694	1,626
Electrical machinery :—			
Railway and tramway motors...	6,577	—	—
Other motors and generators ...	83,875	—	—
Elec. machinery (unenumerated)	54,572	61,838	2,786
Switchboards (not telegraph or telephone)	5,174	20	—
Telegraph and telephone cable and apparatus :—			
Telegraph and telephone wires and cables (not submarine)...	98,621	254	—
Submarine telegraph and telephone cables	107,527	—	—
Telegraph and telephone instruments and apparatus ...	91,453	7,938	3,320
	£1,150,234	£193,255	£18,699

NEW PATENTS APPLIED FOR, 1920.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by MESSRS. SEFTON-JONES, O'DELL AND STEPHENS, Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

14,721. "Electric fuses." G. AUSTIN. May 31st.
14,732. "Method for generating electrical energy." R. NORRBY. May 31st. (Sweden, February 24th.)
14,741. "Sound-wave amplifying devices." E. G. BEKEN, T. E. B. CHALMERS and F. R. SWINBURNE. May 31st.
14,759. "Duplex electric ignition systems for internal-combustion engines." E. E. EDWARDS. May 31st.
14,770. "Electric lamp for cycles." R. FRAUENFELDER. May 31st. (Switzerland, July 23rd, 1919.)
14,774. "Electric meters." BRITISH THOMSON-HOUSTON Co. (General Electric Co.). May 31st.
14,775. "Manufacture of incandescent electric lamps." BRITISH THOMSON-HOUSTON Co. (General Electric Co.). May 31st.
14,802. "Electric water-heaters." L. J. SCHNEIDER. May 31st.
14,807. "Supports for filaments for thermionic valves." H. MORRIS-AIREY, A. K. MACRORIE and G. SHEARING. May 31st.
14,812. "Means for electrically reciprocating hammers, pistons, plungers, &c., for rock drilling, &c." G. F. D. CAMPBELL, J. KNIGHT and J. TATTERSALL. June 1st.
14,815. "Arrangement for automatically indicating train arrivals and departure, &c." AUTOMATIC TELEPHONE MANUFACTURING Co. June 1st.
14,829. "Electrical plug-and-socket switches." J. A. CRABTREE. June 1st.
14,832. "Fittings for erection of screwed tubing in electrical installations." G. A. COTTON. June 1st.
14,838. "Driving gear for ignition magnetos." ALBION MOTOR CAR Co. June 1st.
14,849. "Wristlet electric light." F. T. BARROW and L. A. DAYLEY. June 1st.
14,870. "Combined electric switch and plug coupling." G. MARR. June 1st.
14,873. "Electric switches." REMY ELECTRIC Co. June 1st. (United States, June 11th, 1919.)
14,891. "Ignition device for internal-combustion engine." OESTERREICHISCHE WAFFENFABRIKS-GES. June 1st. (Austria, February 15th, 1917.)
14,899. "Relay-contact and method of making same." F. L. DODGSON. June 1st.
14,900. "Train control system." F. L. DODGSON. June 1st.
14,979. "Protective systems." BRITISH THOMSON-HOUSTON Co. (General Electric Co.). June 2nd.
14,986. "Mine signalling systems." W. C. DAVEY and STERLING TELEPHONE & ELECTRIC Co. June 2nd.
14,995. "Electric signalling systems." WESTERN ELECTRIC Co. June 2nd. (United States, September 20th, 1918.)
14,998. "Electrically heated tubes, muffles, &c." MORGAN CRUCIBLE Co. and G. I. PAYNE. June 2nd.
15,010. "Apparatus for cooling electrodes." SIEMENS-SCHUCKERTWERKE. June 2nd. (Germany, June 4th, 1918.)
15,018. "Electric lamps." J. D. DRYSDALE (Crickmay). June 2nd.
15,050. "Galvanic batteries." G. FULLER and FULLER'S UNITED ELECTRIC WORKS. June 3rd.
15,075. "Electro-magnetic relays." CREED & Co. and T. LENAGHAN. June 3rd.
15,076. "Telephone systems." CREED & Co. and T. LENAGHAN. June 3rd.
15,083. "Impulse-transmitters for telephone systems, &c." F. BAKER and SIEMENS BROS. & Co. June 3rd.
15,089. "Protective mountings for electrical apparatus." WESTERN ELECTRIC Co. June 3rd. (United States, November 24th, 1917.)
15,111. "Tool for electric cable stripping." E. A. CLAREMONT and G. H. SCHOLES. June 3rd.
15,120. "Electrodes for vacuum tubes, &c." L. GUINET. June 3rd. (France, December 26th, 1918.)
15,124. "Sparking plugs." BREWSTER-GOLDSMITH CORPORATION. June 3rd. (United States, June 9th, 1919.)
15,129. "Manufacture of electric incandescent lamps." E. R. GOOTE. June 3rd.
15,137. "Electrical power-transmission systems." A. M. TAYLOR. June 4th.
15,180. "Electrically-operated indicator or annunciator." L. DE M. G. FERREIRA and SIEMENS BROS. & Co. June 4th.
15,188. "Electric arc welding, &c., and electrodes therefor." C. J. HOLSLAG. June 4th.
15,195. "Modulated wireless, &c., signalling systems." N. LEA and RADIO COMMUNICATION Co. June 4th.
15,196. "Electric foot and food heater and vaporiser." L. A. EDWARDS. June 4th.
15,202. "Reactance or choke coils." F. E. BERRY. June 4th.
15,205. "Galvanic batteries." G. & J. OLDHAM. June 4th.
15,206. "Electric lamps to be carried on the person." G. & J. OLDHAM. June 4th.
15,210. "Telephone exchange systems." WESTERN ELECTRIC Co. June 4th. (United States, August 23rd, 1919.)
15,222. "X-ray plant." G. HUBERS. June 4th. (Germany, March 27th, 1916.)
15,223. "X-ray plant." G. HUBERS. June 4th. (Germany, Aril 8th, 1916.)
15,235. "Electric switches." J. D. SPARK. June 5th.
15,253. "Electric fuse carriers, &c." BRITISH INSULATED & HELSBY CABLES, LTD., and E. HONNOR. June 5th.
15,258. "Telephone systems." WESTERN ELECTRIC Co. June 5th. (United States, January 24th, 1919.)
15,274. "Land, line, and wireless telephony." W. H. NOTTAGE. June 5th.
15,276. "Filaments, &c." BRITISH THOMSON-HOUSTON Co. June 5th.
15,283. "Alternating-current measuring-instruments." CHAMBERLAIN & HOOKHAM and S. JAMES. June 5th.
15,286. "Cathodes for electrolysers." J. F. WEBB. June 5th.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1918.

18,915. WIRELESS-SIGNALLING APPARATUS. A. A. Hall, November 18th, 1918. (142,886.)

1919.

955. ELECTRIC INDICATING, MEASURING AND REGULATING APPARATUS. J. C. Todman. January 14th, 1919. (142,900.)
3,642. MANUFACTURE OF ELECTRODES FOR SOLDERING AND DEPOSITING METALS BY THE ELECTRIC ARC. E. H. Jones and Alloy Welding Processes, Ltd. February 14th, 1919. (142,934.)
3,711. LAMP TELEPHONE RELAYS. M. Latour. February 14th, 1918. (Addition to 140,506.) (142,937.)
7,175. ELECTRICAL CONTACTORS OR SWITCHES. W. Brooke and E. M. Kerr. March 22nd, 1919. (142,976.)
8,469. LIGHTING OF THE ELECTRIC LAMPS OF BICYCLES AND THE LIKE MACHINES. C. J. Hamilton. April 4th, 1919. (142,983.)
9,453. DYNAMO-ELECTRIC MACHINES. A. A. Price. April 14th, 1919. (142,994.)
10,179. APPARATUS FOR ELECTROLYSING LIQUIDS. J. S. Withers. (National Electro-Products, Ltd.) April 23rd, 1919. (143,002.)
11,304. LAMP FITTINGS. A. H. Midgley and Vandervell & Co. May 6th, 1919. (143,021.)
12,313. SIGNAL AND LIGHT REPEATERS AND CIRCUITS. A. W. Szlumper and W. J. Thorpowgood. May 16th, 1919. (143,033.)
12,412. IGNITION APPLIANCES FOR INTERNAL-COMBUSTION ENGINES. T. H. Martyn. May 16th, 1919. (143,038.)
12,925. METHOD OF AND APPARATUS FOR RECEIVING RADIO-SIGNALS. Marconi Wireless Telegraph Co. February 7th, 1919. (138,586.)
12,985. IGNITION SYSTEM FOR INTERNAL-COMBUSTION ENGINES. M. S. Conner and C. C. Puckette. May 23rd, 1919. (143,047.)
13,022. ELECTRIC LAMPHOLDERS. D. Assersohn. May 23rd, 1919. (143,048.)
14,684. ELECTRICAL ENGINE-STARTING DEVICES. S. T. Henn and Rushmores, Ltd. June 10th, 1919. (Cognate application 30,851/19.) (143,063.)
15,140. ELECTRICAL ENGINE-STARTING DEVICES. S. T. Henn and Rushmores, Ltd. June 16th, 1919. (143,068.)
15,270. JUNCTION BOXES FOR ELECTRIC CABLES AND THE LIKE. T. S. Jones, W. A. Mortimer and E. Jones. June 18th, 1919. (143,069.)
16,077. ELECTRICALLY-HEATED CLOTHES-PRESSING MACHINES. M. Cohen. June 26th, 1919. (143,081.)
16,154. APPARATUS FOR ELECTROLYSING LIQUIDS. J. S. Withers (National Electro-Products, Ltd.). June 26th, 1919. (143,083.)
16,378. SPARKING PLUGS FOR IGNITION PURPOSES. P. J. Barker and C. F. Willis. June 30th, 1919. (143,085.)
17,215. MAGNETIC ATTACHMENT FOR ENGINES. H. L. Keun. July 9th, 1919. (143,092.)
18,525. ELECTRICALLY-OPERATED DIAPHRAGM HORNS. H. W. Bradbury. July 25th, 1919. (143,098.)
19,997. RULING AND BLOTTING DEVICE. G. Whitehead. August 14th, 1919. (143,106.)
20,387. TELEPHONE EXCHANGE SYSTEMS. Western Electric Co. and G. Deakin. August 19th, 1919. (143,108.)
21,876. ELECTRIC PLUGS. H. N. H. Cobbold and Porthholme Aircraft Co. September 5th, 1919. (143,115.)
26,493. ELECTRIC MACHINES SUCH AS MAGNETOS, DYNAMOS, MOTORS AND THE LIKE. F. J. S. Jones. October 28th, 1919. (143,138.)
29,626. ELECTRIC AND OTHER LIGHT FITTINGS. A. and H. R. Hardie. November 27th, 1919. (143,152.)
31,169. ELECTRIC SPARKING PLUG FOR INTERNAL-COMBUSTION ENGINES. P. C. Grosjean. November 14th, 1918. (136,567.)
32,770. MEANS FOR MEASURING ALTERNATING ELECTRIC CURRENTS. M. B. Fields. December 31st, 1919. (143,160.)
32,886. APPARATUS FOR THE ELECTROLYSIS OF METAL-SALT SOLUTION. Fredriksstad Elektrokemiske Fabriker Aktieselskabet, F. E. F. February 13th, 1919. (138,862.)

1920.

4,231. DISTRIBUTING DEVICES FOR HIGH-TENSION IGNITION MACHINES. R. Bosch Akt. Ges. March 9th, 1918. (138,913.)
5,907. DEVICE FOR ATTACHING ELECTRIC CONDUCTING WIRES TO PIPES, RODS, AND SUCH LIKE. G. Turnock. February 27th, 1920. (143,178.)
8,118. DEVICE FOR LUBRICATING THE BEARING OF THE DISTRIBUTOR-SHAFT OF AN IGNITION APPARATUS FOR INTERNAL-COMBUSTION ENGINES. R. Bosch Akt. Ges. May 16th, 1919. (143,175.)
9,997. ELECTRIC FURNACES. W. E. Moore. February 14th, 1919. (Divided application on 3,693/19.) (143,176.)

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THE

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FRENCH ELECTRICAL INDUSTRY—AMERICAN RELATIONS.

THE report of the directors of the Compagnie Française pour l'Exploitation des Procédés Thomson-Houston states that 1919 was a year of transition, and the reorganisation of the whole of the works which was proceeded with after the fusion with the Eclairage Electrique, had not taken place without some inconvenience in the activity of certain departments. During the year the company continued to clear up pre-war orders which had not been settled, and with the spirit of conciliation shown by all parties, it had been possible to bring them to a satisfactory issue in nearly all cases, without legal proceedings, and without excessive sacrifices. After referring to the capital augmentation from 120 to 200 millions of francs, the report approaches the question of exchange, particularly with the United States, in consequence of the company's purchases from the General Electric Co. It mentions that the rise in exchange might be followed by a very onerous burden on the French company for the purchases made for its own account, and much more still for its customers. Desirous, indeed, of not running any risks, the directors adopted the principle of fixing their sale prices for American material almost always in dollars. Thanks to the co-operation of their New York friends, who endeavoured to spare them this injury, and who understood that the exorbitant rise in exchange could not fail to be seriously prejudicial even to the United States by rendering exports more and more difficult, the French company had been able to carry through successfully an important credit transaction in dollars for a period of five years. It was hoped that in the course of this period the improvement in the public financial situation would permit both the company and its customers to pay off the debts under conditions which were less onerous than those existing at present.

After referring to the previously announced programme for the organisation and extension of the different works, the report stated that the work was being pushed forward as actively as possible, having regard to existing difficulties. The investigation services, centralised and reorganised, had devoted their attention to the standardisation of the constituent parts of the company's manufactures, particularly production in bulk, in order to increase the output and reduce prices. They had developed the study of large alternators up to 25,000 KW., transformers of 15,000 KW., and pressures up to 120,000 volts; high-tension apparatus, motors and apparatus specially intended for the equipment of Rumanian oil wells, and new ventilated motors for tramways. Special attention was also paid to the study of plant for the electrification of the French main railway lines, and the technical co-operation of the General Electric Co. was assured, as being infinitely precious in the case of all this special plant

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and the organisation of its manufacture. Passing on from details of the various sales departments and the orders received, the directors stated that several large schemes in which they were co-operating were under examination, including the proposed installation of electric haulage on the canals of the Marne to the Rhine, extending over 217 miles. Concerning the projected electrification of various French railways and the conclusion reached to adopt the high-tension direct-current system as being the most suitable on main lines, the directors mentioned that this was the conclusion which they themselves had maintained for years past in agreement with the General Electric Co. The complete experience which the American company possessed of the construction and working of plant of this type would place the French company in a favourable position when the time arrived for the realisation of this great enterprise.

M. Charles Laurent, chairman of the company, addressing the shareholders at the recent annual meeting, referred at some length to the question of coal and coal prices and to the situation of England in this respect. If it was necessary for us to economise in the consumption of coal, he submitted that it was all the more essential for France to do so, seeing that her coal resources were extremely limited. It was necessary to substitute for coal other fuels as far as possible, as, for instance, mazout and petroleum, but the future salvation of the country lay in the utilisation of white coal—this source of inexhaustible energy which was offered by the mountains, the torrents and the rivers over a large portion of the territory, and which it was only essential to collect in order to serve the needs of industry, agriculture, transport and large centres of population. The company was particularly well situated for taking a large share in the execution of this great work.

In conclusion, the chairman paid a warm tribute to the French soldiers for having driven back the German hordes, and for now having given the same answer—*On ne passe pas*—to the new enemy which had risen before them, namely, revolution, anarchy and Bolshevism.

An Imperial University?

OUR comments on this subject, in our issue of June 11th, have brought us a letter from Mr. F. Peake Sexton, which will be found in our "Correspondence" columns to-day. The letter is charmingly inconsequential. Having demonstrated, to his own satisfaction, that the University of London does not fulfil our ideal, our correspondent invites our support for the claim of the Imperial College of Science and Technology to rank as a university. But "two blacks do not make one white"; he has not met our case in the least, for his argument, if well founded, merely shows that the University of London, like the Imperial College, ought *not* to rank as a university.

However, his argument, or rather his contention, is not well-founded. Whether our views with regard to the functions of a university are "slowly dying out" or not is a matter of opinion, which we need not discuss, but the extent to which the University of London fulfils our ideal is a question of fact, and we happen to possess exceptional opportunities of knowing the facts in this connection. Mr. Sexton himself admits that the cultural facilities for which we contend "may be found" in some of the "recognised schools" of which the Imperial College is one group; we know that it *is* found in the constituent Colleges of the University, some of which are seething with social and intellectual activity, outside the class-rooms. The handicaps under which the University labours—widely scattered colleges, lack of funds, and that worst handicap of all, its situation in a city so vast that the residential suburbs are remote from one another and from the Colleges—hinder it from attaining the efficiency in this respect that can be justly claimed by most other universities; but steps are being taken to remove such of these disadvantages as are capable of removal, and even now there is a striking contrast between the social amenities of the constituent colleges of the University and those of the Imperial College. At work, the latter is unrivalled; at "play"—the play that cultivates the best qualities of a man, or woman, as no course of study can do it—it is literally not in the running.

But it was not, and is not, our aim to champion the cause of the University, which is well able to look after itself; we asked, quite explicitly, whether the Imperial College, if granted a charter, would undertake to become a university in fact as well as in name, and we have had no answer. As Mr. Sexton says:—"Here we have a large group of colleges combined for the purpose of technical education"—and they fulfil that purpose exceedingly well. But that is all.

Incidentally, we may note that Manchester University is experiencing a difficulty of similar origin but different nature. The College of Technology, originally established by the Corporation for Technical Training, has become the Faculty of Technology in the University of Manchester; it has earned a high reputation, and there are so many candidates for the degree course that, as reported in our last issue, the Education Committee has found it necessary to limit the number in order to leave room for the local technological students who do not aim at the degree.

The incident illustrates the intensity of the modern demand for scientific training in both categories, and the only right solution, to our mind, is to provide accommodation sufficient for all comers in our educational institutions.

Price Dictatorship in Germany.

A SHORT time ago Herr Walter Rathenau, addressing the shareholders at a special meeting of the A.E.G., referred in strong terms to the enormous prices charged for raw and semi-finished materials, and remarked that they were living under the dictatorship of the heavy industries, meaning the coal and iron and steel industries. Since then various German newspapers have taken up the challenge on behalf of the heavy industries, but the best statement on the subject probably is that which has just been published giving a comparison of the A.E.G. list-prices early in 1914 and in 1920. The figures are of such interest as to be worthy of being set out prominently. They are as follows:—

A.E.G. LIST-PRICES IN 1914-1920.

	Marks.	Marks.	Percentage addition over 1914.
Normal rotary-current motor of 20 H.P.	1,100	28,362	2,478
Normal rotary-current motor of 40 H.P.	1,600	39,270	2,354
Normal rotary-current motor of 50 H.P.	1,800	44,968	2,398
Direct-current motor of 16 KW. and 1,400 revolutions	1,000	26,180	2,518
Direct-current motor of 40 KW. and 1,050 revolutions	2,000	59,290	2,865
Osram lamp of 1,000 C.P., 90 to 260 volts	8·65	245	2,733
Dynamo wire (per ?)	2 to 3	70 to 80	3,000

The percentages are given from the original statement, and have not been checked. On the other hand, the prices of coal between 1914 and the present time have been raised by 1,550 per cent., coke by 1,600 per cent., pig-iron by 3,300 per cent., and steel ingots by 3,600 per cent. Included in the price of coal are burdens which are beyond the control of the colliery owners. Thus, there are the 20 per cent. *ad valorem* tax imposed upon the production of coal, the tax on the turnover, the tax of 6 marks per ton to defray part of the cost of providing miners' dwellings, and the additional expenditure for the payment of special overtime rates to the miners. All these causes re-act upon the prices of iron and steel, apart from the fabulous prices which have to be paid for Swedish and other foreign ores. Moreover, the prices of coal and iron and steel are under the public control of the Federal Coal Board and the Federation of the Steel Industry, which have been created by the Government, and which include representatives of both consumers and workmen. Such control, however, does not exist in the electrical industry, and so long as this kind of regulation is absent it is considered that Herr Rathenau has the least justification of all to speak of dictatorship in the heavy industries.

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THE INCORPORATED MUNICIPAL ELECTRICAL ASSOCIATION.

The Annual Convention at Ilkley.

THE Convention of the I.M.E.A. this year opened under the most favourable conditions that could be wished for. The headquarters, at Ilkley, were situated in one of Britain's most famous beauty-spots in Wharfedale, the heart of the Yorkshire moors, a district which afforded an abundant choice of enjoyable excursions for those on pleasure bent, while its midland situation rendered it comparatively easy of access from all parts. Regarding the site from an industrial point of view, it is interesting to note that Bradford, which as the President's "home town," was the determining factor in the choice of venue, was one of the first English municipalities to embark on the business of electricity supply; the original power station at Bolton Road, which commenced public supply in 1889, was, in fact, the first of its kind to employ direct-coupled engines and dynamos, and it is amusing, in the light of modern developments, to record that the plant comprised three sets of 81 KW. and two of 125-KW. output, all, of course, being bipolar machines. Since those early days two other stations have been erected at Valley Road, in 1897 and 1902 respectively; the former was but a modest step in advance of its prototype, the largest set being of 375-KW. output, but the third station contained sets of 1,000 KW. each, and was typical of the final stage of development of the direct-current power station. Much of the D.C. plant is still in use at Valley Road, but the rapid increase in the demand for power in Bradford, led to the inevitable change of system to three-phase generation. Mr. T. Roles came into office as chief electrical engineer and manager in 1912, and under his control the undertaking has been developed on up-to-date lines, the plant now including turbo-alternators of some 30,000-KW. capacity, of which the largest set is rated at 15,000 KW.—with another of the same size on order. The station forms an epitome of the progress of steam generating plant, examples of bipolar high-speed and multipolar low-speed D.C. generators, and both vertical and horizontal, Curtis and Parsons, turbo-alternators being at work together.

The Convention, which commenced with an informal reception and social evening at the Winter Garden, Ilkley, on Monday, was formally inaugurated on Tuesday morning at the Queen's Hall, "The Windsor," Bradford, when the Lord Mayor, Alderman Wm. Wade, J.P., extended a hearty welcome to the Association. He said that Bradford claimed to be the first local authority to use powers to supply electricity, in 1889. Mr. Roles returned thanks and then delivered his address, of which an abstract follows.

The leading feature of the address was his commentary on the recent and pending legislation with regard to electricity supply. Incidentally, Mr. Roles referred to the removal of the obstacle which has hitherto restricted the attendance of representatives of local authorities at the Convention, a concession which was certainly long overdue, and which should not only prove helpful to the Association, but should also facilitate attendance at various other gatherings in the public interest. Mr. Roles endorsed the complaint of members of the Association that the powers to carry on the hire-purchase system and to sell apparatus outright, for which they have long yearned, had not been granted by the Act, and expressed the hope that these additional powers might ultimately be secured by agreement with the Electrical Contractors' Association. His natural optimism is here revealed; we hope it will be justified by the event, but at the moment the prospects of the attainment of that desirable consummation seem remote.

Turning to the major theme, Mr. Roles plumps for the compulsory and financial clauses of the new Electricity Bill, although he complains that municipal authorities in general are singularly indifferent to the matter, and some are openly hostile to the Bill. He admits that the terms of purchase might with advantage be amended, a view with which we cordially agree, and which, we think, will find few objectors; but he is not disposed to allow the compulsory powers of purchase to be dropped, or even delayed. His contention that such powers are indispensable, in order to coerce recalcitrant authorities, "either municipal or private," as he says, is one that we ourselves advanced when the Bill of 1919 was before Parliament; we are, however, inclined to sympathise with those who hold that the existing Act should be given a trial before any further legislation on these lines is enacted. The Commissioners have their hands full already with schemes in active progress; a considerable time is likely to elapse before they feel the need of compulsory powers of purchase, and in that time valuable experience will be gained on which to base legislation. Purchase by agreement is already authorised under the Act of 1919, and is free from the objections justly raised to the terms of purchase that were foisted upon the companies in the original Bill. Apart from the question of purchase, voluntary co-operation in the establishment of Joint Electricity Supply Authorities is producing valuable results, and is very much to be preferred to compulsion. It may be that considerations such as these are at the root of that municipal indifference to the new Bill which Mr. Roles deplores.

The financial clauses, however, stand on a different footing. Finance is the stumbling-block in the path of the progress of the embryo Joint Authorities, which, unlike the individual municipalities, have not the rates at their backs. No such authority can mortgage the rates of any of its constituents, some of which, moreover, will be private undertakings. Nor can it even pledge the plant and mains of the undertakings which it controls. It will be impossible for Joint Authorities to raise the necessary capital for any developments outside the constituent undertakings, under the existing conditions. We are of the same mind as Mr. Roles that Government ownership and control of power stations and mains would be in the last degree unwelcome and contrary to the public interest, but that the provision of funds for the purposes of the Joint Electricity Authorities is a vital necessity, and, as he says, the financial clauses are the most important part of the amending Bill.

It is interesting to learn from the address that the Association is likely to appoint a salaried secretary and to secure suitable office accommodation. We were pleased to see that Mr. Roles commended the E.D.A. to the attention of the members; seeing that the great majority of electricity supply undertakings in this country are in municipal hands, and that the operations of the E.D.A. are directed towards the increased utilisation of electricity, it is obvious that the I.M.E.A. is in duty bound to give its whole-hearted support to the Electrical Development Association.

A vote of thanks to Mr. Roles was moved by Councillor Barge, of West Ham, who eulogised the work of the President for the Association, especially during the past year. Mr. Gillin read his paper in abstract, after which Mr. Roles presented the author with a Premium in the form of a stop-watch. A lively discussion followed, in which Messrs. Wordingham, Staniland, Ayton, Bell, Fedden, Purse, Watson, Brooking, Webber, and Ferranti participated. Later the Association was entertained to luncheon by the Bradford Electricity Committee. Councillor Wilfrid Turner, the chairman, presided. Alderman Sinclair, Mayor of Swansea, proposed the toast, "The City of Bradford," and the Lord Mayor responded. Mr. Chattock, formerly city electrical engineer there, proposed the health of the chairman, who duly responded. The delegates proceeded by char-à-bancs to the Phœnix Works of the English Electric Co., where they were entertained to tea. Mr. Roles expressed the members' thanks, and Mr. Pybus, joint-managing director, acknowledged. The Corporation electricity works were then visited. After returning to Ilkley there was a reception by Councillor Dixon, chairman of the Urban Council, at the Winter Gardens. In this very enjoyable function singing, dancing, and light refreshments each had a place.

Up to the time of writing, the weather has been fine, and the Convention has proceeded successfully in every way.

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Presidential Address.

By THOMAS ROLES (City Electrical Engineer and Manager, Bradford). (*Abstract.*)

As far as the electricity supply industry is concerned, the past year must for ever remain memorable, as during its course the Electricity (Supply) Bill received the attention of both Houses of Parliament, and the Electricity (Supply) Act, 1919, which resulted, came into operation. This Act has been well referred to as "the great charter of electricity," and it cannot fail to have far-reaching effects on electricity supply in the British Isles.

Many of the provisions of the Act give powers which the Association has itself for years laboured to secure, and a number of such powers have been obtained directly as the outcome of the efforts of the Association's Council. Representatives of a number of local authorities are for the first time attending the Convention without fear of their reasonable expenses being questioned by a Government auditor. The removal of the disability which previously existed as regards subscribing to associations has been of distinct advantage to the Association, in that its membership has increased during the year as a result, and under the circumstances now existing it is to be hoped that no municipal electricity supply undertaking will fail to avail itself of the advantages which membership of the Association affords.

As regards the section of the Act which authorises the supply of apparatus on hire, considerable disappointment has been expressed by many members of this Association that the powers given are restricted to the hiring of such apparatus, as it is considered that powers to provide apparatus on the hire-purchase system and to sell outright are very necessary in the interests of municipal undertakings. Personally, I have every sympathy with these views, and consider that such powers, if given, could be utilised for the benefit of consumers of electricity, electricity supply undertakings, electrical manufacturers, and electrical contractors; and I sincerely hope that in the course of time the relations between the Electrical Contractors' Association (Incorporated) and this Association may become such that some agreement may be reached under which a successful attempt may be made by municipal electricity supply undertakings to secure powers for hire-purchase and sale, to be utilised under certain agreed conditions which may be recognised by the electrical contractors as reasonable and just, and as being likely to advance rather than in any way to militate against their interests.

It is a matter for regret that the Government found it necessary, in order to save those portions with which more or less general agreement had been expressed by the whole of the electrical industry, to withdraw certain clauses from the original Bill. This regret, I am aware, is not shared by a large number of those who are connected with the industry, who are of the opinion that the Act as it now stands is sufficiently comprehensive for all practical purposes, and that its provisions should be given a trial prior to any further legislation on electricity supply matters being promoted. The Government, however, and it must be remembered that the Government has now the advantage of the advice of the Electricity Commission, appears to be of the opinion that it is desirable that the whole of the powers sought under the original Bill should be obtained. The clauses in the new Bill may be divided into two groups, those in the first of which have for their object the setting-up of District Electricity Boards and the compulsory acquisition of generating stations and main transmission lines belonging to existing electricity supply undertakings; the clauses in the second group, usually referred to as "the financial clauses," have for their object the empowering of the Joint Electricity Authorities which are to be constituted under the existing Act, as well as the District Electricity Boards contemplated under the Bill, to borrow moneys, and to authorise the issue of stock. They will also allow authorised undertakers to give financial assistance to Joint Electricity Authorities and District Electricity Boards, and the Electricity Commissioners, under certain circumstances, to lend money to such authorities and boards.

From the point of view of the electricity supply industry the financial clauses may be said to be the most important, as it has become clear to all who have been considering the setting-up of Joint Electricity Authorities that the financing of such authorities is impracticable until some such provisions as are contained in the clauses in question are made.

With regard to that part of the Bill which concerns the setting-up of District Electricity Boards and the compulsory acquisition of generating stations and main transmission lines, it appears to me that, although in many cases such powers may not prove necessary, yet it is essential that the Commissioners should be provided with them, as otherwise it is difficult to see how the Commissioners are to enforce the carrying-out of a desirable scheme in face of unreasonable opposition which may be experienced from one or more electricity undertakings in the district to which such scheme is to apply. As things are at present, it would appear that one unreasonable electricity supply authority might hold up for a considerable time, or even permanently, a scheme which would be to the benefit of the consumers of electricity in a very large area. In view of the general satisfaction which has been expressed throughout the country with the appointments which have been made to the Electricity Commission, I consider there is no reason why the Commissioners should not be furnished with the powers necessary to enable them to enforce the carrying-out of proposals which they deem to be in the public interest. It is possible that the terms of compulsory purchase, as set forth in the Bill, may, with advantage, be to some extent amended, but I think it will be generally conceded that provision should be made under which generating stations and main transmission lines may, under certain circumstances, be compulsorily acquired.

As a private citizen having some knowledge of the subject I hold that the provision of an adequate supply of electricity at the cheapest possible price is an absolute necessity to the welfare of this country and its inhabitants, and I should not be prepared to allow any interest, either municipal or private, to stand in the way of such an adequate and cheap supply being furnished. As President of this Association and chief officer of a municipal electricity supply undertaking, it is my duty to ensure as far as possible that municipal interests are conserved and furthered.

In the light of these remarks, I feel that on general principles the Bill before Parliament should command the support of local authorities. Of the two noble lords who first opposed last year's Bill on its being introduced into the Upper House, one is a director of certain electricity supply companies, and the other was very recently the President of the British Commercial Gas Association. Having in view the sources from which opposition to the measure emanated, I think local authorities would not be wrong in coming to the conclusion that last year's Bill, including the clauses which were deleted, was one which on the whole might be regarded as in no way inimical to their interests. If such conclusion is come to, it follows that municipalities should look with favour on the Bill at present before Parliament, but up to the present there seem to be few signs that this Bill is receiving any great amount of support from local authorities. I would suggest it is high time that municipalities and the Associations representing them came to some decision with regard to this matter, and defined a policy which their representatives and officials may pursue on their behalf.

It has been put forward as an objection to the formation of Joint Electricity Authorities and District Electricity Boards that, in view of the heavy financial liabilities which municipalities are having to incur in connection with housing and other matters, they cannot be expected to incur further responsibilities of this nature by financing electricity supply schemes. It is, I think, advisable to consider the probable result should this attitude be generally taken up. The very great demand for electricity which is now being made must be met, and the Government has apparently rightly determined that it shall be met. If the principle of public control is to be given effect to, this must be done either by schemes financed by the Government or by municipal bodies individually or in association. It appears quite clear that under present circumstances the Government is not in a position to finance such schemes, and were it able to do so I think it is generally felt that Government control of the generation and main transmission of electricity would not be in the interests of the community. If the Government will not or cannot supply electricity under a national scheme, and municipalities object to carry out the work by reason of the financial risks involved, the only alternative of the Government will be to hand over the task of the development of electricity supply to private enterprise.

Personally, I cannot bring myself to believe that grounds for serious apprehension with regard to the financial position exist. The Engineering Commissioners are gentlemen fully acquainted with the principles underlying the giving of supplies of electricity under conditions which are likely to prove satisfactory from a financial point of view, and one cannot conceive that they would urge any authority to embark on any rash scheme, or sanction the carrying-out of an unsound scheme put forward by any such authority. Moreover, one of the Commissioners has been specially appointed to give attention to financial matters in relation to electricity supply, and, therefore, one may expect him to place his veto on any scheme the financial aspects of which may appear to him unsatisfactory.

To my mind the principle underlying the legislation which has been enacted and which is proposed is as follows:—

A great demand for supplies of electricity is being made throughout the country, and this demand will be an increasing one. The supplies can be given by existing authorities acting for the most part individually as they are doing at present. If, however, such authorities will co-operate or amalgamate in order that electricity may be generated on a larger and more efficient scale, cheaper and more reliable supplies should be available than if individual generation is continued.

The situation would probably be best dealt with in the following manner:—

Immediate demands for electricity must in the national interest be met, and this will for the time being entail the extension of many existing generating stations, whether good, bad, or indifferent. Generating stations in reasonably close proximity to each other should be linked up by main transmission cables, and on this being accomplished the most efficient stations of those so linked would naturally, for economic reasons, be called upon to meet the greater part of the demand, the least efficient stations being operated for as short periods as possible. As far as practicable extensions should only be allowed in connection with the most efficient

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stations. Where and when the demand renders it necessary, a capital station should be erected and equipped for the provision of the supply required in the district, instead of several smaller generating stations being erected, each of which would supply the needs of one particular distributing area only. On the capital station being put into commission it should, owing to its efficiency, be run at a high load factor. The most efficient of the previously existing generating stations would be run at moderate load factors, and the smaller and less efficient stations would only be utilised at peak load periods or otherwise would be entirely dispensed with. On these lines an efficient system of generating electricity would be gradually evolved, which should tend to cheap production and reliability of supply, and at the same time the capital already sunk in the industry would for the most part continue to be utilised to full advantage.

As far as one is able to judge from decisions which the Electricity Commissioners have from time to time been reported to have made, it is on these lines they are proceeding.

It is somewhat remarkable that power companies seem to be expressing no fear of taking the financial risks involved in supplying electricity over large areas; on the other hand, they appear eager to accept such risks, and I have little doubt in many cases would be prepared to relieve municipalities of the financial responsibility regarding which some are so apprehensive.

I would, therefore, repeat that it is for municipal authorities to decide upon the line of action they intend to pursue, both with regard to the new Bill and the formation of Joint Electricity Authorities, and that their decisions should be come to without delay, as, if public control of the supply of electricity is desired, there is unlikely to be a better time than now for obtaining it.

The Design of Distributing Networks.

BY C. A. GILLIN, A.M.I.E.E. (Bradford Electricity Department). (*Abstract.*)

PRACTICALLY all generating stations (in the United Kingdom) have been at one period of their evolution the sole distributing centres in their areas of supply. In the larger areas they have been superseded by larger generating stations and by virtue of their positions they have automatically become distributing centres for their respective districts.

The objects to be aimed at in designing distributing networks are: (1) Economical service and distribution; (2) continuity of supply; (3) satisfactory operation; (4) minimum expenditure on repairs.

I (*a*). E.H.T. DISTRIBUTION.

In figs. 1 and 2 the four squares A, B, C, D represent diagrammatically four districts in a supply area having a reasonably uniform density of load, the centre of each being at the points ×, and to represent scattered districts one merely thinks of the squares as being separated by as many miles as their boundaries are apart.

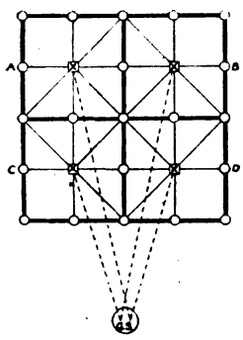


FIG. 1.

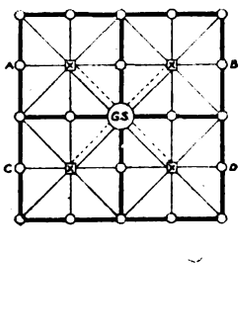


FIG. 2.

cubicles in each chamber; total permissible pressure drop on cables 7½ per cent.

If the situation of a generating station is such as to allow of its later use both as a station for the economical generation of large supplies of energy and as a distributing centre for its immediate district, the voltage for the latter purpose should be from 6,000 to 10,000; but for even comparatively short distances the most economical voltage for the transmission of reasonably heavy loads from the generating station to distributing centres in other districts will be 30,000 volts or more. The curves shown in fig. 4 illustrate this fact. The figures upon which the curves are based are as follows:—

The total permissible pressure drop (including transformers) is within 10 per cent.; all transmission losses have been neglected, the figures being only capital outlay; step-up and step-down transformers are included in the 30,000-volt curves, but no transformers are necessary in the case of 6,000 volts; only 6,000-volt switchgear has been provided for, it being assumed that transformers and cables will be treated as one complete unit for each 30,000-volt line; one spare cable and the necessary transformers have been allowed for in each instance considered. In all curves and data in this paper present-day prices form the basis, with copper at £125 per ton, lead £40 per ton; cables unarmoured, taped, laid direct under average roadway conditions.

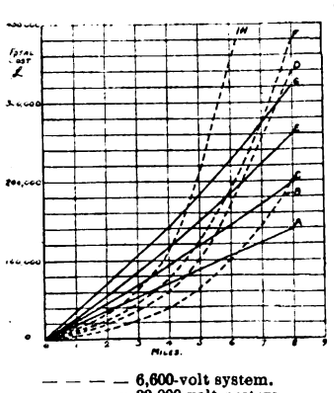
If the correctness of the above principles be conceded, the logical deduction is that a supply area would ultimately resolve itself into a number of districts whose boundaries should be a maximum distance of approximately 5 to 8 miles from their respective distribution centres; the latter (unless themselves generating stations) receiving the requisite supplies from a generating station and transforming down to a pressure of from 6,000 to 10,000 volts for district distribution.

This splitting-up of a supply area into constituent districts will be a natural process consequent upon the size of the existing cables connecting the districts to the sources of supply having become inadequate to cope with the increased demands.

The distributing centres will not necessarily be near the centres of their respective districts, as their positions will be determined by power demands in unexpected directions and their strategic value for directional distribution.

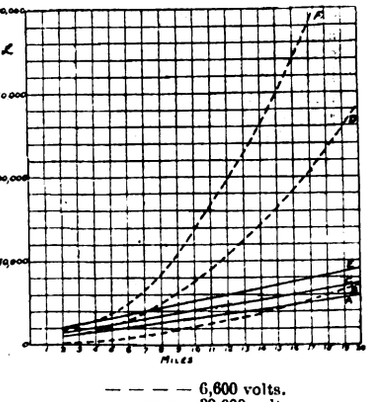
The lay-out of the E.H.T. distributing network is intimately bound up with the question of the section of the cables, the system of electrical protection from the effects of faults, the satisfactory isolation of the faulty apparatus, and the maintenance of the continuity of supply despite breakdowns. The early provision of an adequate number of telephone lines for point to point communication is a factor of importance.

All feeders as soon as possible after leaving the source of supply should be laid along different routes. After a few years they become a united fmaily again and the network is thus created. All future extensions must be made with one eye on finance, the other on potential consumers, and the mind on prospective distributing centres. Unfortunately, good finance often means bad engineering (in distribution schemes), but this could and should be altered by judiciously



6,600-volt system.
33,000-volt system.
Transformer chambers per mile, curves A and B, 4; C and D, 6; E and F, 8; G and H, 10.

FIG. 3.—TOTAL COST OF DISTRIBUTION AT 6,600 AND 33,000 VOLTS.



6,600 volts.
33,000 volts.
Power transmitted, curves A and B, 1,000 K.V.A. C and D, 5,000 K.V.A.; E and F, 10,000 K.V.A.

FIG. 4.—COST OF TRANSMISSION AT 6,600 AND 33,000 VOLTS.

Taking into account the cost of switchgear, number of transformer chambers per mile and their average K.V.A. demand, the most economical distribution pressure from 1 mile up to about 5 miles radius is 6,000 volts and up to about 8 miles radius is 10,000 volts. In order to show how the high cost of switchgear for use at higher pressures overbalances the reduction in cost of cables, the curves shown in fig. 3 have been prepared.

Comparison has been made between 6,000 volts and 30,000 volts distribution, because the majority of stations are already using the former, although 10,000 volts would have shown results more favourable to the lower pressure at a greater radius of distribution than is shown with 6,000 volts. The higher values of the curves are of no particular importance, as the radius of distribution of a main distributing centre would seldom exceed 4 miles. The curves are based on the following data: No duplicate cables; all cables split-conductor type; transformers and buildings not included; average capacity of transformer chambers 250 K.V.A.; three switchgear

increasing the tariffs for electrical energy. Supply undertakings are inclined to be too philanthropic, except to their employés.

When the early outgoing feeders are visibly approaching the limits of their carrying capacities is the time to spend a lot of money wisely for future requirements. And here lies the advantage of building up a considerable reserve fund instead of allocating a mythical "surplus" towards the reduction of rates. This is the time to establish distributing centres and give some of them, via new transmission lines at 30,000 volts or more, a "cheap and abundant supply," at the same time linking-up or cross-connecting to other districts until it becomes necessary for these in their turn to be augmented by similar means. Thus we reach the scheme shown diagrammatically in figs. 1 and 2, where the squares A, B, C, D represent districts each of about 16 square miles area, × represents the distributing centres, G S the generating station, and all intersections or junctions of lines sub-stations, transformer chambers, or switching chambers.

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In the early days practically all cables laid were too small, chiefly perhaps because of difficulties with regard to capital expenditure; the practice should not be repeated. All cable sizes should be decided more by the dictates of experience than as the result of calculation. The only limits to the sizes of cables between generating stations and distributing centres should be those due to difficulties in handling, desirability of duplication, limitation of reliability of switchgear operation under extraordinary loads, and financial checkmates.

The sectional area of network cables will depend upon their position relative to the other portions of the network, and on the loads they may be called upon to carry in the event of faults on neighbouring or co-related cables. It is generally uneconomical to load up cables to their safe carrying capacity. The curves in figs. 5 and 7 give an interesting illustration of the extent to which cables may be safely loaded. The results shown should be used discreetly for A.C. pressures higher than 400 volts, as L.T. A.C. currents were used in determining the curve values, and allowance must be made for heating due to energy loss in the dielectric. The curves in fig. 5 shows the temperature rise due to a steady current of uniform value, and those in fig. 7 have been obtained by increasing the current in any particular cable in successive stages after the

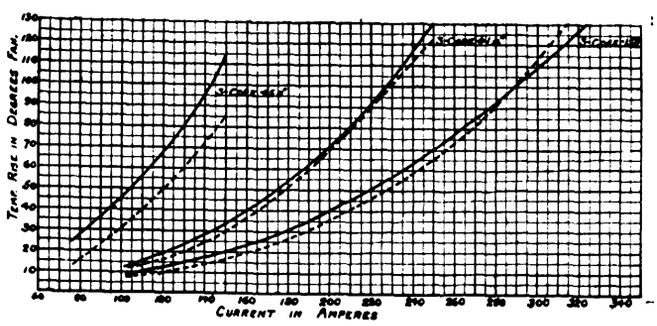

Fig. 5.

temperature due to the current value in the immediately preceding stage had ceased to increase. Each of the latter readings involved a run of several hours before the temperature became steady, and the tests occupied three weeks. There was only one three-core cable used in each test, so that the results require adjustment where two or more loaded cables are laid near each other.

The system of protection should be the first point to be tackled, instead of—as it often is—the last. Effectual protection is one of the most important items in the whole undertaking.

The Merz-Price, the split-conductor, and the Hunter-Beard compensated pilot appear to be the only well-tried systems of protection which fulfil the conditions; and of these the split-conductor seems to be the best for our purpose up to about 20,000 volts. Beyond this voltage the compensated pilot has the advantage if it turns out as good as it seems. Are the extra advantages worth the extra cost? A duplicate radial system of mains, with tees off wherever necessary, judiciously interlinked at points provided with reverse power relays and equipped wherever necessary with time-limit overload pro-

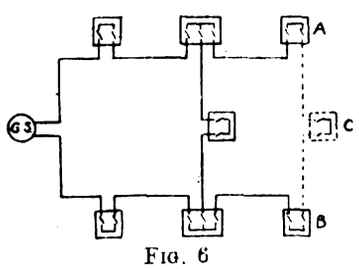

Fig. 6

tection, with, generally, the transformer chambers and sub-stations divided between the two feeders, has been and still remains a popular arrangement. Its disadvantages are small having regard to the infrequency of E.H.T. faults, and in practice lie in the fact that perhaps once in five or six years half the consumers connected to a feeder have their supply cut off for an hour or so until they can be changed over to the duplicate feeder. Until a very few years ago our experience was that most of the supply interruptions were due to faulty protective apparatus, particularly in the case of reverse power relays, but these drawbacks no longer apply if discretion in the choice of suitable instruments be employed.

The greatest asset in the claim to superiority of the balanced-current or split-conductor system of protection is the fact of the non-interference of cable faults with the continuity of supply. This fact, of course, presupposes the completion of all the interconnections necessary to ensure a supply being available from another cable at all sub-stations and transformer chambers. The reliability of modern cables, however, is so great that one is quite justified in taking, and is, indeed generally economically compelled to take, the small risks of temporarily supplying via only one cable with a view to interlinking later when the opportunity presents itself. The position is illustrated diagrammatically in fig. 6 at A and B with C as a prospective means of completing the cycle.

In order to compare the costs of complete networks constructed to operate under these two systems, *i.e.*, the duplicate-radial system and the split-conductor system, a typical district approximately 16 square miles in area, commencing at a line one mile from the centre of a city and extending outward has been examined. Definite positions for transformer chambers at distances averaging ½ mile apart and 6,000 volts distribution have been assumed. Account was only taken of excavation, reinstatement, cables, their mechanical protection and jointing, feeder switchgear, and protective apparatus in transformer chambers. Buildings and the remaining transformer-chamber equipments have been left out. As a fair comparison two 3-core 0.05 cables, unarmoured, taped and with copper earth sheath in the one case, and one 3-core 0.1 sq. in. split-conductor cable, unarmoured, taped and without copper earth sheath in the other case, were taken. The resulting costs approximated so closely in the two cases that financial considerations do not at all enter into the discussion.

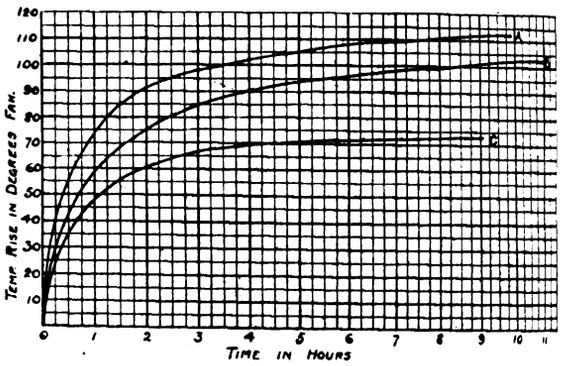

Fig. 7.

as to which system is the better to adopt. In fact, by changing about the assumed positions of transformer chambers either system can be shown to be slightly cheaper than the other.

I (*b*). Medium-Pressure A.C. and D.C. Distribution.

Medium-pressure supply areas are now always divided up into districts, which may be called feeder areas, a feeding point or transformer chamber answering the same purpose and performing the same functions in a minor degree as the distributing centres referred to in section 1 (*a*). Each district is connected with its neighbouring districts through a number of fuse pillars. Most municipal supply areas have a good deal of productive capital sunk in D.C. networks of fair heavy density within a reasonable distance of the original generating station. As the demand for energy increases, and more economical and larger units of plant become practicable, generation is of necessity by turbo-alternators, which replace gradually the smaller machines. The tendency will be to narrow down the D.C. areas by the encroachment upon their boundaries of the A.C. mains. It will not only be found a sound commercial proposition to encourage this A.C. advance by a reasonable lopping-off and changing-over to A.C. of the extended arms in the D.C. areas, but these prospective alterations should be anticipated by putting down suitable distributing mains and arranging the local balancing in advance whenever extensions are made where this seems appropriate. The subsequent change-over to the A.C. system then becomes both inexpensive and comparatively simple.

D.C. feeders should not be of large size except where necessary to compensate for voltage drop, because (1) the supply to an area having its feeder out of commission has to be maintained by the distributors of its own and its adjoining areas in addition to their own load; (2) disturbance is more circumscribed in the event of feeder troubles; (3) the distribution voltage is more uniform. For these reasons also the radius of a feeder should be extended or reduced according to the density of its load, and any later adjustments rendered necessary to cope with increased loads may be met by putting down another feeder and creating an additional feeder area. These remarks apply equally to the capacities of sub-stations, transformer chambers, and transformer pits in the case of the A.C. areas.

In the matter of individual feeder areas, the following observations are applicable both to D.C. and A.C. systems of supply.

Every proposed extension must be carefully considered as to its bearing on all other parts of its own and adjoining feeder areas. Arterial cables leaving a feeding point must have ample provision not only for carrying their own local loads, but also for any supplementary loads they may have imposed upon them in consequence of the failure of another arterial cable or a feeder supplying an adjacent area. The number of cables radiating from a feeder point should be as large as possible, and each of them should feed a small section of

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an area, the said section being controlled by a heavy fuse at the feeding point and connected to adjoining sections of the same area and to neighbouring areas through sectional fuse pillars in which the fuses are carefully graded to suit their local obligations. Between these points network disconnecting boxes, switch pillars, and other fuse pillars should be inserted at strategical intervals. Intelligently followed out, these provisions will restrict to a minimum the inconveniences due to faults, facilitate the quick restoration of healthy circuits, and allow of comparatively rapid location of "earths" and other troubles.

It would be a good plan to provide a sum annually out of revenue to be used for the sole purpose of converting into a decent engineering job those cases where capital expenditure is curtailed in order to make an extension to a prospective consumer a paying proposition. The use of a provision of this sort should be exercised with careful discretion, but it would certainly be of great advantage to be able to propose a scheme for approval at a specified cost, with an addition from such a fund for engineering purposes.

A limited range of cable sizes should be definitely standardised for all the above purposes. For feeders two sizes, viz., 0.5 sq. in. and 1.0 sq. in. sectional area, with a smaller neutral for D.C. districts, should be sufficient, keeping in mind the desirability of increasing the number of feeders rather than their carrying capacity. Pilot cables are sometimes not very satisfactory when laid up under the same sheath as the feeder cables, but several instances have occurred where they have saved very inconvenient interruptions to district supplies by indicating incipient faults before these have affected the cores of the feeder. For this reason, amongst others, pilot wires should always be protected by a light fuse at the feeding point as well as at the station.

For distributors, sizes varying from about 0.3 sq. in. to 0.05 sq. in. sectional area in four stages should be adopted, the existence of the smaller sizes being forgotten wherever possible. A smaller neutral would, of course, be used on D.C. networks but not on A.C. networks, as it must be remembered that an out-of-balance on the two systems has not always the same effect in the neutral cable. The same sizes, with the range extended to a minimum of 0.022 sq. in., would also be used for services. It seems hardly worth while considering a smaller size than 0.022 sq. in. nowadays when the size of the house is no longer an indication of the affluence of the resident.

(To be concluded.)

THE KEEPING OF BATTERY RECORDS.

ACCUMULATORS, although necessarily only a minor part of most generating stations, are nevertheless very important articles, and unless accurate records are kept of them it is very unlikely that the best possible results will be obtained from them. The study of accumulator behaviour is almost a science in itself, and one which a large number of engineers are inclined to treat somewhat lightly. Of the value of complete records of the behaviour of accumulator batteries there can be no doubt; indeed, practically all the leading battery manufacturers who guarantee their goods demand that full records be sent to them regularly in order that they may watch very carefully the life of the cells themselves, and in many cases they are able, by this method, to prevent serious damage to the battery.

When keeping records of accumulators it is well to remember two things: one, the record should show at a glance everything of importance, and two, everything that is not of importance should be left out, as it only occupies valuable space and helps to confuse the issue. We can now ask ourselves what records are necessary in order that the engineer may see clearly what is taking place in the battery. A suggested form of log sheet is shown in fig. 1; readings should be entered on this every half-hour. From it we can see at a glance the exact condition of the battery. We can see whether it is charging or discharging, its capacity in ampere hours, and the rate of charge or discharge. As it is impracticable to test each cell in the battery every half-hour, we can select one cell as the "pilot cell," and its condition as indicative of the condition of the remaining cells. The voltage, specific gravity, and temperature of this cell are noted every half-hour, and from these readings we can get a very accurate conception of the condition of the battery. In very large batteries two, or even more, cells may be used as pilot cells.

In addition to the pilot cell readings, however, a careful examination of the battery should be made every night at a specified time (preferably when the load on the station is at a minimum). These readings should be entered in the "Individual Cell Readings," columns, and upon the voltage or specific gravity of any cell varying from the average, a careful investigation of its condition can be made. A record of all work done on the battery should be noted in the remarks column. Special log sheets could be printed for the battery only, but the better way is to embody it in the station log sheet.

TIME	CHARGING OR DISCHARGING	RATE OF CHARGE OR DISCHARGE AMPS.	PILOT CELL No.			PILOT CELL No.			AMP. HR. METER.	AMP. HRS. CHARGED.	AMP. HRS DISCHARGED.	INDIVIDUAL CELL READINGS.		
			Volts	Sp. Gr.	Temp.	Volts	Sp. Gr.	Temp.				Cell No.	Sp. Gr.	Volts.

FIG. 1.—SUGGESTED FORM OF BATTERY LOG SHEET.

LEGAL.

STOBIE *v.* NEWCASTLE-ON-TYNE ELECTRIC SUPPLY CO.

(Continued from p. 778.)

MR. NORMAN WEST, electrical engineer on the staff of the Supply Co., said that he first met Mr. Stobie when he got in touch with the Supply Co. with a view to that company financing him. That was in 1911, at which time he (Mr. Stobie) had a small works at Sheffield. He (witness) was directly connected with the construction of the Stobie Steel Works at Dunston, which were lent by the Supply Co. In 1915 he became secretary of the Stobie Steel Co., the business of which, at that time, was going very badly, and a supplemental agreement was entered into to get over the difficulty. A control committee of the Stobie Steel Co. was appointed, and witness was a member of that committee from that time until July 31st, 1917. He was at the Stobie Steel Works practically seven days a week, being in charge when Mr. Stobie was away. Mr. Stobie had no separate office in Newcastle, but used to work in a room in his private house. Between 1913 and the early part of 1917 he never heard that Mr. Stobie was carrying on any separate business in the nature of a construction business, and so far as he knew he had no building where he could do any construction. In 1917 the plant of the Bradley Williams works at Dunston was sold by auction. Witness attended the sale with Mr. Stobie and bought for the Stobie Steel Co. a store and 114 yards of main line sidings. That was bought for removal to the steel works. At that time there had been no suggestion of the purchase of the site of the Bradley Williams works. Shortly afterwards, however, Mr. Stobie reported to the committee that he had had an offer from the liquidators of the Bradley Williams Co. to sell the site for £2,000, and gave a glowing account of the possibilities if it were purchased. Mr. Sloan, the managing director of the Supply Co., and a member of the Stobie Control Committee, was against the proposal at first, but in the end he was won over by Mr. Stobie's glowing account of the possibilities. In the end the committee asked Mr. Stobie to prepare an estimate of the cost of equipping the new works with plant and machinery. The object of that was to see to what extent the Stobie Steel Co. would be committed if the project was

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gone on with. Already they had made pig iron in the electrical furnaces at the Stobie Steel Works. Mr. Stobie's idea in acquiring the Bradley Williams works was to manufacture synthetic "pig," and he gave a glowing account of the profits which could be made out of synthetic pig iron, and said he had entered into negotiations with a Sheffield firm, Messrs. Dunford & Elliott, Ltd., to purchase all their output of synthetic pig. He also said that the machinery used for the manufacture of synthetic pig could afterwards be adapted to steel production, and that it would revolutionise the manufacture of steel by the electric smelting process. Upon that the committee sanctioned the project.

Although the hearing had stood adjourned until Wednesday, June 16th, Mr. Tomlin, K.C., mentioned the case on June 15th in the form of an application for postponement. He said that both sides had received telegrams from their respective clients suggesting the desirability of an adjournment with a view to a settlement, and he asked that the case might be allowed to stand out of the list while negotiations were taking place.

His Lordship agreed to this, and the further hearing was ultimately adjourned for three weeks.

COMPENSATION CLAIM.

AT Sunderland County Court, on June 17th, Robert Lawson Black, of Southwick-on-Wear, claimed compensation from Messrs. William Gray & Co., Ltd., of the Wear Shipbuilding Yard, for the death of his son, Robert Allan Black.

Defendants were not legally represented, but wrote offering a payment of £75 in settlement of the claim.

Mr. MALONE, barrister, on behalf of the appellant, stated that on December 16th last the deceased youth was repairing an electric wire at the Wear shipyard when the current was inadvertently switched on by some person unknown, and he was instantaneously killed. Although only 16 years of age, deceased was over six feet in height, and doing journeyman's work. He took a keen interest in his profession, and was attending technical classes with a view to improving his prospects. Under those circumstances he asked his Honour to fix the amount of compensation at £150.

Judge MOORE complied and allowed costs on C scale.

At a later stage of the day Mr. THOS. RICHARDSON, barrister, entered the Court and informed the judge that he had been instructed to appear for the defendant company, but owing to the unsatisfactory train service the solicitor concerned and himself did not arrive in the town until the case was over. He therefore asked for a re-hearing on the ground that his clients considered the sum paid into Court was adequate.

Plaintiff's solicitor said Mr. Malone had then gone, but he (the solicitor) would raise no objection to the case being reopened.

His HONOUR said he would grant a rehearing at the next sitting of the Court, but on the facts as placed before him, he did not think there was much chance of his decision being altered.

In view of this expression from the judge, Mr. Richardson said his clients would again consider the matter.

CUDDON *v.* ROBINSON.

A NOVEL and interesting point of law, arising out of the special war legislation, involving the question as to whether electrical installation for lighting purposes could be regarded as coming within the term "decorations" was raised in an action before Sir Francis Newbolt, High Courts Official Referee, which terminated on June 15th, after a hearing which occupied five days. The plaintiffs, Messrs. John Cuddon and Co., builders, of West Norwood, claimed from Mr. Henry Taylor Robinson, of Rosendale Road, Dulwich, the sum of £89, balance of account of £609 for work done and materials supplied, and the defence set up was that the contract being one for over £500 the work required the sanction of the Minister of Munitions, and such sanction not having been obtained, the money was irrecoverable. The plaintiffs' case in answer to this plea was that the work was done under orders given from time to time, and that even if the work could be regarded as coming within the terms of the order, after deducting the expense of putting in the electric light (£123) the cost would be brought down to a figure considerably below the £500.

Mr. HENRIQUES, representing the plaintiff, argued that electric lighting was not decoration, and therefore did not come within the regulation laid down by the order of July, 1916, which made it lawful for the Minister of Munitions to authorise or prohibit the carrying on of building work. But the regulation was in relation to construction work or demolition, and the question was whether the work in question could be called either the one or the other. The electric lighting was carried out by Mr. Seagrove, electrical engineer, of Dulwich, whose charges included the supply of Osram lamps, brackets, and fittings, and defendant said that when an estimate of the probable cost of the work was given to him he understood it was to include the electric light installation.

The evidence related chiefly to matters of detail, after hearing which, judgment was reserved.

The OFFICIAL REFEREE, in giving judgment on June 18th, decided that the defence of illegality had not been made out. It was, he said, abundantly clear that when the contract was made it was thought by both parties to be a smaller job than it turned out to be, although, even now, including the cost of electric lighting, it scarcely exceeded the limit of £500 named in the order of the Ministry of Munitions. The work was certainly not illegal *ab initio*, and the defendants contended that it became illegal when items were ordered bringing the cost over the limit at which time the parties ought to have known that a licence would be required, but he was not convinced that the electrical installation which amounted to £123 16s. 3d. was included in the words "construction, alteration, repairs, decoration, or the demolition of buildings," and it was clear to his mind that in this particular case the total cost of the whole completed work in contemplation relating to repairs and decorations never exceeded £500. That defence, therefore, failed. It was common ground that until the work was finished and the final account prepared neither party knew that a licence was necessary. In deciding, upon an analysis of the evidence, that plaintiffs were duly entitled to the reduced amount of £21 5s. 3d. on the claim, Sir Francis said that although the defendant had succeeded in reducing the claim, the expenses had been increased by the defence of illegality, and he therefore, in giving judgment for the plaintiffs for £21 5s. 3d., ordered the defendants to pay to plaintiffs half of the taxed costs on the High Court scale.

HUGHES *v.* BRITISH ENGINE, BOILER & ELECTRICAL INSURANCE CO., LTD.

MR. JUSTICE P. O. LAWRENCE, in the Chancery Division, on June 17th, heard an action in which Edwin Hughes, an insurance broker, of Swansea, sued the defendant company, of Manchester, for payment of commission on all policies of insurance effected with the defendant company through his introduction, and for an allowance for expenses and services rendered in connection with a scheme of "Engine Time Lost" insurance which was dropped.

Mr. R. A. WILLES, for the plaintiff, said he acted as the defendant company's whole-time agent in South Wales for ten years, viz., from 1908 to 1918, and the connection came to an end as a result of a dispute concerning the payment of expenses. The terms upon which he worked were 15 per cent. on all boiler, engine, and electrical plant insurances. There was no agreement about expenses, but the defendant company told him that if they found that he had incurred travelling expenses on their behalf, they would act in a businesslike and reasonable way.

Mr. BEEBEE, for the defendant company, said they disputed the rate of commission. While it was 15 per cent. on boiler and electrical plant policies, it was only 10 per cent. on engines.

Mr. WILLES went on to say that the "Engine Time Lost" scheme was for insurance in case of engine breakdowns, but although the plaintiff made considerable preparations for working the scheme and obtained favourable terms for underwriting the policies at Lloyd's, the defendant company were compelled to drop it, as they were bound by an arrangement with their own London underwriters to do the business through them. The plaintiff claimed something on account of the time and trouble he had been put to in connection with the matter.

Following an intimation from the judge, the parties agreed to an account being taken of the commission to be paid.

With regard to the claim for expenses and services rendered, Mr. Beebee submitted that there was no contract between the plaintiff and the defendant company.

His LORDSHIP said he should allow him something for his trouble.

Mr. BEEBEE then said the defendants were prepared to make him an entirely *ex gratia* payment of £10.

His LORDSHIP said that this would meet the case, and the plaintiff accepting, he made an order for this payment in full discharge of all claims under this head, and reserved the further consideration of other questions, including that of costs, until after the account had been taken.

UNFENCED MACHINERY.

AT the Hang East Petty Sessions the Masham & District Electric Supply Co., Ltd., were summoned for failing to have the projecting end of the main horizontal shaft at the Masham Electric Power Station securely fenced on April 15th. Mr. S. R. Bennett, H.M. Inspector of Factories and Workshops, prosecuted.

Mr. BENNETT stated that on April 15th a fatal accident occurred at the power station, and it was arising out of that that the case had been brought before the court. The shaft was 3½ in. in diameter, and was the main driving shaft of the dynamo. It was situated horizontally about 3 ft. above the floor and the end of it projected 8 in. from the bearing quite close to the passage, which was used for entering and leaving the station. On the date mentioned a youth, Frank Atkinson, aged 19, who was not an employé, visited the place for the purpose of seeing someone. His coat was caught

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in the shaft, which was a revolving one, and he received injuries to which he later succumbed.

Evidence showed that the youth who was killed was wearing a mackintosh which was wet owing to a heavy shower of rain.

Mr. HEDDON, for the defendants, admitted the facts, and said the death of the youth was a most lamentable affair. The shaft was a perfectly smooth one, and it appeared that the mackintosh had stuck to it. There had now been a proper fence placed round.

The CHAIRMAN said the magistrates thought that the inspector did quite right in bringing the case, but they felt that no useful purpose could be served by inflicting a fine, as it was the publicity which was needed. They thought justice would be met by the payment of costs by the company.—*Yorkshire Herald.*

FAWCETT *v.* LINDSELL.

AT Devon Assizes, at Exeter, before Mr. Justice Bray, this action was down for hearing. Plaintiff, an electrical engineer, of Plymouth, claimed from defendant, Mr. W. J. Lindsell, of New Street, Paignton, £147 for work and material supplied in connection with an engine for a kinema theatre. There was a counter-claim, the defendant alleging that the engine was defective.

Mr. ROBERTS, for the defendant, informed his lordship that Mr. Lindsell had agreed to judgment for the full amount claimed and the dismissal of the counter-claim with costs on the plaintiff undertaking to repair the defect in the engine to the satisfaction of some engineer to be mutually agreed on.

Judgment was entered accordingly.

CHARGE OF STEALING LAMPS.

AT the West London Police Court, on Saturday, before Mr. Boyd, Jack West, 17, electrical engineer, 213, Hampton Road, Twickenham, was charged with stealing, by means of a trick, 30 electric lamps, valued at 15 guineas, belonging to Messrs. W. C. Tackley & Co., electrical engineers, 93, Hammersmith Road, W.; also 24 electric lamps belonging to the Delta Electrical Co., 584, High Road, Chiswick, and 36 electric lamps belonging to Ernest Chamberlen, electrical engineer, 196, King Street, Hammersmith.

Mr. D'ARCY HAMILTON, manager to Messrs. Tackley, said that on May 28th the accused entered the shop, and, representing himself as an agent of the City, Hall & Ellerman Shipping Co., ordered 30 half-watt lamps. He requested that a messenger should accompany him to the docks with the lamps, and said that payment would be made at the company's office. Witness dispatched a messenger with the lamps, but the lad afterwards returned without the money, and witness informed the police.

Evidence having been given, Det.-Sergt. Parsons told the magistrates that the accused had confessed to 17 cases, and had promised to assist the police to recover the property.

A remand was ordered.

THE DESIGN OF A SUPER-POWER STATION.*

By H. GOODWIN, Junr., and A. R. SMITH, of the General Electric Co., U.S.A.

(*Continued from page* 797.)

The first consideration in the electrical design is the determination of the fundamental connections between the generators, buses and feeders.

In this particular case one of the specified conditions was distribution by means of 66,000-volt underground single-conductor cables. It was decided that the concentration of energy in a short circuit on these cables should be limited to 500,000 K.V.A. on account of the possible resulting damage to adjacent cables. Comparing this with the rupturing capacity of available 66,000-volt oil switches showed that a switch having a rupturing capacity of 583,000 K.V.A. would best suit the service. It should be noted that the capacity of a generator is practically equal to the capacity of a transformer bank, and that one feeder working at full capacity would distribute the entire load of a generator and transformer bank.

Preliminary calculations proved the necessity of sectionalising the station bus by reactors in order to approach the 500,000-K.V.A. limit which had been set. Both low-tension and high-tension buses were considered, but the use of a low-tension bus was not only found unnecessary, but made the problem much more difficult. The reactance of the transformers added directly to the generators before either were connected to the bus would assist in reducing the short-circuit intensities very considerably.

The transformers in any case would have a reactance of 8 per cent. The generators would have a minimum reactance of 12.3 per cent., and under certain conditions this might be increased to 28.5 per cent. Therefore, the calculations were carried through for various values of generator reactance.

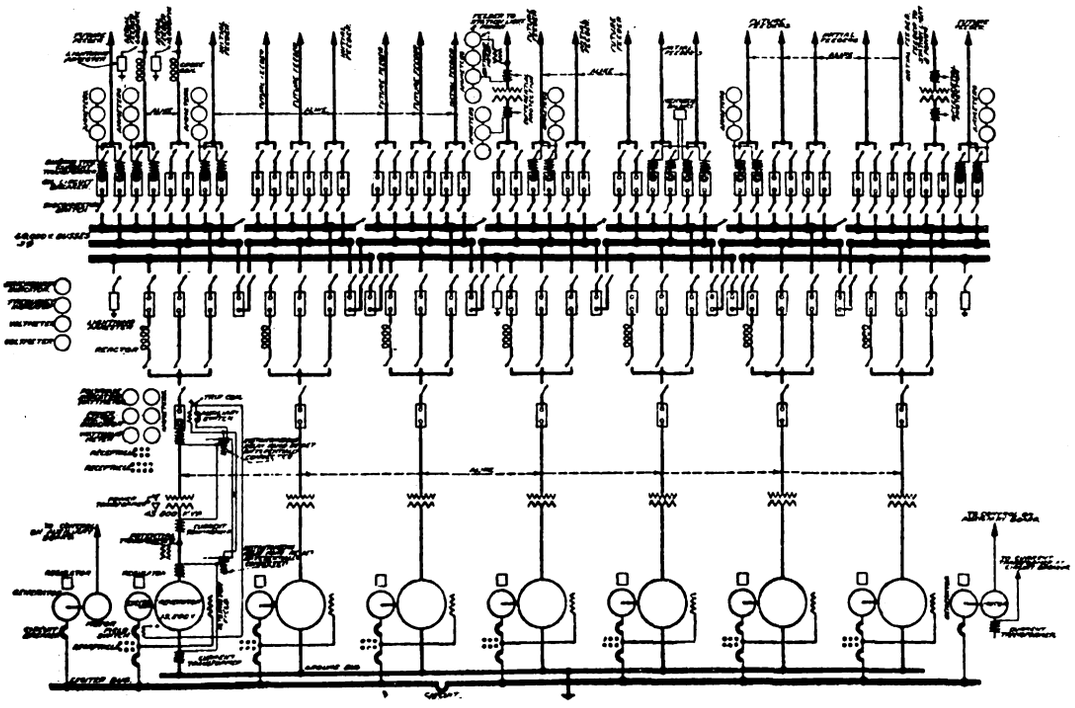

FIG. 5.—MAIN SINGLE-LINE WIRING DIAGRAM.

The minimum size of reactor which could be used with generator reactance of 15 per cent. in order to limit the short circuit intensity to approximately 500,000 K.V.A. was 9 per cent. A synchronising bus is necessary in order to limit the reactors to a reasonable size. The reactors should be rated to carry the total output of a generator.

It was desired to keep a unit arrangement right through the station, and this meant that the switchgear for each generator and its group of feeders should not occupy more length than would be required for the corresponding mechanical equipment of generator and boilers. Fortunately these

* From the *General Electric Review*, May, 1920. Abstract.

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all work together very well and allow enough space on each generator stub-bus for the feeders required.

Fig. 5 shows the final solution. The neutral point of each generator will be earthed directly and positively. Since there is no low-tension bus, earthing of all generators cannot cause circulating harmonic currents between the generators. The main leads of each generator are connected directly to the corresponding transformer bank and through a main oil switch to a stub-bus.

The transformer connection is delta on the low-tension side and Y grounded on the high-tension side. It is particularly necessary that the earth resistance be made very low so that in case of short circuit on one of the single-conductor cables the neutral may not be distorted, thus placing an increased voltage stress on all the cables of the other phases.

From each generator stub-bus three connections are made; one through the reactor to the synchronising bus and the other two to double feeder stub-buses. The three selector switches connecting to the buses are non-automatic. The main switch is arranged for automatic opening in case of internal failure in the generator or transformer. This is accomplished by the use of relays differentially connected around the generator and around the transformer bank. Oil switches are shown for breaking the synchronising bus at two points, so that a section may be readily cleared for cleaning, extension, or repairs. The stub-buses are also arranged to be connected together so that at times of light load a small number of generators may carry the load of the whole station without feeding through the reactors. Referring to fig. 5, connection between the stub-buses in the lower line is provided for by oil switches, and in the upper line by horn-pipe air-break switches. The oil switches would be operated from the main bench board and the air break switches locally by hand through permanent levers.

Each feeder is equipped with two oil switches to select either of the two stub-buses. Each would be equipped with induction-type overload or other suitable type of relay, depending on the detail connection and interconnection of the distribution system.

It is thus seen that a very complete and flexible arrangement is provided. Normally, the generators are operated in parallel through the reactors and synchronising bus, but it is possible by proper interconnection of the feeder stub-buses to transfer loads from one generator to another in almost any manner desired.

Each generator will have a direct-connected exciter controlled by an automatic regulator. With this method no main field rheostat is necessary. The exciter will be provided with a field rheostat. For emergency excitation two motor-generator sets are proposed, supplying a sectionalised bus. These spare exciters will also be provided with automatic regulators. The motors driving the exciters will be supplied from the main station power board, but will be controlled from the main auxiliary board opposite the bench board. Indicating lamps on the power board will show the position of the switches so that there may be no danger of the operator of the station power board pulling disconnecting switches or otherwise interrupting service to a motor-generator exciter set while in operation.

As previously outlined, it was determined that turbines for auxiliary power would be necessary and that these should be connected with the main buses through a central auxiliary switchboard and transformers. A detailed study showed that one auxiliary turbine could best be used in connection with two main turbines, and that these auxiliary units should be rated at 2,500 KW., 0.7 p-f., 3,570 K.V.A.

For the control of the auxiliary turbines and the supply of essential auxiliary power it was found necessary to provide a switchboard near each auxiliary turbine, and for the general auxiliary power a central switchboard located on the switchboard gallery with tie cables to the four auxiliary units.

Fig. 5 shows two banks of station power transformers. It it proposed that each bank be composed of three single-phase 1,250-K.V.A. units, making a bank capacity of 3,750 K.V.A. connected delta-delta. These transformers would be located out of doors. The high-tension switches would be controlled from the main bench board and the low-tension switches from the auxiliary power board.

The reactance of the auxiliary transformers must be considered in connection with the reactance of the main units in order to limit the concentration of energy on the station power bus to a value which can be handled by reasonably small switches. Reactors are required in each of the four feeders connecting to the turbine auxiliary switchboards to limit the short-circuit intensity and permit the use of small rupturing capacity switches. It is proposed that these tie feeders to the turbine auxiliary boards be protected by differential relays connected to current transformers at each end of each line. In case of trouble on a cable it will be automatically disconnected and will allow the auxiliary turbine to continue supplying the essential auxiliaries without interruption. Reverse energy protection at the turbine auxiliary boards is also provided so that in case of a severe drop in voltage or frequency on the main system, the auxiliary turbines will be automatically disconnected and allowed to run independently, carrying the essential auxiliaries.

The central auxiliary board would be a vertical one with mimic buses and electrically-operated remote-control oil switches.

For station lighting three 75-KW. single-phase transformers controlled independently would form the supply. It is proposed that all lighting feeders be 3-wire, 115/230 volts, and be arranged in three groups which will normally operate on different transformers, but which in case of failure of a transformer can be manually thrown to one of the other transformers. By a connection from the 125-volt D.C. board, which will control the storage battery for circuit-breaker control, in case of failure of service on the A.C. lighting system certain emergency lights will be automatically connected to the battery.

The low-voltage power board is supplied by two 150-K.V.A. transformer banks operating at 240 volts, 3-phase. This board is arranged for miscellaneous power supply, such as the machine shop, turbine room cranes, house supply pumps, &c., also for the supply of motor-generator sets for charging the storage battery and a spare motor-generator exciter set for the auxiliary turbines.

(To be concluded.)

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

A New Car Lighting Dynamo.

A new dynamo for the lighting systems of light cars has recently been developed by MESSRS. H. F. FOSTER & Co., LTD., Ashley Works, Epsom, and is illustrated in fig. 1. The output regulation of this small dynamo at varying speeds is achieved by a novel method, namely, by slightly shifting the brush rocker so as to give the brushes a greater "lead" as the speed increases. This movement is imparted automatically by means of either a control arm or, if desired, a Bowden wire, one end of which is attached to the brush rocker and the other either to the accelerator pedal or to the throttle lever of the carburettor, so that as the throttle is opened the lead of the brushes is automatically increased. The advantages claimed for this method are, first, a very close and accurate regulation of output at widely differing speeds; secondly, the ability to fix the point in the output curve at which it is desired to commence the regulation at any figure desired, either for fast or slow traffic; and thirdly, the fact that until this predetermined point is reached the output is not interfered with in any way, the dynamo generating up to such point as a simple shunt wound machine. The dynamo is so designed as to ensure sparkless commutation at all positions of the brush rocker. The M-type model for light cars is extremely compact, the dimensions of the magnet frame being only some 4 in. by 4 in. by 5 in., and generates its full rated output of 50 watts at 6 volts at the exceedingly low speed, for such a small machine, of approximately 1,500 R.P.M. The automatic cut-out is incorporated as a self-contained unit in the dynamo, avoiding the necessity of mounting a separate instrument on the dash board of the motor car.

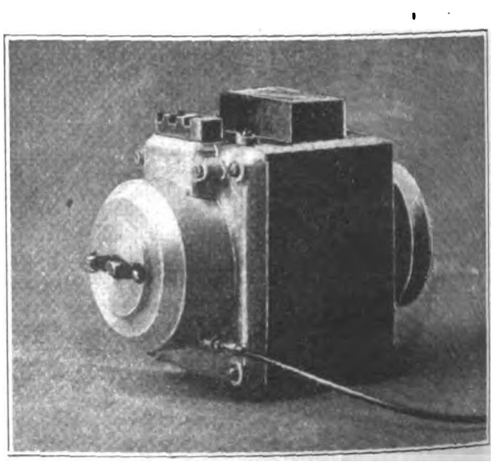

FIG. 1.—CAR LIGHTING DYNAMO.

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A B.T.H. Pedestal Switch.

A recently published catalogue of oil-break switchgear by the British Thomson-Houston Co., Ltd., of Rugby, includes the pedestal switch illustrated in fig. 2. This is composed of an oil-break switch (300 amps. at 660 volts), time lags, ammeter, voltmeter (up to 660 volts), and a low voltage release.

"Welco" Fixing Frames.

In view of the constantly increasing cost of labour, any device which effects a saving in that quarter is sure of a welcome. All operations that can be performed in the factory should be done there, and as little as possible should be left to do on site.

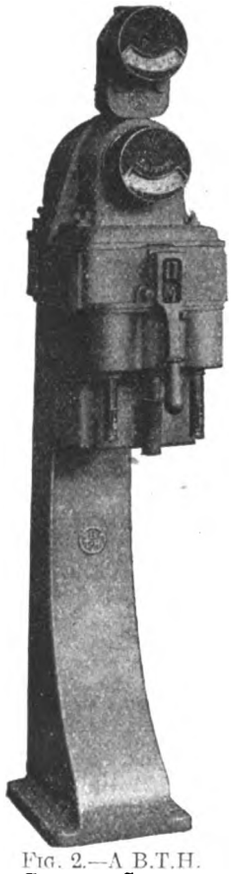

Fig. 2.—A B.T.H. Pedestal Switch.

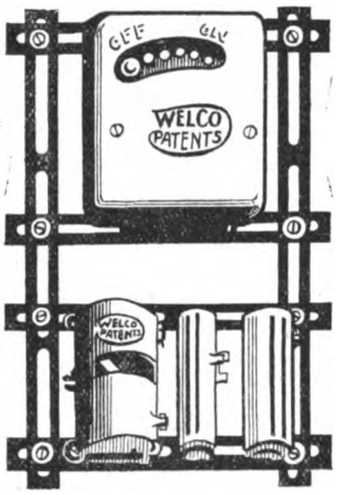

Fig. 3.—Welco Fixing Frames in Use.

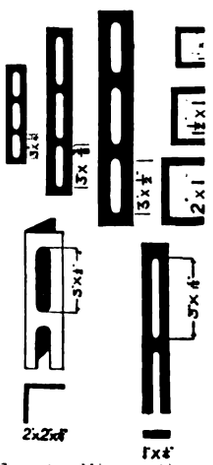

Fig. 4.—Welco Frames and Materials.

These principles are embodied in the "fixing frames" brought out by Messrs. Welco Patents, of 150, Alma Street, Birmingham. The frames consist of slotted channel bars, which are fixed direct to the wall; across these any number of slotted channel bars can be mounted with the greatest ease, forming a framework of any shape or size to carry switchgear, motor starters, meters, &c. Drilling, tapping, forging, and fitting are completely dispensed with. The bars are made in standard sizes, and in addition, mild steel channel, flat, and angle bars are stocked, all ready slotted for mounting on the frames, so that practically all requirements can be met. The simplicity and adaptability of this device are obvious, and it is certain to be found extremely useful in a great variety of applications. Fig. 3 shows a meter and switch mounted on the frame, and fig. 4 shows some of the patterns of bars and materials that have been standardised.

The fixing frames are provided with lugs giving a clearance between the frame and the wall of 1¼ in. The slotted bars are made up to 8 ft. long, and the slots can be adjusted to meet any screw or bolt holes in the apparatus to be fixed thereon; should it be necessary to fix new apparatus on the frame, it can be readjusted to suit the new spacing of the holes with facility.

Lugs for Clamping Bands.

In many cases a flexible band is necessary wherewith to constrain to a certain diameter a number of pieces to complete a whole circle. These pieces must be securely held while certain operations of boring, turning, or facing, or all of these, are being performed. The usual way is to rivet L-shaped lugs on a steel band, but this is useless for holding the segments under the lugs, as the band pulls away from the segments and these become loose. In fig. 5 a band is shown, devised by Mr. J. T. Towlson, of Silvertown, which removes this objection. The fore feet protect the lugs from bending, and so long as the lugs do

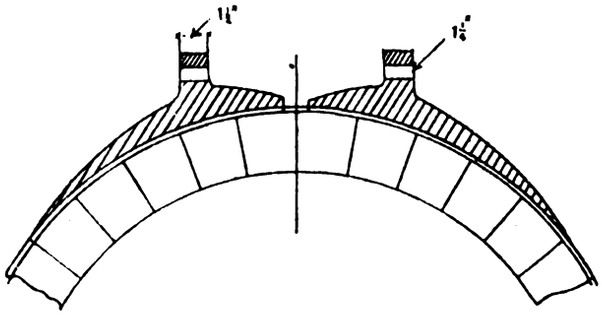

Fig. 5.—Lugs for Clamping Bands.

not bend the whole of the segments are securely held. The lugs may be riveted, but the up-to-date method is to weld them on.

An Electric Soldering Iron.

An electric soldering iron, designed by Mr. W. H. Browning and manufactured at the Imperial Electrical Works, 7-12, Imperial Mews, St. Martin's Avenue, East Ham, E.6, is illustrated in fig. 6. This is a very compact device weighing only 2¼ lb. and measuring 16½ in. in length. The main

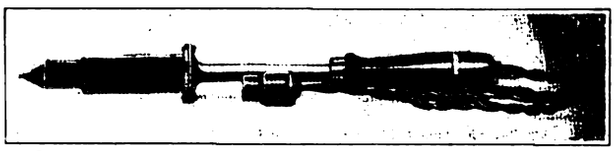

Fig. 6.—Electric Soldering Iron.

feature of this iron is that no screws are used in the construction of the heating portion, and scaling, with consequent loss of heat, is eliminated. Every part is easily renewable, and a six months' guarantee of reliability is given. The element is wound for any standard voltage, and the total loading is 300 watts.

The Decimal Association.—The report of the Association for 1919-20 gives a complete record of activities in many directions. A list of bodies to whom lectures on the subjects of decimal coinage and the metric system have been given is included, as well as the names of Chambers of Commerce and other associations and councils which have passed resolutions in favour of the adoption of the schemes for which the Decimal Association stands. In recording the Majority Report of the Royal Commission on Decimal Coinage, the Association makes it clear that the adverse result will only serve to stimulate its energies. The result of a *questionnaire* sent to over 15,000 firms, &c., resulted in an overwhelming majority in favour of the metric system. The financial statement for the year shows a deficit of £578, and it is hoped that special donations will be received from subscribers to ensure a better result for the present period.

Lighting the Albert Hall.—The Albert Hall, after preserving for so many years its Victorian atmosphere has at last linked itself with modernity through the installation of up-to-date lighting. The present lighting is provided by 16 1,000-watt Mazda half-watt type lamps in large Mazdalux metal reflectors. These units are fixed high up in the central dome, from which position they shed an intense illumination over the whole auditorium. The great height of the lamps eliminates any risk of glare, because it is impossible to see them without looking directly upwards. The improvement in the illumination, as compared with that given by the arc lamps, is extraordinary, and is due, not to any increase in the light generated, but rather to its more effective distribution, and the audience is able to read its programmes and papers with perfect ease.

In a place like the Albert Hall, where the lighting units are necessarily very difficult to get at, the question of maintenance is of extreme importance. Obviously, the new method of illumination is vastly superior to the arc lamps in this respect. The half-watt lamps need no attention whatever until the time arrives for replacement, and with the vitreous enamelled Mazdalux reflectors used the amount of cleaning required is reduced to the absolute minimum.

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BUSINESS NOTES.

Openings for Salesmen.—Messrs. Fuller's United Electric Works, Ltd., wish to secure the services of a number of well-educated young men for their outdoor sales staff who have a live connection amongst garages and electrical engineers.

The King's Car.—Messrs. Vandervell & Co., Ltd., the manufacturers of the C.A.V. electrical products, have just completed the addition of their new coil ignition system to the lighting and starting installation already fitted to His Majesty's 57-h.p. Daimler. This company recently received the Royal Warrant, its equipment being fitted to the whole of the Royal fleet of automobiles.

Efficiency Exhibition.—We have received an advance prospectus of an "Efficiency Exhibition" which is being organised by the *Daily Mail* to be held at Olympia from February 10th to 26th, 1921. Special attention is being devoted to the place of science in industry, and the Electrical Development Association, the Federation of British Industries, the British Science Guild and similar bodies have offered their assistance to the scheme.

Annual Outings.—The staff of the General Electric Co., Ltd., Glasgow branch, held their annual outing on Saturday, June 12th, at Tighnabruaich. A fine programme of sports was carried through in very fine weather. After tea Mr. P. J. Sims, manager, thanked the staff for the splendid support given him during the year just closed. Mr. A. G. Hawkins, assistant manager, also addressed the staff. Mrs. P. J. Sims presented the prizes.

The Designs Section of the Engineer-in-Chief's Office, G.P.O., held their fifth annual outing on Saturday, June 19th. The party of 24 visited Richmond, walked through the Park, Ham Common, and the tow-path to Kingston, where tea was provided. After a short stay at Kingston, the party divided and made for Hampton Court by tram and steam launch respectively. The Maze proved a severe test of the mechanical training and bump of location possessed by those entering it. The glorious weather helped to make the outing the most successful yet held.

Trade with Spain.—The *Board of Trade Journal* for June 17th contains some notes giving advice to firms anxious to establish connections in the Spanish market. Those who are not quite familiar with that market would be well advised to study the suggestions that are made, as the result of reports from British Consular officers and others, respecting signature of letters, language, addresses, and style of correspondence.

American Cable for Sweden.—According to a Stockholm newspaper, a contract has been concluded with an American firm for the supply of an underground cable, to be laid between Stockholm and Gothenburg. It will be from 250 to 300 km. long, and will cost about $3,200,000. The cable, it is said, will be the longest underground cable in Europe, and the third largest in the world.

Liverpool Electrical Strike.—The strike of the Liverpool cable-jointers and street-box examiners, Electrical Trades Union men, and 200 navvies employed in cable-laying for the Liverpool Corporation electrical supply department, has been in progress now over five weeks, and there seems no prospect of an immediate settlement being arrived at. The navvies' grievance is that they are not being paid the town rate of 2s. per hour, which is paid by the Master Builders' Association. The work of relaying and repairing the Corporation cables is, therefore, being held up.

Conduits for Canada.—United Kingdom firms who can quote for early delivery of standard sizes of conduits for electrical installations are invited to cable to H.M. Trade Commissioner at Toronto ("Toroncom, Toronto"), who has telegraphed to the D.O.T. in London on behalf of an inquirer in Ontario.

Hydro-Electric Strike in Canada.—The *Times* stated on June 19th that practically all the employés of the Ontario Hydro-Electric Power Commission engaged on the Chippewa power canal were striking for a 10 per cent. increase in wages, which would add about £450,000 to the cost of the work. Two days later our contemporary reported that owing to the strike, the Commission had decided to suspend work there, and 1,500 employés would be obliged to seek work elsewhere.

Copper and Lead Prices.—Messrs. F. Smith & Co., report June 22nd:—Electrolytic copper bars, £105, £5 decrease; electrolytic sheets, no change; electrolytic wire rods, £120, £5 decrease; electrolytic h.c. wire, 1s. 3¾d., ¼d. decrease; silicium bronze wire, 1s. 11½d., ¼d. decrease.

Messrs. James & Shakespeare report June 23rd:—Copper bars (best selected) sheets and rods, £158, £3 decrease; English pig-lead, £35 10s., 10s. increase, on last week's prices.

Lamp Manufacture in Belgium.—With the title La Société Belge pour la Fabrication de Lampes Electriques L.E.B., a new company has lately been formed in Brussels (4, Montagne du Parc), with a capital of 2,000,000 fr., to manufacture electric lamps.

International Commerce.—Meetings are now in progress in Paris, attended by representatives of various British banking and commercial organisations, for the purpose of establishing an International Chamber of Commerce.

Catalogues and Lists.—The General Electric Co., Ltd., 67, Queen Victoria Street, E.C. 4.—Installation Leaflet No. P 2,327 (4 pp.). An illustrated description of the electrification of a large Scotch hosiery mill.

The Vaughan Crane Co., Ltd., Openshaw, Manchester.—Booklet No. 7 (29 pp.). A well-produced, photographically-illustrated booklet describing the "Vaughan" electric block and its application to various types of cranes.

The Anglo-Mexican Petroleum Co., Ltd., 16, Finsbury Circus, E.C. 2.—"The Story of Mexican Petroleum" (35 pp.). A photographic record of the work of the company, reproducing from pictures on exhibition at the Crystal Palace some excellent views of Mexican oilfields, &c.

Messrs. Mann, Egerton & Co., Ltd., Norwich.—Booklet, "The Sign of Service," giving a *résumé* of the firm's various departments and their activities and addresses.

Messrs. Higgs Bros., Dynamo Works, Sand Pits and Summer Hill Street, Birmingham.—Latest abridged list of A.C. and D.C. motors. Priced and illustrated.

Messrs. Charles Churchill & Co., Ltd., 9-15, Leonard Street, Finsbury, E.C. 2.—Pamphlet illustrating "Fluxio" high-speed tipped cutting tools of various types.

Messrs. R. B. Hand & Co., Ltd., 63, High Holborn, W.C.1.—Up-to-date price-list of electrical fittings, including most wiring necessaries, conduits, cables, switches, &c.

Messrs. Watson & Sons (Electro-Medical), Ltd., Sunic House, Parker Street, W.C. 2.—Leaflet (265) dealing with clocks for timing X-ray exposures and the Smart-Bristow medical coil. Illustrated and priced.

British Insulated and Helsby Cables, Ltd., Prescot, Lancs.—Two illustrated leaflets, No. H 89, dealing with Leclanché batteries; and P 161, describing "Prescot" jointing materials and accessories, including compounds, tapes, and connectors. The latter is fully priced.

Dissolutions of Partnerships.—Wheeler & Ison, electrical and mechanical engineers, Homeleigh, Whippendell Road, and 190, Harwoods Road, Watford.—Messrs. G. Wheeler and W. Ison have dissolved partnership.

Wood & Hague, ignition and lighting specialists, 1A, Saunders Street, Southport. Messrs. T. & J. Hague and S. Wood have dissolved partnership. The Messrs. Hague will attend to debts and continue the business.

Trade Announcements.—Mr. W. Johnston, for over 30 years with Messrs. Wm. Dow & Sons, Ltd., has, with his son, commenced business as electricians at 20, St. Andrew Street, Kilmarnock, under the style of William Johnston & Son.

Mr. R. Millett has been recently appointed by the Electric Construction Co., Ltd., Wolverhampton, as their sole Lancashire and Yorkshire agent. Offices, 30, Cross Street, Manchester. Tel. No.: 7772 City.

Messrs. E. Shipton & Co., of 14, Great Queen Street, Kingsway, W.C. 2, announce that on June 28th their business will be transferred to larger premises at 52, Floral Street, Covent Garden, W.C. 2. Telephone No.: Gerrard 374.

Owing to expiration of lease, Mr. E. Goldston, electrical engineer, 28, Marefair, Northampton, has removed to temporary premises at 13, Horsemarket, Northampton.

The B.E. Co. (of London and Birmingham), Ltd., is desirous of appointing agents for its Hendon drawn-wire lamps, not for its general supplies.

Company Liquidations.—The Kinetic Co., Ltd.—Winding up voluntarily. Liquidator, Mr. T. Rimington, 43, Gallowtree Gate, Leicester.

Telephone Manufacturing Co., Ltd.—Winding up voluntarily for reconstruction purposes. Liquidators, Mr. F. T. Jackson and Mr. C. W. Rooke.

Selson Engineering Co. (France), Ltd.—Meeting of creditors is called for June 28th, at 85, Queen Victoria Street, E.C.

Norman, Johnson & Co., Ltd.—Voluntary liquidation. Mr. J. K. Garioch, 16, King Street, E.C. 2, liquidator. Meeting of creditors, June 30th.

For Sale.—West Hartlepool Corporation Electricity Department has for disposal one 600-kw. Belliss-Parker D.C. generator set; also one 100-kw. Belliss-Crompton D.C. generator.

By direction of the Disposal Board, Ministry of Munitions, Mr. H. Baskett will sell by auction, on July 13th, 14th, and 15th, at the Ordnance Stores, Abbey Field, Colchester, a quantity of electrical stores, including cable, telephone sets, switchboards, &c.

Assets Auctions Co., Ltd., will sell by auction, at 119-121, Newington Causeway, S.E., on June 30th, the stock of an electrical goods factor.

Wigan Corporation Electricity Department invites offers for one Willans high-speed compound engine and condenser, direct-coupled to Dick, Kerr 560-volt generator; also a quantity of spares. Full particulars are given in our advertisement pages to-day.

White City Motor Show.—There is to be a great motor show at the White City in November. The buildings there have now been vacated by the Government, and members of the Society of Motor Manufacturers and Traders are to fully co-operate in the display. A further series of exhibitions representative of the various trades and industries of the country will follow.

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Lead.—In their report dated June 19th, Messrs. James Forster & Co. say :—

We estimated last week a current consumption of 145,000 tons per annum, which we considered less than the actual. We are informed by actual consumers that the consumption of sheets and pipe has averaged 5/6,000 tons per month since May last year. We are also informed that the consumption of the electrical trades is nearer 100,000 tons a year than our figure of 60,000 tons. Our total should therefore be increased to 180,000 tons, or 15,000 tons per month, against which we have in available imported lead 30,000 tons in the last seven months. This condition of things is certainy not reflected on the London Metal Market, where values have been knocked down daily by continued realisation of old "Bull" accounts, and on Wednesday reached the heavy fall of £3 per ton on the day. . . . Consumers, naturally, have been absent, and there has been little export demand.

Messrs. G. Cawson & Co. state :—

The liquidation of the June account in lead has continued; in fact this account has turned out to be much larger than anticipated. June lead sold down to £31 5s. At the decline consumers have come forward and bought considerable quantities. The lower prices no doubt have encouraged them to cover not only prompt but also some of their forward requirements. Quite a good business has been done in all positions. The market has now a healthier appearance. There has been a little more export enquiry. . . . We calculate roughly that the total quantity of Australian lead still to be shipped is about 30,000 tons. Part of this, however, may go to the States, so that if the strike is not soon settled we may perhaps see some scarcity of lead later in the year. Many things, however, may happen before this occurs. Meanwhile, the supply of lead is ample. . . . The outlook is now decidedly more encouraging, and the lower level of prices will no doubt bring fresh buyers.

Electrical Window Displays.—The contributor of a recent article entitled "What is the Contractor Doing?" mentioned among other matters the want of attractive window displays. The criticism appears to be justified, and it is to be hoped that at a time when the public interest can be easily drawn to electrical labour and coal saving and dirt-avoiding appliances, there will be a greater display of show-window originality and enterprise in all our big centres. Messrs. A. Emanuel & Sons, Ltd., of George Street, Manchester Square, W.1, who have written to us on this matter, hold that the criticism is particularly applicable to British manufacturers, while American firms in this country are alive to this important side of electrical selling. They have sent us the accompanying photograph of a window display of electrical cooking devices, which shows the co-operation that

ELECTRICAL WINDOW DISPLAY.

is sometimes noticeable between the contractor and the American manufacturer. The contractor in this case was not very easily persuaded to agree to the window display, but we are assured that the results have been remarkable considering that this was his only shop, and that it was in a side thoroughfare. We would urge manufacturers and contractors to co-operate enthusiastically along such lines, for we believe that the effort would be well worth while.

Herr Deutsch on German Industrial Conditions.—According to the *Economic Review*, the *Excelsior* publishes a statement by Herr Deutsch, a director of the A.E.G., concerning the effect of a Franco-German economic rapprochement and present conditions in Germany. Such a rapprochement would, he averred, have excellent results, and France need not fear Germany's competition, as the latter was scarcely in a position to carry out the orders already in hand. The whole world was inundating Germany with orders far beyond her present capacity. The word "sale" had no longer any meaning; in future, it would only be possible to speak of "production." The eight-hour day was a calamity for the whole world. If normal conditions were ever to be restored the miners must work ten hours, and all other workers twelve hours a day. Production was everywhere hampered by the lack of labour. Germany would call upon her workers to strain every nerve, and they would obey without fail, if only wholesome and ample food could be assured; otherwise all efforts would be in vain. In reply to the question whether the Customs tariff would have to be altered if an agreement were reached, Herr Deutsch said that no change would be made at present, but the commercial treaties would have to be revised at a later date. With regard to Germany's foreign exchange, he declared that it would recover for a space, but would then, he believed, experience another heavy fall.—*Neue Freie Presse*, May 26th.

Notes on Trade with Japan.—The Commercial Counsellor to H.M. Embassy at Tokio (Mr. E. F. Crowe, C.M.G.), has recently made a tour among firms and works in this country. In the *Board of Trade Journal* he writes :—

"This is my third experience in visiting the industrial centres in this country, and on each occasion I have found that the interest displayed in foreign trade has grown. In the past, complaints have often been made about British manufacturers not adapting themselves to the needs of particular markets, but as far as my own experience goes I have been surprised at the wonderful adaptability of the British manufacturer and his keenness to seek trade abroad, and his anxiety to conform to foreign requirements. Many of the firms are, of course, booked far ahead, but they are prepared to allot part of their output to foreign buyers, and all of them appear to be anxious to avail themselves of the machinery which the Government have now placed at their disposal for the purpose of collecting information abroad. In the course of my tour I have met several associations of manufacturers and merchants, and it has been possible, with their assistance, to draw up forms of questionnaires giving the kind of information which is needed by firms in this country. It is hoped that by adopting this system a great mass of useful information will be collected and will be immediately available for those who require it."

He says that the subject which has come up for discussion most frequently has been that of trade marks. It is well-nigh impossible in England to talk about trade with the Far East without touching on this complicated subject, complicated for two reasons: (1) That in China there is as yet no trade mark law, and that the arrangements for the mutual protection of trade marks as between the various countries, have not yet been completed; and (2) that unfortunately as regards Japan there have been a very great number of piracies. Goods bearing imitations of British trade marks have found their way into many parts of the world, and the complaints received have been very numerous. Japan is a signatory of the International Convention for the Protection of Industrial Property, and due protection is given to firms who have registered their trade marks in Japan, but much of the trouble has arisen from the fact that there have been imitations of marks of those firms who have not actually done business in Japan, and have consequently not registered their marks there, while there have also been imitations which, though not exactly close copies, are near enough to deceive the ordinary purchaser who is not well acquainted with the English language.

"At the present moment interest in Japanese trade undoubtedly centres in the immediate crisis. At a time when nothing but cancellations of orders are in the air, it is practically impossible to place new business, but I feel convinced that the future is rosy, and that very shortly matters will be adjusted, and a great many orders will once more be placed in England for those types of British goods which have deservedly earned so high a reputation in Japan in the past."

There has been a good deal of misapprehension about wages in Japan. Many people in England still think that a Japanese workman gets about sixpence a day and a bowl of rice. It is difficult, after there has been much talk of cheap Japanese competition, to make people realise that the cost of living has advanced more in Japan since the war than in either England or the United States, and that the average Japanese workman expects to receive about 7s. a day.

There are a large number of minor questions affecting Japanese trade, but on the whole it may be said that the chief problems at the moment are, on the one side, trade marks and quality of export goods, and on the other delivery of cotton spinning machinery. For the moment there is to be added also the all-important question of the cancellation of contracts above referred to, but it is to be hoped that when the banks find themselves in a position to render the usual facilities these difficulties will be got over and trade will once more run in its normal channels. The storm will have cleared the air, conditions will be much healthier, and the ordinary business man will be able to continue his steady and profitable business unhampered by the wild alarums and excursions introduced by the irresponsible speculator whose innings has now been terminated.

Bankruptcy Proceedings.—C. J. F. HAYMAN, electrical engineer, lately carrying on business at 96, Woodhouse Road, Leytonstone, and 1, Goodmayes Road, Goodmayes.—The first meeting of creditors was held on June 15th at the London Bankruptcy Court, before Mr. D. Williams, Official Receiver, under this failure. The debtor filed his own petition on June 2nd. He has stated that in January, 1919, being without capital, he took an empty shop at 96, Woodhouse Road, and there commenced to trade in the name of Cuthbert Hayman, as an electrical engineer. At first he was successful, but owing to difficulty in obtaining copper wire, he was unable to carry out all his orders. He was further handicapped by

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lack of capital, and in December last he was advised to convert the business into a company. A Mr. Wood, to whom he was introduced, told him that he had several friends willing to take up shares, and early in December Hayman, Wood and Co., Ltd., was registered with a nominal capital of £4,000, of which £825 was subscribed within a week. He (debtor) was appointed managing director at a salary of £500 per annum, but in all he only received about four weeks' salary. As vendor he was allotted 700 shares for the stock (valued at between £300 and £400) and the goodwill; the registered office was at 45, Cheapside, E.C., but the business was carried on from Leytonstone and Goodmayes. The trading at the latter place was a failure, and the company gradually declined through want of capital, with the result that the business was closed down, and he was now employed as a fitter. The company agreed to take over the whole of his liabilities with the assets, but was unable to carry out its obligations to pay the debts, and in March last one of the creditors obtained judgment and levied execution upon his furniture. Further pressure followed, to escape which the debtor filed his petition. He now owes between £200 and £300 and has no assets whatever. The case was left in the hands of the Official Receiver to be administered in bankruptcy.

I. J. HODSON and B. H. NEWMAN (Hodson & Newman), electrical engineers, 85, Queen Street, Exeter.—Receiving order made June 17th on debtors' own petition. First meeting, July 1st; public examination, July 8th, both at Exeter.

GEORGE FREDERICK KIVERSON, electrical engineer, Goulders Place, Attercliffe Common, Sheffield, late 38, Shrewsbury Road, Sheffield.—The following are creditors:—

General Electric Co.	£188
Siemens Bros., Ltd.	76
Siemens Bros. & Co., Ltd.	159
Edison Swan Electric Co., Ltd.	178
Metropolitan-Vickers Electrical Co., Ltd.	31
Western Engineering Co.	12

A Modern Installation. — The electric lighting and power installation at the Metropolitan Water Board's new offices has been carried out by MESSRS. STRODE & CO., LTD., on their improved steel conduit system of wiring; they have also installed their special system of telephones, fire alarms, and electric bells. From the electric lighting mains sub-mains are carried to sub-distributing boards, from which circuits are run to the various lights, the whole of the cables and wires being in heavy gauge screwed enamelled steel conduit. Similar mains are also taken to the main power panel, from which sub-power mains are run to distributing boards for various motors. The lighting installation includes about 3,000 lights, and the power installation for the various motors totals about 200 H.P. Approximately 100,000 ft. of steel tube has been fitted for the lighting and power wiring, and about 40 miles of cable. For the electric bells and telephones about 20 miles of wire has been employed. A special system of telephone communication has been provided to 74 stations, in addition to the G.P.O. system for which Messrs. Strode have provided the necessary steel conduits. Forty fire alarms have been fitted at various points, and a special call system to ring up the various departments has been installed at 32 stations. Sixty "Magneta" clocks have been fitted throughout the building. The electric light fittings were manufactured to special designs of the architect.

Garden Settlements for Steel Workers.—A considerable number of houses, in every way superior to those to which most workers have hitherto been accustomed, is now being built by John Brown & Co., Ltd., for the steel workers employed at their new steel foundry at Scunthorpe, Lincolnshire. These houses are of the bungalow type, constructed of concrete slabs, and with a careful regard to interior domestic conveniences. Each house, moreover, is provided with its own allotment plot, or garden. An extension of the same idea is, in addition, being carried out by the company in conjunction with several other large firms in the Scunthorpe district; a considerable estate is being developed there on garden city lines. A large number of houses is being erected, mostly of brick, and all the resources of modern town-planning utilised to provide in this busy manufacturing centre a healthy and picturesque residential quarter equipped with ample open spaces, and amenities associated with country, rather than industrial life.

Insurance Against Unemployment.—In the course of discussion at the annual meeting of the National Alliance of Employers and Employed at Birmingham, it was strongly urged that the Alliance should take up this problem and produce a scheme satisfactory to both parties. As a result the following committee has been appointed:—On the trade union side,

Mr. Arthur Pugh, of the Iron and Steel Trades Confederation.
Miss Julia Varley, Women's Branch of the Workers' Union.
Mr. Harry Dubery, of the Federation of Post Office Supervising Trade Unions.

The employers' representatives are:—

Major D. C. McLagan, of the National Federation of Iron and Steel Manufacturers.
Mr. Charles Tennyson, of the Federation of British Industries.
Mr. Philip H. Lockhart, of Messrs. W. & A. Bates, Ltd.
Mr. T. E. Jackson, of the Incorporated Association of Retail Distributors.

This committee will meet at an early date to make investigations, set out a general questionnaire, and obtain evidence.

Employés' Investment Scheme. — Messrs. Rashleigh, PHIPPS & CO., LTD., electrical engineers and contractors, of Oxford Street, W., have adopted an investment scheme giving an opportunity to their employés to take an interest in the business. Out of an issued capital of £23,000 in £1 shares, 2,000 are described as employés' shares. The profits are divisible as follows: First payment, 6 per cent. per annum on employés' shares; second payment, 6 per cent. per annum on the ordinary shares; third payment, division of the surplus among both classes of shareholders in proportion to the capital paid up. The employés' 6 per cent. has therefore first claim. If there were a bad year and the 6 per cent. could not be paid, the dividend would be cumulative, and have first claim in the following year if that were not also a bad year. In the event of liquidation the employés' payments for shares would be repaid in full after the satisfaction of the company's creditors. Shares may be bought either outright or in instalments. If an employé leaves he must sell his shares to the directors for re-issue to other employés; he can only hold them at the directors' discretion. A pamphlet explaining the scheme has been issued, and no doubt the company would forward a copy to anybody interested.

Book Notices.—"The Decimal Educator." June, 1920. (31 pp.). London: The Decimal Association. Price 6d.—This little quarterly maintains its high standard, and the number before us is particularly interesting. The report of the Royal Commission on Decimal Coinage is ably criticised; we note that although 74 per cent. of the evidence from individuals or bodies outside official circles was favourable to decimal coinage, the majority reported against the very principle of decimalisation, a verdict which has never before been given by any inquiry, and which we venture to assert is contrary to the judgment of the great majority of the community.

"*Journal* of the British Science Guild, No. 11" (obtainable on application to the Secretary, 6, John Street, Adelphi, W.C. 2, price 1s. 1½d., including postage). Contains annual report of Guild for 1919-20; and memoranda on the Milk Question; State Awards for Scientific and Medical Discovery; Utilisation of Science in Public Departments; Army Hygiene in the War and After, &c.

"The How and Why of Radio Apparatus." By H. W. Secor. New York Experimenter Publishing Co., Ltd. Price $1.75.

"A Theory of Metallic Arc Welding." (11 pp.) By Ralph G. Hudson. Massachusetts Institute of Technology.—An illustrated reprint from the *Journal* of the American Welding Society, recording observations of the electric arc during welding operations, and deducing an explanation of the nature of the welded joint.

The "Bulletin" for 1918 of l'Association des Ingénieurs sortis de l'Ecole de Liége. (163 pp.).—Accounts of the six sections of the Association are given, and the commencement of a seventh at Hasselt is recorded. It is noticeable in the reports of meetings of the Association that purely technical discussions have been replaced by the study of the new economic conditions and problems attending the reconstruction of devastated Belgium.

"*Journal* of the American Institute of Electrical Engineers." Vol. XXXIX, No. 6. June, 1920. Annual Convention number. New York: The Institute. Price $1.

"Elements of Radiotelegraphy." By E. W. Stone. Pp. xii + 267; 125 figs. + 33 plates. London: Crosby Lockwood & Son. Price 16s. 6d. net.

"The Tramways and Light Railways Association *Journal*." Special Congress number. No. 210, June, 1920. London: The Association, Caxton House, S.W. Price 2s.

"Übersichtskarte der Elektrizitäts-unternehmungen und Gaswerke in den Nationalstaaten der ehemaligen österreichisch-ungarischen Monarchie," and "Übersichtskarte der Elektrischen Eigenanlagen in den ehemaligen österreichischen Ländern." Vienna: Verlag für Fachliteratur.—Two large maps compiled by Dr. Viktor Stöger, showing undertakings in Austria, Hungary, Czecho-Slovakia, Jugo-Slavia, Galicia, &c., indicating size and type of plant.

Strike.—Last week there was a strike of 300 employés of MESSRS. FALK, STADELMANN & CO., LTD., of Farringdon Road, London, on the question of wages and union membership.

Electricity Supply Rifle League. — We have received from Mr. E. Mathews, hon. sec., particulars of the matches of the league up to May, 1920, from an inspection of which it appears that very creditable results have been achieved. The Metropolitan Co's team that won the championship last year is unbeaten for the first half of the season, whilst Shoreditch has put up the best score—viz., 582—and Mr. Marriott, of Hackney, is the first to score a possible in this season's competition.

The Australian Trade Commissioner's Visit.—H.M. Senior Trade Commissioner in Australia (Mr. S. W. D. McGregor), who is now in this country, will commence a tour of certain areas on Tuesday, July 13th. He will begin in London, and firms who are desirous of meeting him should communicate with the Department of Overseas Trade, at 35, Old Queen Street, S.W.1. Provincial firms should apply to the Secretary of their Chamber of Commerce.

Home Counties (No. 9) Electric Supply Industrial Council.—The schedule of consolidated rates has been got out by the Home Counties (No. 9 Area) Industrial Council, and approved by the National Council and circulated to the Member-Companies, the date from which the schedule becomes operative being May 1st.

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LIGHTING AND POWER NOTES.

Ayr.—BULK SUPPLY.—The Corporation has been recommended by the Electricity Commissioners to negotiate for a bulk supply of electricity from the Kilmarnock Corporation.

Australia.—MELBOURNE STRIKE SETTLED.—The City Council ratified a proposal to grant the electricians an increase in wages of 3s. 6d. a day, and the strikers resumed work on June 18th. The whole trouble relating to the electricity supply is now ended, and lighting and power for the tramways will be made available.

Birmingham.—YEAR'S WORKING.—The total revenue for the past year's working of the electricity undertaking was £1,068,826, and expenditure £776,291, leaving a gross balance of £292,535. The payment of loan charges, &c., left a net surplus of £15,324. The total number of units sold was 127,938,924, at an average price of 2·005d. per unit.

Canada. — HYDRO-ELECTRIC DEVELOPMENTS. — The *Canadian Engineer* gives details of a new hydro-electric development, plans and specifications of which have been recently prepared by the Hydro-Electric Power Commission of Ontario. This project is to utilise the power afforded by the Ranney Falls, about one mile below Campbellford, Ontario. Two 5,000-H.P. turbines are to be installed, coupled to two three-phase, 60-cycle, 6,600-volt generators, each of 4,500 K.V.A. capacity. Under normal conditions a head of 47 ft. will be available. This will be the ninth installation in the Trent and Severn divisions.

Carlisle.—SUPPLY SCHEME.—A scheme for supplying a number of Cumberland villages, including Wigton, is under consideration.

Burnley.—EXTENSIONS.—In connection with the extensive scheme for the improvement of the undertaking, the Electricity Committee has now recommended the Council to place the contract for the work with the English Electric Co., Ltd., Preston, the total amount of the tender being £107,400.

Bury.—LINKING-UP.—In connection with the scheme for inter-supplies of electricity between the Corporation electricity department and the Lancashire Electric Power Co.'s works at Radcliffe, the Town Council proposes to apply for sanction to borrow £95,000 for the necessary extensions at the electricity works. After consultation with the company, the engineer has placed orders for the tranformers required. To meet present obligations, Heywood requires 1,870 H.P. and Radcliffe 1,440 H.P. in addition to their present supplies. Subject to the scheme being approved by the Electricity Commission, and the sanction of the Minister of Health being obtained to borrow the money, a contract is to be placed for the supply of an 8,000-10,000-KW. set.

No change is to be made in the charges for electricity by the Corporation until the end of the present quarter.

Chester-le-Street.—PROPOSED ELECTRICITY SUPPLY.—The Rural District Council has decided to obtain prices for the supply of electricity for comparison with prices of gas supply to the Council's housing scheme at Washington.

Chirk.—ELECTRIC LIGHTING.—At a special meeting of the Rural District Council, held to consider the lighting question, the chairman stated that, in view of the small population, he did not think that electric lighting would be remunerative, while another member urged that the gasworks should not be proceeded with until it was known what an electricity scheme would cost. Ultimately it was decided to ask Mr. G. Bremner Smith to advise the Council on the matter.

Co. Dublin.—ELECTRICITY SUPPLY.—The question of having a centralised electricity supply for the Co. Dublin coast townships was mentioned at the Blackrock Urban Council, when a letter was received from the Electricity Commission to the effect that the Commissioners were in communication with the Dublin Corporation, and were suggesting that a bulk supply should be given to Blackrock and Pembroke. It was hoped to deal with the matter as soon as the Corporation had gone into it. The Kingstown Urban Council appointed a Committee to consider a scheme for the lighting of the township by electricity, with a view to having a centralised source of supply for the other townships of the surrounding district, a conference is being convened to consider the proposal, to which representatives of Blackrock, Dalkey, Killiney, and Rathdown, are being invited.

Colwyn Bay.—YEAR'S WORKING.—The chairman of the Lighting Committee announces a profit of £217 for the year ended March 31st last.

Cullompton (Devon).—LIGHTING SCHEME.—The promoters of the electric light scheme have decided to go on with the project, a circular letter to householders to ascertain the probable number of consumers having proved highly satisfactory.

Dalkeith.—EXPERT ADVICE.—The Town Council has requested the Electric Supply Corporation to allow an independent engineer to examine and report on the plant in the works at Croft Street, in view of the unsatisfactory lighting provided in the town last winter.

Devonshire.—ELECTRICITY SUPPLY.—For the purposes of electricity supply, Devonshire has been divided into four sections, with centres at Plymouth, Exeter, Torquay, and Barnstaple. Since this partition was made, a map has been prepared, introducing a part of Somerset and part of Cornwall into the scheme. A Committee of the Devonshire County Council will meet the Electricity Commissioners on June 29th in London, to confer on the scheme.

Electricity Districts.—The Electricity Commissioners have provisionally determined that the undermentioned areas shall be constituted separate electricity districts for the purposes of the Electricity (Supply) Act, 1919 :—

WEST RIDING.—The cities and county boroughs of Bradford, Leeds and Wakefield; the county boroughs of Barnsley, Dewsbury, Halifax and Huddersfield; the municipal boroughs of Batley, Brighouse, Keighley, Morley, Ossett, Pontefract, Pudsey and Todmorden; the urban districts of Altofts, Ardsley, Ardsley East and West, Baildon, Barkisland, Barnoldswick, Bingley, Birkenshaw, Birstall, Burley-in-Wharfedale, Calverley, Castleford, Clayton, Clayton West, Cudworth, Darfield, Darton, Denby and Cumberworth, Denholme, Dodworth, Drighlington, Earby, Elland, Emley, Farnley Tyas, Farsley, Featherstone, Flockton, Garforth, Gildersome, Golcar, Goole, Greetland, Guiseley, Gunthwaite and Ingbirchworth, Haworth, Hebden Bridge, Heckmondwike, Hipperholme, Holme, Holmfirth, Honley, Horbury, Horsforth, Hoylandswaine, Hunsworth, Ilkley, Kirkburton, Kirkheaton, Knottingley, Lepton, Linthwaite, Luddenden Foot, Marsden, Meltham, Methley, Midgley, Mirfield, Monk Bretton, Mytholmroyd, New Mill, Normanton, Oakworth, Otley, Oxenhope, Penistone, Queensbury, Rawdon, Rishworth, Rothwell, Royston, Scammonden, Selby, Shelf, Shelley, Shepley, Shipley, Silsden, Skelmanthorpe, Skipton, Slaithwaite, South Crosland, Southowram, Sowerby, Sowerby Bridge, Soyland, Spenborough, Stainland, Stanley, Thurlstone, Thurstonland, Whitley Upper, Whitwood, Wombwell, Worsborough and Yeadon; the rural districts of Barnsley, Goole, Halifax, Hemsworth, Hunslet, Keighley, Penistone, Pontefract, Selby, Tadcaster, Todmorden, Wakefield, Wetherby and Wharfedale and the parishes or townships of Addingham, Bank Newton, Beamsley, Bolton Abbey, Bracewell, Bradleys Both, Brockden, Broughton, Carlton, Coates, Cold Coniston, Cononley, Cowling, Draughton, Elslack, Embsay-with-Eastby, Farnhill, Gargrave, Glusburn, Halton East, Hazlewood-with-Storiths, Kildwick, Lothersdale, Martons Both, Salterforth, Thorlby-with-Stirton and Thornton, in the rural district of Skipton.

SOUTH-EAST LANCS.—In the County of Lancaster: The City and County Borough of Manchester: The County Borough of Bolton, Bury, Oldham, Rochdale, Salford and Wigan: The Municipal Boroughs of Ashton-under-Lyne, Eccles, Heywood, Leigh, Middleton and Mossley: The Urban Districts of Abram, Ashton-in-Makerfield, Aspull, Atherton, Audenshaw, Billinge, Blackrod, Chadderton, Crompton, Denton, Droylesden, Failsworth, Farnworth, Golborne, Haydock, Hindley, Horwich, Hurst, Ince-in-Makerfield, Irlam, Kearsley, Lees, Littleborough, Little Hulton, Little Lever, Milnrow, Norden, Orrell, Prestwich, Radcliffe, Ramsbottom, Royton, Standish-with-Langtree, Stretford, Swinton and Pendlebury, Tottington, Turton, Tyldesley-with-Shakerley, Upholland, Urmston, Wardle, Westhoughton, Whitefield, Whitworth and Worsley: The Rural Districts of Barton-upon-Irwell, Bury, Leigh, Limehurst and Wigan; and the Township of Rixton-with-Glazebrook in the Rural District of Warrington.

In the County of Chester: The County Borough of Stockport: The Municipal Boroughs of Dukinfield, Hyde and Stalybridge: The Urban Districts of Alderley Edge, Altrincham, Ashton-upon-Mersey, Bowdon, Bredbury and Romiley, Cheadle and Gatley, Hale, Handforth, Hazel Grove and Bramhall, Hollingworth, Knutsford, Lymm, Marple, Mottram-in-Longendale, Sale and Wilmslow: The Rural Districts of Bucklow and Tintwistle.

In the County of Derby: The Municipal Borough of Glossop: The Rural District of Glossop Dale.

In the West Riding of the County of York: The Urban Districts of Saddleworth and Springhead.

Objections or representations may be made on account of the inclusion of any area in, or the exclusion of any area from, the districts so provisionally determined, and all such objections or representations must be made in writing addressed to the Secretary, Electricity Commission, Gwydyr House, Whitehall, London, S.W. 1, stating the grounds upon which the objections or representations are made, and must reach the said offices of the Commissioners not later than October 31st, 1920.

It being apparent to the Electricity Commissioners that the existing organisation for the supply of electricity in the districts so provisionally determined should be improved, notice is further given that they intend to hold local inquiries into the matter, and any authorised undertakers, as defined in the Electricity (Supply) Act, 1919, any County Council, any local authority, any railway company using, or proposing to use, electricity for traction purposes, any large consumer of electricity, and any association or body directly concerned with the production or use of electrical energy within the districts, may, on or before the said 31st day of October, 1920, submit in writing schemes for effecting such improvement in organisation, including the formation of joint electricity authorities for the districts, and any proposals for altering or adjusting the boundaries of the districts so provisionally determined.

Notice will be given of the dates of the proposed inquiries.

Exeter.—YEAR'S WORKING.—The electrical engineer reports a surplus of £1,833 for the year ended March 31st, comparing favourably with a deficit of £1,735 for the previous year. This result is attributed partly to increased prices, and partly to the removal of lighting and power restrictions.

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Derby.—PAYMENT OF "AWARD."—The failure of the Corporation to give effect to the £30 bonus award, as from Jan. 1st, led to the presentation of notice to withdraw by members of the staff. A special meeting was called, when it was decided to accede to the terms of the award by paying the bonus from the stipulated date.

Federated Malay States.—ELECTRICITY SUPPLY.—The *Board of Trade Journal* states that the Governor of the F.M.S. recently foreshadowed a scheme for the uniform supply of electricity to the States and Straits Settlements for power, drainage, and railways. An expert has been engaged to investigate and formulate a scheme.

Fleetwood.—LOAN.—Application is to be made to the Electricity Commissioners for sanction to borrow £5,000 for new mains and services, and £2,000 for the provision of meters for the Council's housing scheme.

PRICE REVISION.—The Urban District Council has decided to apply to the B.O.T. for an order under the Statutory Undertakings (Temporary Increase of Charges) Act, 1918, for such modifications of the Fleetwood Electric Lighting Order, 1908, as will enable the Council to charge a flat rate of 8·4d. per B.O.T. unit.

Hinderwell.—ELECTRIC LIGHTING SCHEME DEFERRED.—The Cleveland and Durham E.P. Co. has informed the Urban District Council that with reference to the electric lighting scheme it would be necessary for the Council to lay its own cables, as the town is outside the company's area. The cost would be at least £6,000, in addition to from £2,000 to £3,000 for a sub-station, and the cost of a prov. order. The Council has decided to defer the matter, and to await mining developments in the district.

Kingston-upon-Hull.—YEAR'S WORKING.—The statement of accounts for the year ended March 31st last records a total income of £218,136, as against £144,369 for the previous period. The expenditure increased by 32 per cent. to £166,724, leaving a gross surplus of £51,412. The deduction of income-tax, loan interest, &c., resulted in a net balance of £8,931, of which £7,987 was transferred to the reserve fund, the remainder cancelling a deficit of £944 from last year.

Leeds.—YEAR'S WORKING.—The total income of the electricity undertaking for the year ended March 31st, was £230,895, as against £141,767 for the previous year. Expenditure, including loan charges, income-tax, &c., amounted to £186,486 against £141,118, leaving a gross surplus of £44,409, comparing with a profit of £649 for 1918-19. The total number of units sold increased from 63,387,433 to 63,023,502, and the average price per unit from 1·26d. to 1·79d.

Littleborough.—HOUSING SCHEME.—The General Purpurposes Committee of the Urban District Council has instructed Mr. Hawtayne, electrical engineer, to prepare plans and estimates for cables and fittings for the supply of electricity to the houses which are to be erected by the Council at Calderbrook, as well as for the street lighting in connection with the scheme.

Liverpool.—STRIKE.—The Executive Committee of the Electrical Trades Union has ratified the action of the cable jointers and street-box men employed by the Liverpool Corporation, who are on strike for higher wages. The Mersey District Secretary of the Electrical Trades Union has resigned from the Joint Industrial Council for the Electricity Supply Industry, one of the reasons, we understand, being that the Council has not held a meeting during the several weeks this dispute has been in progress.

London.—ST. MARYLEBONE.—The statement of accounts of the electricity undertaking for the year ended March 31st, 1920, records a total revenue of £307,973, as against £245,156 for the previous year. The total expenditure was £174,007, as against £134,707, leaving a gross balance of £133,066, compared with £110,449. Interest charges, loan repayments, &c., amounted to £109,954, as against £111,452, and the net result was therefore a surplus of £23,112, which compared very favourably with last year's deficit of £1,003. A total of 19,770,781 units was sold at an average price of 1·798d. Last year's figures were 16,245,133 and 1·712d. respectively.

Loughborough.—YEAR'S WORKING.—After meeting all interest and sinking fund charges for the year ended March 31st last, the electricity undertaking showed a balance of £1,144—the highest since its inception. The average price per unit sold was 1·95d., and a total of 2,964,096 units was generated.

Manchester.—HOUSE LIGHTING.—The Gas and Electricity Committees are to prepare and submit a joint report as to the system of illumination most desirable for the Corporation's housing scheme.

Nottingham.—ELECTRICITY SCHEME.—An admirable site contiguous to the Trent, and at no great distance from Clifton Colliery, one of the largest undertakings in the immediate neighbourhood of the city, has been acquired for Nottingham's new electricity generating station, but considerable criticism has been already forthcoming locally as to the alleged undue haste with which the report of the responsible Committee dealing with the matter, was presented and adopted, involving as to the first section of the work an expenditure of over £800,000. Mr. A. R. Atkey, M.P., a member of the Corporation, and one of the City's Parliamentary representatives, questions whether the Council was wise in summarily ignoring the offer to supply electricity, which was made by the Notts. and Derbyshire Power Co., possessing statutory powers for the area outside the municipal boundary. He urges that this alternative plan should have received a larger measure of consideration before the Council arrived at its precipitate decision.

Price Increases.—In consequence of additional working expenses, the following towns have adopted increased scales of charges:—Ascot, Barnes, Basingstoke, Batley, Birmingham, Clacton-on-Sea, Darlington, Doncaster, Dublin, Dundee, Fleetwood, Gillingham, Glossop, Godalming, Heywood, High Wycombe, Meeksham, Paisley, Ramsgate, St. Annes, Southend-on-Sea, Taunton, Warrington, Whitehaven, Wolverhampton and Worksop.

Wallasey.—EXTENSIONS.—To meet immediate demands, Wallasey Corporation has decided to lay a high-tension main to New Brighton, with the necessary transformer and switchgear at a total cost of £2,728. The Corporation has taken into account the anticipated load for the next five years. A rebate of ¼d. per unit is to be allowed consumers from the June quarter bills, as defined by the Coal (Pit's Mouth) Prices Order, 1919, in respect of energy consumed for the whole period from December 1st, 1919, to May 12th, 1920.

Worksop.—EXTENSION OF SUPPLY.—Considerable extension of the existing system of electricity supply was decided upon at the last meeting of the Worksop Urban District Council, the estimated cost being over £50,000. The original lighting scheme entailed an expenditure of £37,000, of which £26,000 has been repaid. The Committee had had two schemes under consideration, one for taking energy from Manton Colliery and the other involving an extension of the Council's own plant, the Committee being favourable to the first-named plan. One of the items of £17,830 included in the estimate would only be spent, it was explained, when necessary, and extensions would not be undertaken unless there was guarantee of an adequate return.

Yeovil.—ELECTRIC LIGHTING ORDER.—Messrs. Petters, Ltd., have informed the Town Council that it is not their intention to carry out the Electric Lighting Order they obtained in 1914, and asked if the Council would consider taking on the rights. The Council has declined the offer.

TRAMWAY AND RAILWAY NOTES.

Ayr.—FARE INCREASE.—The raising of additional revenue from the tramways has been under the consideration of the Town Council. The deficit of £3,227 last year was taken from the reserve fund, reducing the latter to £1,772. The estimated deficiency for the year ended May 15th, 1921, is £5,617. It was decided to adopt certain recommendations of the Tramways Committee permitting increases in the fares, discontinuing privilege and permit tickets, and readjusting workmen's fares. By these means it is estimated an extra income of £4,867 will be obtained.

Belfast.—FARE REVISION.—The question of revision of fares and stages was on the agenda at a meeting of the Corporation Tramways Committee, last week, and was adjourned for further consideration. Mr. J. Johnstone, of the National Amalgamated Union of Labour, and Mr. John Malcolm, of the Municipal Employés Association, appeared before the Committee in support of an application for an advance of 1½d. per hour on the basic rates for motormen, conductors, and the depôt staffs. After some discussion the matter was adjourned pending a report from the general manager.

Bolton.—WAGES.—Following the action of the Corporation Tramways Committee in refusing the tramway men double pay for the four days of the Royal Lancashire Agricultural Show, the employés have asked the Committee to reconsider its decision, and to receive a deputation. The men are also applying for an alteration in the basic rates of pay.

Continental.—ITALY.—RAILWAY ELECTRIFICATION.—Steps are being taken by the Italian Ministry of Public Works for the electrification of the Ligurian and Piedmontese railways, including the Genoa-Turin-Modane line, the Union of Central and Northern Italian railways, the Rome to Naples and Sulmona and other Southern lines. Similar operations will be carried out on the Brenner Pass and the Florence to Bologna and Faience lines. It is estimated that altogether 1,400 km. of railway lines will be electrified at a cost of 800 million lire.—*Economic Review.*

Darlington.—EXTENSIONS DEFERRED.—Consideration of the proposal to lay a tramway track from Market Place to the Victoria Road entrance to Bank Top Station, at an estimated cost of £15,000, has been deferred.

Gateshead-on-Tyne.—TRAMWAY DEFICIENCIES.—At a meeting of the Town Council on June 16th, a letter was read from the Ministry of Transport with reference to complaints regarding the tramway services in Gateshead. The Director-General of Traffic wrote that on the information which had been obtained and which had been laid before him, the Minister of Transport was satisfied that the Gateshead and District Tramways Co. was honestly endeavouring to cope with post-war conditions, having, as was natural, due regard to the interests of the undertaking. There appeared to be no sovereign remedy for the conditions to be

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immediately applied by either the company, the Corporation, or the Ministry of Transport. It was considered, however, that the action which the company had agreed to take was calculated to improve the situation as quickly as was practicable. The Minister suggested the following action by the Corporation, which he thought would contribute to this end :—

1. Co-operation with the tramway company in keeping the loading of cars within reasonable limits, and stopping the practice of travelling on platforms, steps and buffers.

2. Keeping the company advised of any specific requirements, and particularly definite cases of shortage of accommodation.

3. Further consideration, as an important means of relieving congestion under the circumstances, of the question of admitting to the borough, 'buses bringing passengers in from the surrounding d strict.

4. Consideration whether it was possible to take any steps to spread the "peak" load over a longer period.

5. If possible, removal of the cab rank from Wellington Street to one of the adjacent streets.

Huddersfield.—Car Building.—The Tramways Committee has decided that as soon as possible cars will be constructed by the Department.

Leeds.—Wages.—Leeds tramwaymen are to receive £2,000 in retrospective advances in wages from March 29th last. Motormen now receive £3 18s. for a week of 48 hours, compared with £1 18s. 6d. for a week of 60 hours before the war, and conductors get £3 14s., as against £1 13s. 6d.—*Financial Times.*

Accident.—One of the Corporation's trackless cars travelling from Guiseley to Otley, on June 14th, crashed into a wall on the roadside at Menston. The driver was badly shaken, and received cuts on the hand from the broken glass, but the 16 passengers escaped injury. The front of the car was wrecked. It is thought that something went wrong with the steering gear.

London.—L.C.C. Motor-'Bus Scheme.—Having been compelled to withdraw the clauses of the L.C.C. (Tramways and Improvements) Bill, providing for extensions to tramways, the L.C.C. has asked for powers to provide a subsidiary omnibus system at a cost of £400,000. The object is to link up the termini of the tramway system, and to serve new housing schemes, &c. Mr. Vesey Knox, K.C., on behalf of the County Council, said that the refusal of the local authorities to permit the laying of new lines in their districts had given the L.G.O. Co. an opportunity to raise its rates in these localities, thus enabling it to compete with the cheaper tramways in other parts. Mr. G. H. Hume, answering Mr. Freeman, K.C., who appeared for a number of London authorities, and Mr. Honoratus Lloyd, K.C., for the L.G.O. Co., denied that the idea of the scheme was to run in opposition to existing omnibus services, although he admitted that the Bill as drafted would enable the Council to do this. Mr. Hume also deprecated the suggestion that the Council wished to be authorised to run an omnibus service before the setting up of a traffic authority.

London.—Fare Increase.—Acting on the authority of the Ministry of Transport, the Metropolitan Electric Tramways raised the fares on their system on June 22nd. The new scale of charges is :—Two stages for 1½d. (minimum fare): three stages for 2d. ; five stages for 3d. ; and for each additional two stages, 1d. Some of the new fa es are :—Golders Green - Barnet, 6d., instead of 5d ; Finsbury Park—Waltham Cross, 10d., instead of 8d. ; Edgware Road—Sudbury, 8d., instead of 6d. Workmen's fares, single fare for return journey. The fares on the omnibuses serving the same districts will be revised on the same scale.

Stopping Places.—Several alterations in stopping places for tramcars and omnibuses at Greenwich, Battersea, Herne Hill, &c., were made on June 16th, upon the recommendation of the Advisory Committee on London Traffic.

Preston.—Additional Plant.—The Tramways Committee has authorised the engineer to obtain tenders for the supply of additional plant at the power station, in view of the increase in the service.

Railless Cars.—Mr. A. H. Wilkinson, Bradford, in a paper at the annual meeting of the Municipal Tramways Association (managers' section), at Birmingham, last week, said he had been favourably impressed with the performances of railless electric vehicles, and could see a brighter future in store for them. Up to the present they had been considered as an auxiliary or adjunct to the main tramway service, but under existing conditions a considerable extension of railless electric transportation appeared very probable.—*Financier.*

West Riding.—Wages Award.—The award which has been made by the Joint Industrial Council to the tramway industry affects the towns in the West Riding area as follows :—Group 1 (3s. per week increase): Leeds, Sheffield, Bradford, Hull and Huddersfield ; Group 2 (2s. per week) : Halifax, Doncaster, York and Barnsley ; Group 3 (1s. per week) : Wakefield, York, Keighley, Rotherham, Mexboro' and Swinton, Dewsbury and Ossett. The award is retrospective from March 29th last, and is in addition to the award of 6s. per week made by the National Council.

Weston-super-Mare.—Time Extension.—The Electric Supply Co., Ltd., has applied to the Ministry of Transport for an extension of time until August 6th, 1922, for completing the tramways under the Order of 1900.

TELEGRAPH AND TELEPHONE NOTES.

Ecuador.—New Wireless Stations. — A wireless station has been erected at Quito by the Société Française Radio Electrique on account of the Government of Ecuador, and similar stations are also being erected at Guayaquil and Esmeraldas. These stations are of 10 kw.

A Presidential Decree was published in the "Registro Oficial" of March 13th, prohibiting all private parties from importing and establishing wireless apparatus in the Republic.—*Board of Trade Journal.*

Finland.—Telephone Extension.—The South Finland Inter-Urban Telephone Co. proposes to extend its network of lines over another 1,000 km., which will involve an expenditure of F.Mk.3 mill. With this end in view, the capital will be increased from F.Mk.5 to 7 mill.

French Colonies.—New Wireless Stations.—The *J. de Marine Marchande* (May 20th) gives an account of the wireless telegraphy stations in course of construction in the French Colonies.

In 1917 it was decided that the military colonial wireless system should include powerful stations at Saida, in Southern Algeria, Bamako, in French West Africa, Brazzaville, in French Equatorial Africa, Antananarivo, in Madagascar, and Saigon, in Cochin China. The construction of the four latter stations has reached the following stages :—

Bamako : The buildings are nearly finished ; a great deal of the material is already to hand or in place, and the electrical fittings will be forwarded in June.

Brazzaville : The buildings are started, the yards having been opened in December, 1919 ; the plans for the establishment of a hydro-electrical works are drawn up.

Antananarivo : A site for the station has been definitely fixed ; a contract for the supply of electrical energy has been drawn up ; the electrical fittings will arrive at the end of the year.

Saigon : The buildings are nearly finished ; the contract for the supply of electrical energy is signed ; the material will be delivered at the beginning of 1921.

These four large stations, planned for military purposes, will be transferred, when finished, to the Administration of the Postes, Télégraphes et Téléphones. Smaller stations, established by the colonies themselves, and intended for communication in West Africa between neighbouring colonies or between certain centres in the same colony, will be at Port-Etienne, Dakar and Rufisque in the Senegal, Monrovia in Liberia, Conakry in Guinea, Tabou on the Ivory Coast, Bamako—a small temporary station—and Kabara. —*Economic Review.*

Telephone Service.—Deficit.—The Postmaster-General announces that a deficit of £1,750,000 is expected as a result of working for 1919-20. This allows for the payment of interest on capital to the extent of £880,000.

Select Committee.—The Government has decided to ask the House of Commons to appoint a Select Committee to examine the present charges made to the public for the use of the telephone service and to report in what respect these charges require revision, in order to place the service on a remunerative basis. The proposal is that the Committee should consist of Sir Edward Coates, Sir Harry Brittain, Mr. Archdale, Sir Hamilton Benn, Mr. Briant, Mr. Tyson Wilson, Mr. John Robertson, Mr. Carr, and Mr. Purchase.—*The Times.*

Wireless Operators' Strike.—Developments. — *The Times* states that the Association of Wireless Telegraphists has announced its agreement to negotiate on the wages question, but will not advise the men to resume work while negotiations are in progress. The suspension of the order that vessels of 1,600 tons and above must have wireless installations and operators, has resulted in one or two cases in the refusal of crews to sail, causing inconvenience to passengers. The Joint Seafarers' Council has not "recognised" the strike, and other seamen are, therefore, "permitting" the employment of non-Union operators.

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the Electrical Review, *in which the "Official Notice" appeared.*

OPEN.

Australia.—Sydney.—August 4th. N.S.W. Government Railways and Tramways. Two 1,000-kw. sub-station units. Chief Electrical Engineer, 61, Hunter Street, Sydney.

August 3rd. Department of Public Works. Turbines and generators for the Barren Jack hydro-electric development scheme. Department of Public Works, Sydney.

N.S.W.—Postmaster-General's Department. August 2nd and 5th. Aluminium sheet, brass rod, &c., scheduled 769 ; platinum wire, gold and silver wire, scheduled 768. (June 11th.)

Western Australia. — Postmaster-General's Department. August 3rd. 326 accumulators, schedule 668. (June 11th.)

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Belgium.—June 26th. Municipal authorities of Bierset (Province of Liége). Tenders for the concession for supply of electrical energy for lighting and power purposes in the town.

Colne.—Electricity Department. Steam and water piping. (June 11th.)

Darlington.—July 16th. Electricity Department. One 5,000-KW. turbo-alternator and surface-condensing plant. (See this issue.)

Dartford.—June 26th. Electricity undertaking. Rotary converter, transformers, switchgear, &c., L.T. twin cable-feeder, pillar and feeder-panel. (June 11th.)

Edinburgh.—July 13th. Corporation. Electric lighting installations of houses at Gorgie. The Town Clerk.

Glasgow.—July 6th. Tramways Department. One 10,000-KW. steam turbo-alternator, with condensing plant. (June 18th.)

Huddersfield.—Electricians' work in girls' high school, Greenhead. H. Sutcliffe, Borough Architect, 1, Peel Street.

Hull.—July 12th. Electricity Department. One three-motor electrically-operated overhead travelling crane. (See this issue.)

Hoylake and West Kirby.—Coal for a year, for the Urban District Council Electricity Works. Electrical Engineer, Carr Lane, Hoylake.

Middlesbrough. — Corporation. Electric lamps and general stores. Town Clerk.

New Zealand.—AUCKLAND.—September 1st. Harbour Board. For the supply of electric capstans and spares. Messrs. W. & A. McArthur, Ltd., 18-19, Silk Street, Cripplegate, London.

Newport.—June 26th. Electricity Department. Turbo-alternating plant, surface-condensing plant, boilers, economisers, draught plant, steel flue and stack, &c. (June 4th.)

Nuneaton. — June 30th. Electricity Department. 1,000-KW., D.C., geared turbo-alternator, surface-condensing plant and pipework. (June 4th.)

Southampton. — July 3rd. Electricity Department. E.H.T. and H.T. switchgear and D.C. control panel. (June 4th.)

Swindon.—June 26th. Electricity Department. 2,000 yards 3-in. four-way stoneware conduits, light steel poles for overhead lines. (June 11th.)

Warrington. — June 29th. Electricity Department. Truck type ash elevator and hopper. (June 11th.)
July 13th. Electricity and Tramways Committee. Two 6,000-KW. turbo-alternators. (June 18th.)

CLOSED.

Belgium.—The municipal authorities of Horion-Hozemont (Province of Liége) recently invited tenders for the concession for the supply of electrical energy for lighting and power purposes in the town. Not a single offer was received.

Burnley.—The Electricity Committee recommends that the contract for the extensions, at the electricity works, be placed with the English Electric Co., Ltd., the total amount of their tender being £107,400.

Mansfield.—Town Council :—
Cables.—Western Electric Co., £9,888.

Southend-on-Sea.—Town Council :—
600 tubes and 300 bends for condenser.—Ledward & Beckett, £4,575.

Swansea.—Corporation. Accepted :—
British Thomson-Houston Co., Ltd.—Turbo-alternator, complete with condenser, £45,660.

Worcester.—Town Council :—
Messrs. Ward.—Electric bells for police cells, £13; electric fan, £49.

FORTHCOMING EVENTS.

Institution of Electrical Engineers. — Wednesday, June 30th. At the Institution of Mechanical Engineers, Storey's Gate, S.W. At 6 p.m. Paper on "Overhead and Live Rail Conductor Systems," by Sir Philip Dawson.
Thursday, July 1st. At the Natural History Museum, Cromwell Road, South Kensington. From 8 p.m. to 11 p.m. Annual conversazione.

Junior Institution of Engineers.—Wednesday, June 30th. At the Café Monico, Piccadilly Circus. 6.30 p.m. for 7 p.m. Dinner to celebrate 36th anniversary.

Tramways and Light Railways Association. — Friday, July 2nd. At Caxton Hall, Westminster, S.W. At 2.30 p.m. Annual congress. At 7.30 p.m. at the Connaught Rooms: Annual dinner.

NOTES.

The I.M.E.A. Meeting.—Continuing the report of the I.M.E.A. Convention, appearing on page 803, the proceedings were resumed on Wednesday morning. The paper by Mr. I. V. Robinson, Wh.Sc., of the B.E.A.M.A., on "Power Station Design in Relation to Thermal Efficiency," was discussed by Messrs. Carnegie, Selvey, Ferranti, Wilkinson, Swallow, Ayton, Lea, and Hunter. Mr. Robinson replied. In the afternoon an excursion to Bolton Abbey took place, also a golf handicap. Mr. Robinson's paper was contributed as the result of an invitation to the B.E.A.M.A. to give the views of manufacturers. Copies of the specifications and tests agreed between the B.E.A.M.A. and the Association were circulated at the meeting.

Industrial Research.—The Department of Scientific and Industrial Research has approved the Research Association for the British Motor Cycle and Cycle Car Industry. The Secretary of the Committee engaged in the establishment of this Association is Major H. R. Watling, "The Towers," Warwick Road, Coventry.

Vulcanised Rubber.—A new vulcanising process has been invented by Mr. S. J. Peachey, of the Manchester College of Technology. It is stated that instead of the usual high temperatures, the new method employs sulphuretted hydrogen and sulphur dioxide at ordinary temperatures. The process will enable a large class of materials to be treated, which could not be used previously on account of the high temperature involved.

Electricity on South African Farms.—None can doubt the complete present supremacy of the oil engine as a power motor on South African farms, withthe wind motor—invariably of foreign manufacture owing to the strange indifference of British makers—a good second. Nevertheless, there are signs that these will soon be faced with a growing competition from small and self-contained electrical plant. Attention is just now being vigorously drawn to the waste of water power in the numerous districts where it is available, and useful attempts are being made to educate the agriculturist as to the possibilities open in this direction. The common impression has hitherto been that a greater and more forceful flow is required than can be continuously relied upon from the average small stream, and the farmer has yet to learn how small and irregular a flow will give a sufficient horse-power to work a plant capable of driving big farm and dairy machines, and also lighting a homestead. Little or no conception exists of the high peak loads obtainable by the use of the storage battery on a low, but more or less continuous, rate of feed. As information on this subject spreads, we foresee a widely-extended demand for small electricity-generating plant in the farming districts of every part of South Africa.

The subject is one which may well engage the practical attention of machinery importing firms, which should be assured of the sympathetic co operation and support of Home manufacturers of the type of plant referred to. The South African farmer was never before so prosperous or in such a good position to spend money on new ideas and developments. All that is needed is a certain amount of propaganda, both by advertising and personal advice, and he will see the important economies and facilities he can effect by utilising the power now generally running to waste. With a stream 10 ft. wide, from 2 ft. to 4 ft. deep, and with about 5 ft. head, the farmer has a free supply of something like 20 H.P., but the trouble is that in few cases does he know this. The opportunity open to machinery firms strikes us as an extremely valuable one, the more so because the commercial opportunities are not limited to the handling of small dynamos and the necessary material, but the door is opened to a new and highly-profitable business in lighting fittings and such domestic conveniences as electric fans, irons, washing machines, and cooking and heating apparatus. Such plants are not unknown in South Africa. Isolated cases exist where enterprising farmers have had them in successful operation for some years. Such cases are certain to multiply, and the commercial opportunities involved will be recognised and fostered by wide-awake firms. In fact, one such house in British East Africa, holding an American agency, has been making a big push lately with electric motors adapted for agricultural purposes, and, we believe, with considerable success. South Africa should provide a still larger field if similar propaganda were pursued in districts offering the necessary water-power facilities, and, in spite of popular misconceptions, it should be realised that there are few which do not.—*B. and S.A. Export Gazette.*

U.S.A. Production of Electric Power and Fuel Consumption.—Data collected and compiled by the Committee on Division of Power Resources, United States Geological Survey, giving the production of electric power and consumption of fuel by public utility plant in the United States for the month of January, 1920, show an increase of approximately 15 per cent. over the figure for the same month in 1919. The figures for January are based on returns received from about 2,800 power plant of 100-KW. capacity or more engaged in public service, including central stations, electric railways and certain other plant which contribute to the public supply. The capacity of plant submitting reports of operations is about 90 per cent. of the capacity of all plant. The average daily production of electricity during January was 124,300,000 KW.-hours, 33 per cent. of which was produced by water power. The total production of electricity by public-utility plant during 1919 was 40·3 billion KW.-hours, 14·76 billion KW.-hours, or 36·6 per cent. by water power, and 25·54 billion KW.-hours,

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or 63·4 per cent. by fuels. The mean daily output for 1919 was 110·4 million KW.-hours. The mean daily production for January, 1919, was about 108 million KW.-hours; the mean for January, 1920, was 124·3 million KW.-hours. The value for January, 1919, is estimated. The fuel consumption for the year was as follows:—35 million short tons of coal, 11·05 million barrels of oil, and 21·7 million M. cb. ft. of gas. Converting the oil and gas consumed to coal, the equivalent coal for all fuels consumed during 1919 would be 38·347 million tons. With 25·540 billion KW.-hours, produced by fuels in 1919, an average of practically 3 lb. of coal was required per KW.-hour of electricity produced. On this basis it would have required the consumption of 22,140,000 tons to have generated the KW.-hours produced by water power. The estimated production of bituminous coal in 1919 is 458,063,000 short tons. The amount of coal used by electric public utility plant during 1919 was 7·6 per cent. of the total produced.—*Power.*

Charges for Electricity Supply and Wages of Employes.—The following is a copy of a letter addressed to the secretaries of the Home Counties (No. 9 area) Joint Industrial Council for the Electricity Supply Industry, by the Ministry of Transport:—

COPY.

Ministry of Transport,
Secretarial and Legal Department,
6, Whitehall Gardens, S.W. 1.
June 14th, 1920.

GENTLEMEN,

I am directed by the Minister of Transport to refer to Mr. Webb's letter of the 13th ult., and to the copy of the resolution passed by the Home Counties Council on May 12th, 1920, and also to the conference which Sir John Snell had with a deputation from the Industrial Council on the 19th ult.

The Minister has decided that companies seeking an increase in their maximum rates of charge may now make application to him under section 32 of the Electric Lighting (Clauses) Act, 1899, instead of under the Statutory Undertakings (Temporary Increase of Charges) Act, 1918. This will enable all companies with very few exceptions to make application should that course be necessary. The few exceptions are those companies whose orders were granted to local authorities prior to the passing of the 1899 Clauses Act, and subsequently transferred to the companies.

Such companies and local authorities to whom Section 32 of the Act of 1899 does not apply may make application under the Statutory Undertakings (Temporary Increase of Charges) Act, 1918.

The Commissioners will conduct any inquiries that may be necessary, and they will be always willing to hear any representations which the Industrial Council for the district may desire to make, and the Industrial Council for the district will be notified when any application for an increase of charges is made.

With regard to the second point raised by the deputation, I am to say that the Minister has no power to allocate to any particular purpose any part of the sum produced by the sanctioned increase of maximum charge, but representatives of the Industrial Council can attend any inquiry and be heard thereat.

As regards the third point raised by the deputation, I am to state that the Minister is advised that he cannot restrict the grant of an increase only to undertakers who agree to carry out the recommendations of the Industrial Council.

I am, Gentlemen,
Your obedient servant,
(Signed) R. FRANCIS DUNNELL.

The Joint Secretaries,
Home Counties (No. 9 Area) Joint Industrial Council
for the Electricity Supply Industry.

The Costs of Gas Fittings.—The electrical engineer, with characteristic modesty, and a lively remembrance of the time when new houses were fitted for gas with a mixture of small iron and compo pipes held up for the most part by the plaster, is apt to assume that his wiring estimates are still much in advance of the expenditure called for by his competitors. Only a few years ago small houses were wired in carcass for 8s. to 10s. a point, without fittings, and gas could be run for half that amount. To-day, however, it would appear that high cost of installation and of apparatus is a more serious difficulty to the gas engineer than to ourselves, checking the popular wiring schemes and radically altering the relation between the cost of gas apparatus and the revenue to be derived from its use. A correspondent of the *Gas Journal* recently complained that a speaker had given a figure of £1 per point as the present cost of simple gas installation work, including inverted pendants, burners, outlets for fires, cooker, &c., at the same time stating that the lowest tender known to him for electric wiring without fittings was 25s. per point; whereas the correspondent considered that it could not be done with material up over 100 per cent.; wages of gas fitter 1s. 9d. per hour; wages of gas fitter mate 1s. per hour. The results were given of two houses piped in carcass to determine the costs for 600, as follows:—

Houses: 3 bedrooms, parlour, living room, scullery, bathroom, usual offices.

Points: 10 lighting, 1 cooker, 1 hot water, 4 fires; total, 16.

Net cost without establishment charges, supervision, use of tools or waste, £12 6s. per house.

FITTINGS.	£	s.	d.
1 2-light pendant		14	6
2 Burners at 5s. 4d.		10	8
8 1-light pendants at 5s. 6d.	2	4	0
8 Burners at 4s. 8d.	1	17	4
10 Mantles at 6d.		5	0
10 Patteresses at 6d., labour, &c.		5	0
	£5	16	6

or a total of over £18 actual net cost for a house with 16 points, only the lighting points being completed with fittings. It would appear that after providing the cooker, water heater, and fires, an expenditure approaching £50 per house might be anticipated.

The Fiat Motor-car Works.—When the Italian automobile industry is under consideration, Italy's lack of coal is often cited as one of the handicaps which will prevent the industry attaining the same development as that of other nations more favourably situated in this respect, but Italy has been so favoured by nature in the matter of water power that coal can almost be dispensed with. There is proof of this in the Fiat motor works, which, whilst being one of the largest in Europe, are also completely electrified, the whole of the electrcity being obtained from water power in the Alps. At the present time no coal whatsoever is used for driving machinery. For power and light the big works of the Fiat Company consume 15,000 KW. daily, out of a total consumption of 50,000 KW. for the whole of the city of Turin. When the new steel works and the forges were laid out, they were designed to be operated entirely by electricity secured from water power; the electric furnaces, in particular, are very fine. The essential features of these furnaces are the subject of a Fiat patent, and excellent results are obtained. It was in 1917, soon after the Fiat Company had bought up the Piemontaise steel works and forges, that the problem was tackled of securing sufficient hydraulic power and designing such a plant that no coal whatsoever would be required in the big Turin factory. Control was obtained of the Mont Cenis Hydraulic Power Co., which, by reason of its topographical and geological conditions, offered good possibilities for obtaining electricity. The plant existing at that time on the Cenischia River was able to supply 65,000,000 KW.-hours, of which 38,000,000 were available in summer and 27,000,000 during the winter months. This quantity will be considerably increased in the near future, for extensive works are being carried out on the Cenischia River. In addition to this, by increasing the size of the natural lake on the top of the Mont Cenis, the power available will be increased to 200,000,000 KW.-hours, of which a large portion will be available during the winter months. When these extensions have been completed, the whole of the electricity produced by the Mont Cenis Electric Power Co. will be reserved for the Fiat motor works at Turin.

Electro-deposition of Iron.—In a paper recently read before the Institution of Automobile Engineers, Mr. B. H. Thomas gave an interesting account of the progress of repairing or building up worn motor parts by means of electrically deposited iron. Ball race housings, stub axles, and the various other parts that, subject to continuous wear, become slack must, under ordinary circumstances, either be allowed to run on to the detriment of the engine in general or on the other hand must be replaced—a costly alternative. In such cases the only satisfactory remedy is the deposition of copper or iron, and it has been found possible to coat with a layer 2 mm. thick any cylindrical wrought iron or steel surface. Properly done this layer cannot be chipped off with a chisel, and when carbonised and hardened the dividing line, shown by micro-photographs, entirely disappears. The surface can be filed or ground and given a high finish. At the Third Heavy Repair Shop, described by the writer, 6,000 parts were rendered serviceable by this method in less than two years, and several examples of the various types of work are given in the paper. The plant consisted of two depositing benches with 24 depositing vats each and a large vat for simple repetition work; machine tools for finishing off repairs; two electrolytic cleaning vats; a set of accumulators coupled in groups for 2, 4, 8 and 12 volts; three ¼ H.P. motors for rocking anodes, besides other necessary smaller appliances. The method of working is detailed by Mr. Thomas. The importance of properly cleaning the material is emphasised by the fact that it is put through seven stages, including two electrolytic baths. Any portion of the work to be left as it stands is then stopped off by means of wax or a similar composition. The bath that gave the most satisfactory results was composed of 75 grammes of ferrous ammonium sulphate to 1 litre of water, with a current density of 1 amp. per 30 sq. cm. The work is suspended in the vat from a standard fixed to the bench, and in order to ensure a uniform deposit the anode is moved about the work by means of a small motor. The best anode proved to be that made up of 16 S.W.G. Swedish iron wire wound into the form of a cylinder and thoroughly annealed. The temperature of the solution should be kept above 68 deg. F., and it is desirable to decant and settle it every three days or so to remove oxides of foreign matter which cause roughness in the deposited metal.

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The Cracking of H.T. Insulators.—A writer in *Elektrotechnik und Maschinenbau*, discussing this question, points out that cracking in petticoat H.T. insulators is nearly always caused by the cement used in cementing the different parts together (he is, of course, speaking of built-up insulators). Most ordinary cements become very hard with time, and having a different thermal expansion to the porcelain used, they cause the latter to become mechanically stressed, and so cause cracking and breaking when the insulators are heated up. A number of firms use an elastic compound between the cement and the porcelain, but here also the same trouble is experienced with the lapse of time, as the elastic medium also oxidises and hardens. The remedy suggested by this article is to add to the cement (only the best Portland cement should be used) materials having a lower thermal expansion than the cement, so that the thermal expansion of the compound is reduced to approximately the same value as that of the porcelain. A compound of this type, termed "Teleo" cement, has been patented by the Porzellanfabrik Freibergi. S., and has given very satisfactory results in use. It has also a higher mechanical strength than pure cement.

E.P.E.A. Bonus of £30.—We understand that a situation of serious concern to the inhabitants of Derby, Nottingham, and Leicester was recently created by the Councils in these boroughs on account of their not agreeing to pay the above bonus in accordance with the recommendation of the National Joint Board of Employers and members of staff (Electricity Supply Industry). The members concerned, supported by the E.P.E.A., had intimated their intention of withdrawing their services on Friday last, if the Councils did not reconsider their decision and agree to pay the bonus as recommended. We are glad to state that the Corporations have since reconsidered the matter and have decided to pay the bonus to the technical staffs, as from January 1st, 1920.

Appointments Vacant.—Armature winder, for the Oldham Corporation Tramways; foreman (Rs. 500 per week), for the Ammunition Power House, Kerkee, India; meter superintendent (105s.), for the Loughborough Corporation Electricity Department; mechanical and electrical engineer, for the Yorkshire Electrical Power Co.; resident electrical engineer (£450) for the Borough of Wrexham Electricity Department; mains and meter assistant for Alloa Town Council Electricity Department. See our advertisement pages to-day.

INSTITUTION NOTES.

Institution of Electrical Engineers.—There was a good attendance of members on June 16th, when Sir Dugald Clerk, K.B.E., &c., read his "Note on the Thermal Efficiency of the Generation and Use of Gas and Electricity." The subsequent discussion, which will appear in a later issue of the ELECTRICAL REVIEW, raised points of great importance. Among the speakers were Messrs. Merz Highfield, Patchell and Wordingham, Colonel Crompton, and Profs. Cobb and Smithells.

STUDENTS' SECTION.—The London Students' Section of the Institution is to visit Scotland this summer from July 24th to 31st. An attractive programme has been arranged, which will include social functions and visits to power stations, works, and other places of interest at Glasgow and Clydebank.

Institution of Civil Engineers.—A conversazione is to be held at the Institution, Great George Street, S.W., on Tuesday, July 6th, from 8.30 p.m. to 11 p.m.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

MR. OSWALD G. COOK, late assistant electrical engineer at H.M. power station, Ripon, has been appointed a director of Messrs. Arthur Cook, Ltd., hauling contractors, Leeds.

The Council of the Royal Society of Arts has awarded medals for the following papers read during the session 1919-20:—MR. SYDNEY PRESTON, C.I.E., "English Canals and Inland Waterways"; SIR JAMES CURRIE, K.B.E., C.M.G., "Industrial Training."

MR. A. E. FIRTH, of the Camp power station at Ripon, has been appointed shift engineer at the York electricity works.

MR. J. ALLAN WILSON has resigned his position as branch manager of Messrs. Johnson & Phillips's Glasgow office, as from June 30th.

The Highways Committee of the London County Council recommends that MR. J. R. WALKER, assistant power-station engineer in the tramways department, be appointed inspecting engineer, at a salary of £440 a year, plus war bonus of 20 per cent., plus £120, making £648.

The marriage took place at Tunbridge Wells, on June 14th, of MR. FRANK ABBOTT, of the staff of the General Electric Co., Ltd., and Miss B. K. Maxwell, daughter of the late Mr. W. Maxwell, of London and Chicago. From his colleagues, Mr. Abbott received a silver coffee service.

Ayr Town Council has granted the electrical engineer a bonus of £150, and the tramway manager a bonus of £135, into which all war bonuses are merged.

MR. W. C. MALLINS, general manager of the Liverpool Corporation tramways, was presented on his retirement with a silver rose bowl, salver, and vases, at a luncheon given by the chairman of the Tramways Committee (Councillor F. C. Wilson), at the London and North-Western Hotel, Liverpool. Warm tributes were paid to his work as tramway manager.

Kilmarnock Town Council has appointed MR. J. H. MENZIES, of Dundee, as tramway manager.

Obituary.—MR. CECIL TREHERNE, who was killed by lightning on June 12th, was an apprentice to electrical engineering with the British Westinghouse Co., at Manchester, and was about to enter Manchester University to take an engineering degree. He was 19 years of age.

MR. T. GOODYEAR.—The death has taken place of Mr. Thomas Goodyear, who was for over 24 years electrical engineer to the late Lord Nunburnholme, at Warter Priory (Yorks.). He was 63 years of age.

MR. JOHN COOPER.—We regret to record the death of Mr. John Cooper, accountant, who was in the employ of the Edison Swan Electric Co., Ltd., for 30 years.

Will.—Mr. H. P. SMALLPEICE, chairman of the Guildford Electricity Supply Co., Ltd., left £138,265 gross and £114,424 net personalty.

NEW COMPANIES REGISTERED.

Greenling Electric Supplies, Ltd. (168,255).—Private company. Registered June 14th. Capital, £5,000 in £1 shares (4,000 participating preferred). To carry on the business of electrical, mechanical, motor and general engineers, manufacturers of and dealers in transformers, radiators, dynamos, motors, &c. The subscribers (each with one share) are: W. H. Roslington, 15, Duke's Avenue, Chiswick, W.4, merchant; H. W. Humphries, 23, King Street, Cheapside, E.C., C.A. The first directors are: W. H. Roslington (governing director) and others to be appointed by him. Solicitor: E. J. B. Hobrow, 9, Ironmonger Lane, E.C.

Garner, Holt & Co., Ltd. (168,355).—Private company. Registered June 17th. Capital, £5,000 in £1 shares. To take over the business of an electrical engineer and constructor carried on by G. Garner at 2, Grange Terrace, Wilmslow Road, Rusholme, Manchester, as "Garner, Yates & Co." The permanent directors are: G. Garner, 2, Grange Terrace, Wilmslow Road, Rusholme, Manchester, electrical engineer; A. O. Holt, 2, Grange Terrace, Wilmslow Road, Rusholme, Manchester, electrical engineer. Solicitor: S. Bishop, 23, Fountain Street, Manchester.

Northern Radiators, Ltd. (168,201).—Private company. Registered June 11th. Capital, £5,000 in £1 shares. To carry on the business of radiator manufacturers, motor, electrical and general engineers, &c. The subscribers (each with one share) are: E. C. Q. Henriques, 477, Bury New Road, Manchester, engineer; K. Howell, 88, Stockport Road, Marple, clerk. The subscribers are to appoint the first directors. Qualification, £100. Secretary: E. C. Q. Henriques. Registered office: Sheepscar Street, Leeds.

Industrial Electroplant, Ltd. (168,192).—Private company. Registered June 11th. Capital, £2,000 in £1 shares. To carry on the business of manufacturers of and dealers in electric and galvanic machinery, motor cars, motor and other cycles, aircraft, range finders, steering gear, gyroscopes, dynamos, cables, switchgear, &c. The subscribers (each with one share) are: F. C. Austin, Thorncroft, Warlingham, Surrey; H. A. Rawlin, 179, St. James' Road, S.E.1. The first directors are: F. Pooley, E. C. Austin, W. L. Wreford, F. Creedy and H. St. Hill Mawdsley. Registered office: 34, Broadway, Westminster, S.W.

Sinclair, Paget & Co., Ltd. (168,209).—Private company. Registered June 11th. Capital, £2,000 in £1 shares. To take over the business of electricians, electrical engineers, &c., carried on by G. F. A. Paul at 8, New Inn Yard, Shoreditch, E.1. The first directors are: W. P. St. John, 151, Fore Street, Edmonton, N.18, accountant; G. F. A. Paul, 32, Falmer Road, Enfield, electrical engineer; L. Lambert, 21, Aldebert Terrace, Clapham, S.W.8, accountant. Secretary: L. Lambert. Registered office: 8, New Inn Yard, Shoreditch, E.1.

Fred Price & Co. (1920), Ltd. (168,229).—Private company. Registered June 12th. Capital, £50,000 in £1 shares. To carry on the business of electrical engineers and contractors, mechanical engineers, &c. The subscribers (each with one share) are: R. Lane, 3-4, Duke Street, Cardiff; F. Price, 9, Gold Street, Cardiff; A. W. Horton, 29-31, St. Mary Street, Cardiff; C. W. King, Pentre Gwylim, Llanishen. The first directors are: Sir Edward Nicholl, Sir Wm. Diamond, R. Lane and C. W. King. Secretary: T. C. Evans. Solicitors: Forsdike, Buchanan and Giles, Cardiff. Registered office: Institute Lane, Park Place, Cardiff.

Bougie Pognon, Ltd. (168,249).—Private company. Registered June 14th. Capital, £100 in £1 shares. To acquire and turn to account the patent and trade mark relating to the Pognon sparking plugs. The subscribers (each with one share) are: A. Peters, 4, Mount Road, Wimbledon Park, S.W.19; A. Keston, Westgrove, 339, Amhurst Road, Stoke Newington, N.16, clerk. The first directors are to be appointed by the subscribers. Solicitor: A. Baker, Lennox House, Norfolk Street, Strand, W.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Accessories Manufacturing Co., Ltd. (Old Co.).—H. A. McCann, of 8, Queen Street, E.C.4, ceases to act as receiver or manager on June 8th, 1920.

Penrith Electric Supply Co., Ltd.—Satisfaction in full on April 29th, 1920, of mortgage dated December 5th, 1918, securing all moneys due or to become due from the company to bankers.

Kent-Mitchell, Ltd.—Satisfaction to the extent of £1,000 on February 20th, 1920, of debentures dated July 11th, 1919, securing £3,000.

Llanrwst Electricity Supply Co., Ltd.—W. J. Parry, of Caetmor Chambers, Bethesda, Carnarvon, as receiver and manager by order of Court dated May 21st, 1920.

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P. E. Baker, Ltd.—Particulars of £10,000 debentures created May 19th, 1920, whole amount being now issued, charged on the company's undertaking and property, present and future, including uncalled capital.

Honiton & District Electric Supply Co., Ltd.—£500 debentures dated May 25th, 1920, charged on the company's undertaking and property, present and future, including uncalled capital. Holders: C. Harding, Burwood, Honiton, and others.

Llangollen & District Electric Light & Power Co., Ltd.—Debentures, and as collateral security, a mortgage, both dated May 13th, 1920, to secure £1,000, charged on company's undertaking and property, present and future, and lease of portion of Deel Mills, Llangollen, with powers therein granted to install dynamos and generators, &c. Holders: E. F. Jones, Llangollen, Denbigh.

W. Saunders, Ltd.—Mortgage dated May 20th, 1920, securing £2,200, charged on 24, 26, and 28, Crouch Street, Colchester. Holders: Miss F. Fitchett, Halstead; W. J. Hankin, 3, Winchester Street, Basingstoke; and F. V. Hankin, Ash Cottage, Clarence Road, Fleet, Hants.

Lancashire Dynamo & Motor Co., Ltd. (61,447).—Return dated December 31st, 1919. Capital, £250,000 in £1 shares (200,000 ordinary and 50,000 preferred), 150,000 ordinary and 48,800 preferred shares taken up. £198,800 paid. Mortgages and charges, £75,000.

CITY NOTES.

Lancashire Power Construction Co., Ltd.

As a result of the Parliamentary Co.'s operations for the year 1919 that company has, after paying debenture interest and putting £15,000 to reserve, declared a dividend of 7 per cent. upon its shares, all of which are held by this company. This will produce £35,660, plus £4,500 interest on the debenture held by this company, plus interest, &c., received £1,317, making £41,477. Debenture interest payable, general expenses, &c., absorb £17,219, leaving £24,258, plus £8,441 brought forward. Dividends of 6 per cent., tax free, on the cumulative convertible first preference shares, 7 per cent. on the 7 per cent. cumulative participating preference shares, and 6 per cent. on the ordinary shares, are to be paid, leaving £9,648 to be carried forward. To enable the extension of the generating station and mains of the Parliamentary Co. to be proceeded with, the company in December last made an issue of 400,000 6 per cent. cumulative convertible first preference shares of £1 each. The following figures indicate the development of the Parliamentary Co.'s business during the year:—

	1918.	1919.
Units generated	49,581,893	50,671,536
Maximum load in KW. ...	14,000	18,600
H.P. connected	35,500	39,000
Receipts	£136,745	£173,338
Expenditure	£88,731	£119,960
Profit on trading	£48,014	£53,378

Owing to the change from war to peace conditions, and especially to the reduction in working hours in practically all industries, the Parliamentary Co.'s output has not quite maintained the normal rate of expansion, but in spite of many difficulties the trading result has improved, and the Parliamentary Co. has been able to increase its dividend to this company from 6 to 7 per cent. New contracts entered into during the year, which are now maturing, will have the effect of approximately doubling the company's output as soon as the plant on order is in commission. In addition inquiries have been received considerably in excess of the company's capacity to supply, even when the present extensions are completed. These inquiries are receiving the careful consideration of the board. The continued high price of coal has brought home to power users in every industry the great advantages of central electric power supply. The extensions at the power station, although somewhat behindhand, are now making good progress, and it is hoped that the first of the two 10,000 KW. sets on order will be operating in October, and the second about four months later; labour difficulties, and particularly the moulders' strike, are responsible for the delay in the delivery of the new plant.

Delhi Electric Tramways and Lighting Co., Ltd.

Mr. A. W. Tait, C.B.E., in the course of his speech at the annual meeting, said that the accounts were the most satisfactory since the formation of the company. The position had been strengthened, and the first dividend on the ordinary shares was recommended; the preference shareholders began to get some return in respect of their participating right. They had received considerable assistance to these ends from the profit obtained on remittances to this country (£7,127), an abnormal circumstance, which they could not expect to be repeated to the same extent in the current year. The satisfactory feature of the accounts was the increase in the revenue from both branches of the undertaking. This would have been greater but for the complete boycott of the cars which took place in April, 1919. The net revenue increased by 13 per cent. It was inadvisable to increase the tramway fares, but they were considering slight increases in the lighting and power rates. There had been a slight fall in the cost per unit generated due to an improvement in the freight charges on oil fuel. They were making arrangements to cope with the demand which was expected during the coming winter. There would be an exceptional demand during the visit of the Prince of Wales. Despite the difficulties of obtaining electrical materials of all kinds, 195 consumers were added, against 117 in the previous year. As they had been able to obtain better supplies of materials the new consumers this year showed a further substantial increase. They had selected a type of car which was at present before the municipal authorities for approval. Rolling stock was costly, and there was difficulty in obtaining delivery and accommodation to India, so they might not be able to supplement their rolling stock to any material extent for some time. It was too early to give a reliable estimate of the prospects for the current year, but the returns so far to hand showed that if conditions remained normal they might hope for as good a result as that now submitted so far as the net revenue of the combined undertakings was concerned—leaving out of account the question of exchange. The general manager, Mr. Griffin, was returning to this country for a rest owing to the state of his health. It was improbable that he would be able to return to India for any extended period, and they would have to consider the question of a successor at an early date.

Greenwood and Batley, Ltd.

Col. O. C. Armstrong, D.S.O., presiding at the annual meeting on 15th inst., said that regarding future prospects they need have no anxiety as to orders; they were in the fortunate position of being able to pick and choose their orders, though under existing conditions this was not always an infallible indication of results. The many factors which might intervene between the acceptance and the completion of a contract were at present abnormally indeterminate, and these in turn were aggravated by the crushing effect of prospective taxation. It was confidently anticipated that within eighteen months of the actual conclusion of the war they would all be in a position to reorganise and develop to their fullest extent the industrial powers of this country. Everyone accepted that industry would have to bear its full and direct share in the taxation necessary to liquidate the vast debt that had been incurred, since, carried to its ultimate conclusion, industry, directly or indirectly, in one form or another, would eventually have to find by far the greater part of the money required for the repayment of the war debt. It was, however, generally and justifiably assumed that in course of time a wise and statesmanlike policy would be initiated which would adjust the burden of taxation in such a manner that it would leave the most important factor in this country, the manufacturing industry, the freest possible use of all its powers of development both in the home as well as in foreign markets. So far from this being the case we are apparently to have an extension of the E.P.D. in an aggravated form—an inequitable and deleterious form of taxation admissible at best as a temporary expedient under war conditions, where the Government practically consumed or controlled the entire output of our factories, and mass production of standard articles was more or less universal. The orders already booked were sufficient to keep all the various departments in the works fully employed for the next twelve months, and, given freedom from labour troubles and loyal co-operation of the men, he thought they could look ahead, in so far as the immediate future was concerned, without any cause for anxiety. A very fair proporiton of the orders are for export, and they found many of their old customers from abroad were again asking them to supply their needs.

Callender's Cable and Construction Co., Ltd.

Sir J. Fortescue Flannery, M.P., presided on June 17th at the Hall of the Institute of Journalists over the annual meeting. He said the results were extremely satisfactory, and when it was remembered that they were achieved in the face of unusual difficulties, they were all the more gratifying. The war had made things difficult for the company, but they had had one steady customer in the Government, who had taken the greater part of their output to the great advantage of both the Admiralty and the War Office. As a result of the suspension of hostilities the Government stopped its war orders within 24 hours, and left on the company's hands large quantities of practically manufactured materials, and a factory which had been built to meet its special requirements. Their original factories, as they had been converted again to meet the special requirements of the Government, were to a large extent in a condition unsuitable for commercial work. The problem left to the company, therefore, was to obtain orders sufficient to fill the works, rearrange the factories to make such work profitable, and at the same time in order to keep their promise to re-engage and re-employ over 800 men. These briefly were the conditions under which they began in 1919, and it was testimony to the inherent strength of the company that first its world-wide agencies, secondly, its sales organisation, and last, but not least, the skill and grit of its management, led by Sir Tom Callender, enabled it to secure the orders, deliver the goods, and obtain the profit which was shown in the accounts. The profit was made between January 1st and December 31st, 1919, and so went to the credit of the whole year, but a large part of the year had elapsed before the changes required by the altered conditions of manufacture were completed, and although the factories were turning out cables in large quantities during the whole of 1919, obviously they could not do so efficiently, and consequently profitably until the changes

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in equipment and organisation were completed. The profit made was, therefore, earned after these changes had been made, and consequently during a portion only of the year under review. The present year was handicapped by no such difficulties, and they expected corresponding improvements in the results. Attention was drawn in the report to the re-arrangement of the factory routine, owing to the working week having been reduced to 47 hours, *i.e.*, by over 10 per cent. The volume of orders recorded was colossal, and quite beyond the capacity of the factories at the present time working for 47 hours a week only, and it was clear that the fullest and most complete employment of the plant must be obtained to achieve the delivery to time of the large contracts for cable which were placed in their hands. Negotiations were opened with the men's unions, and the whole situation explained, reviewed, and discussed, and, after prolonged and difficult negotiations, a scheme of rotary shifts for the cable shops was formulated and agreed, so that the cable works could, to all intents and purposes, keep up a continuous process of manufacture. Such an arrangement enabled them to deal with the extraordinary volume of orders received, and to a limited extent effect some improvement in the cost of manufacture. In this connection, however, the higher rates of pay and the lower efficiency of night work had to be set off against some reduction in general charges per ton of cable manufactured following, as such reduction should follow, upon continuous operation of their plant. All this augured well for the company's future, and forecasted even better results than those shown in the accounts. The volume of orders received after the cessation of hostilities had been prodigious, large contracts had been secured, and others were apparently coming their way, the output of the work was continuously increasing, and, moreover, a new factory had been erected at the Erith works to manufacture super-tension cable for 33,000 to 60,000 volts. Until comparatively recently voltages higher than 11,000 volts were not employed in this country. Now that the supply and application of electricity was increasing so enormously, huge stations were built to distribute current over large areas, higher pressures were employed, and the demand for super-tension cables was already urgent, and was obviously bound to develop. Their employment, however, was not restricted to this country. In every part of the world where electricity was developing the same demand was arising, and as they intended to obtain their share of the orders, they had designed and built a factory especially to manufacture efficiently this class of cable. The factory was now complete, and would commence operations immediately. The prospects of the company as they found them to-day were never more hopeful. The books were full of orders, works were operating efficiently, and the new factory was ready. The network of agents throughout the country and abroad poured into the headquarters a steady stream of inquiries and orders, and the difficulty was not to obtain work, but how to avoid "biting off more than we can chew." The directors intended to seize the opportunity now before them to drive ahead the enterprise for which they were responsible, along the path of even more successful progress. To do so, however, financial resources beyond those already possessed by the company were necessary; and, in a few days' time, the board would appeal to the public to provide them with further funds to develop this successful business towards an even greater financial return. The general terms of the issue were known to them. They were 400,000 7½ per cent. "B" preference shares of £1 each at par, and 100,000 ordinary shares of £1 each at 22s. per share—terms attractive enough, it seemed to them, in themselves to ensure the same great success as occurred in their issue of 1918, which was subscribed nine times over. Supported, however, by the results and the favourable prospects which they had indicated, the new issue should induce shareholders to take a still greater share in the successful enterprise they owned. Touching on the accounts, the chairman said that the balance to the credit of profit and loss account was £161,000, as compared with £134,000 a year ago. After provision for interest on debenture stock, dividend on preference shares, and depreciation, and adding the balance brought from 1918, there was an available total of £198,000, as compared with £184,000 a year ago. They were carrying to special reserve for war taxation £33,000, and after payment of a dividend for the year of 15 per cent. on the ordinary shares, they were carrying forward £105,000. Referring to the reserve for war taxation, he said that the excess profits duty at 60 per cent. was a terrible impost on industry; it must tend to check enterprise, and must cripple industry to a considerable extent. That crippling process affected every company, and this company, of course, did not escape. It was to be hoped that the discussions which were now going on might enable the Government to see their way to some reduction of this very serious taxation.

Sir T. O. Callender (managing director), in seconding the motion, said that 1919 has admittedly been a year of great effort and very hard work, in view of the change of circumstances under which the company had had to operate, and he wished to acknowledge the great help he had received from all the members of the staff during this trying time. In every direction they had endeavoured to push the interests of the company. They had opened up new connections, although they had very large ones already existing before the war, and an interesting item he might mention in this connection was that in the somewhat unlikely country of Ireland they had succeeded in opening up a small but satisfactory business account. They had pushed ahead in South America, where they had opened their own offices on the West Coast with what he hoped would be very satisfactory results. They had widely extended their field of operations in India, and he was confident there would be much business to the good of the company there. The new factory for the manufacture of super-tension cable would relieve the strain on the existing workshops to a considerable extent, and give them an entirely new field of operations. He hoped that before the present month closed they would be actually making this cable in the new shops, and he was sure the results would in every way justify the considerable expenditure incurred. There was still room for improvement in their output. He desired to say, however, that the relations which prevail between the company and their men—especially in their cable shops—were friendly and wholesome, and by the working of the Whitley Council they got into very close touch with each other without the necessity of disputes which had been very unfortunate in some trades, though not in their own, in the past. From all this, and from his knowledge of what was being done, he saw ahead ample work for the company for some time to come, and unless some great disaster occurred to stop all industry throughout the world, he felt sure that the electrical cable manufacturing of which this company stood at the very head, would find during the next three or four years, at any rate, ample scope for all that it could do.

United River Plate Telephone Co., Ltd.

Sir Frederick Green, K.B.E., presided at the annual meeting, last week. He said that the net results, though somewhat less than those of 1918, were decidedly satisfactory considering the position of the world's business everywhere. The earnings in Argentina and London amounted to £976,168, an increase of 7½ per cent. But, on the other hand, maintenance and other expenses of management in Argentina and London increased by 24 per cent., resulting in a profit of £212,092, a decrease of £80,407 as compared with 1918, or 27½ per cent. Negotiations were in progress for obtaining permission to increase their rates, and they had reason to hope that their request might soon be granted. As regards Argentina, the increase in working expenses amounted to £127,097, of which 50½ per cent. was represented by increased operators' wages, 19¼ per cent. by increased cost of plant maintenance, and the balance, 30¼ per cent., by increased cost of administration, taxation, and sundry other items of management. They had to set against this increased expenditure an increase of £66,151 in earnings, making the net decrease for the year in Argentina £60,946. The London expenditure, including income tax, amounted to £105,167—a considerable increase over 1918, but one which was almost entirely due to increased income tax. The addition to the plant account was £148,236, and to real estate £53,733. The latter item was principally due to payments on account of a new building in the city of Buenos Ayres now nearing completion, which would eventually house two 10,000-line exchanges, as well as provide accommodation for a number of the staff. Stocks of material stood at £207,464, nearly double the figure for 1918, and were largely due to heavy shipments during the latter part of 1919 for the purpose of capital extensions. Higher prices, too, played their part in the increased value of this asset. The shortage of materials still prevented them from doing as much renewal work as they desired. At the present moment the waiting list in the city of Buenos Ayres numbered considerably over 5,000, which it would be impossible to reduce to any extent until the additional switchboards (some of which were now in course of erection) were completed. These new switchboards, however, with the exception of one, were merely additions to existing exchanges. To provide the further telephone facilities which were urgently needed, but which during the war years they could not supply, it had been necessary for the company to prepare schemes for altogether new exchanges in other parts of the capital. Accordingly, it had to be decided whether the present Central Battery manual system should be continued for these new exchanges, or whether they should adopt the automatic system which they had had in use for some years in Cordoba and Rosario. Until recently there were difficulties in connection with the introduction of an automatic system into a city where telephone service was already being given by manually-operated exchanges, but these difficulties had now been overcome, and so, after careful consideration, they came to the decision to adopt the automatic system, and had therefore ordered one of the Strowger type, similar, in the main, to that in use at Cordoba and Rosario. It was being manufactured in England, and it was hoped delivery would be made during the early part of next year. This decision to adopt the automatic system for Buenos Ayres would not mean any alteration in the numbers of the present operating staff, as the exchanges in question were entirely new ones; but it should reduce the number of operators necessary for future developments. The Argentine Government had suspended the regulations which since 1912 had seriously retarded telephonic development, and they were now free to proceed with important works which, had it not been for these regulations, would have been completed long ago. Unfortunately, however, the obtaining of the necessary material to-day was very difficult, and this would prevent them from making the rapid progress they desired. These new works, together with the continued expansion of the company's business, would naturally mean a considerable

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expenditure, and it would be necessary to provide further capital. Though there was no need to make a new issue of shares forthwith, they were asking for sanction to an increased share capital, so that, probably next year, they would be in a position to make an issue. The increase of capital would be from £2,000,000 to £2,500,000.

Marconi International Marine Communication Co., Ltd.

Mr. Godfrey Isaacs, presiding at the annual meeting, on June 18th, said that the year had been a somewhat difficult one in consequenec of the dismantling of a great many ships following the cessation of war and for other reasons. In regard to the statement that was frequently made that their charges were far too high, the public did not understand that they received only 2d. per word of the 10½d. charged; 6½d. went to the Post Office and 2d. to the shipowners. Last year he told them it was probable that an additional source of revenue to the company would arise from the use of the direction finder on board ships. This apparatus had been further improved, and was now becoming a really valuable device in assisting navigation, and would become a serious factor in the protection of life at sea. It had been installed on a number of ships, and they looked forward to it being largely employed. The speaker referred to the strike of wireless operators and the negotiations that had taken place prior to the strike. He said that the demands would cost the company £500,000 per annum, and they could not be conceded without reference to the shipowners.

Marconi's Wireless Telegraph Co., Ltd.

The report for 1919 shows a credit balance of £1,220,740 plus £463,787 brought forward, making £1,684,526. Dividends of 22 per cent. on the preference shares and 25 per cent. on the ordinary, also a bonus of 5s. per share, without deduction of income tax, on the old ordinary and the preference shares will leave £955,202 to be carried forward. The report says:—"There having been no settlement with any of the Government Departments in respect of any of the company's claims arising out of the war or for services rendered during the war, no sum in respect of any of these claims figures in the year's accounts. In consequence of unfavourable rates of exchange which obtained at the end of the year, considerable sums of money have been allowed to remain abroad on deposit or invested in foreign Government securities. A sum approximating £58,000 has been debited to profit and loss account, calculating the rate of exchange on December 31st as though the money had been brought home at that date and the loss incurred. The loss, however, has not been actually incurred, and when in the course of time exchanges improve, as no doubt they will do, the sums written off will figure in a future balance sheet as a profit. Further, a sum of £56,000 has been written off, representing depreciation in investments in British and foreign Government securities. Meeting: June 29th.

Anglo-Argentine Tramways Co., Ltd.

The gross receipts for 1919 were £3,296,957, less expenditure £2,578,516, leaving £718,441, plus interest, &c., £39,521, and £83,043 brought forward, making £841,005. Deduct: Annuity to City of Buenos Ayres Tramways Co. (1904), Ltd., £70,660; debenture interest and sinking funds, £587,821; sinking fund for redemption of preference and ordinary stocks, £7,014. The balance to net revenue was £175,510. The directors recommend a dividend of 5½ per cent. on the cumulative first preference shares, being the arrears for the year to June 30th, 1918, less income tax. This absorbs £123,200, and leaves £52,309 to be carried forward. Traffic receipts increased 6.52 per cent. This would have been considerably augmented but for the interruption of services caused by strikes. Passengers carried 370,734,985, being 21,448,647 in excess of 1918, an increase equal to 6.14 per cent. The operating expenses show an increase of £198,178, due to extra cost of all materials and higher wages, a special expenditure during the strikes of £35,737, and a further addition of £54,670 to renewals reserve. The abnormal price of fuel continued to act adversely upon the cost of working, but the second half of the year showed a slight improvement. After protracted negotiations and full investigation by the municipality, the justice of the company's claim for a revision of tariffs was recognised, and an ordinance was promulgated authorising an increase from 10 to 12 cents to take effect as from April 10th this year. The directors record their appreciation of the manner in which the negotiations were conducted by Mr. Pedriali. Sir George Touche, Bart., has been elected chairman of the company in place of the late Mr. J. B. Concanon. Baron L. Janssen and Count C. Cicogna, who joined the board in 1908, have retired. The vacancies on the board were filled by the election of Monsieur Maurice Despret, President of the Société Financière de Transports et d'Entreprises Industrielles, Brussels, Sir Philip Lloyd-Greame, K.B.E., M.P., and Major J. E. Dunning, D.S.O. Mr. Joseph Pedriali, the general manager in Buenos Ayres since 1909, has also been elected to the board. Lengthy extracts from the report by the general manager accompany the statement. Among other matters covered therein are the conditions under which the ordinance relating to the increased tariff was adopted. There are to be as from April 10th, minimum wages of $4 and $4.50 respectively for labourers and all employés; an 8-hours' working day; an increase of 10 per cent. on all wages over the minimum; contribution of 8 per cent. on wages by company towards pension funds. The increased tariff is for three years, at the end of which it is to be revised. Any extra profits after allowing 8 per cent. on full capital actually invested, to go to the municipality. 30 km. of new track to be constructed by the company within three years; arbitration to be provided in case of labour disputes. Although the new obligations are very heavy, it is anticipated that the new tariff, combined with greatly increased traffic and decreased expense in cost of electricity, will have a favourable effect upon the finances of the company during the present year. In regard to prospects, Mr. Pedriali says:—

> The year 1919 gave proof of how rapidly this country can recover from a critical situation, when it is aided by good harvests, which are the backbone of all business here. When writing my report for 1918, at this time last year, the outlook was not brilliant owing principally to the very grave state of affairs existing as regards Labour, but the professional agitator was side-tracked, with the result that confidence was gradually re-established. We are at the present moment experiencing increases in receipts that are greater than we have had before. It would be practically impossible for this rate of increase to continue during the entire year, but I have no doubt that we shall continue to have big traffics. The shortage of cars which we are now beginning to experience is responsible to a great extent for the very high earnings per car kilometre run, and this will continue through the year.

Prospectuses.—*Callender's Cable & Construction Co., Ltd.*—The list is to close on or before June 26th (to-morrow) in an issue of 400,000 7½ per cent. "B" cumulative preference shares of £1 each at par, and 100,000 ordinary shares of £1 each at 22s. per share. The proceeds of the issue are required for erecting additional workshops at Erith, providing further working capital to cope with the increased turnover of the company and its subsidiary, the Anchor Cable Co. The report of the annual meeting of the company appears in this issue of the REVIEW.

A. Reyrolle & Co., Ltd.—The list of applications for the 160,000 ordinary shares was closed on Saturday last, the amount being over-subscribed.

Stock Exchange Notices.—The Committee has ordered the undermentioned to be officially quoted:—

Marconi International Marine Communication Co., Ltd.—440 shares of £1 each, fully paid (Nos. 1,192,287 to 1,192,726).

Mather & Platt, Ltd.—450,000 ordinary shares of £1 each, fully paid (Nos. 600,001 to 1,050,000).

Dealings in the undermentioned have been specially allowed by the Committee under Temporary Regulation 4 (3):—

Aster Engineering Co. (1913), Ltd.—100,000 eight per cent. cumulative participating preference shares of £1 each, 5s. paid, Nos. 1 to 100,000.

Keith (James) and Blackman Co., Ltd.—40,000 new ordinary shares of £1 each, fully paid, Nos. 160,001 to 200,000; and 80,000 ordinary shares of £1 each, fully paid, Nos. 80,001 to 160,000.

South Wales Electrical Power Distribution Co.—The report for 1919 states that units sold show an increase of 8,534,082. After payment of all expenses, the credit balance of the past year's working was £25,627, which with £2,670 to the credit of suspense account, makes £28,297. Deducting interest on prior lien debenture stock and original debenture stock, and making provision for depreciation of new plant, there remains a balance of £676 to be carried forward.—*Financial Times.*

Eastern Telegraph Co., Ltd.—Dividend at the rate of 3⅓ per cent. per annum, less income tax, on the preference stock for the quarter ended June 30th, and a first quarterly interim dividend of 2½ per cent. on the ordinary stock, free of income tax, in respect of profits for the year ending December 31st, 1920.

Electro-Bleach & By-Products, Ltd.—Profit for 1919 £34,637, plus £394 brought forward. Total dividend on the ordinary shares 14 per cent. for the year. £5,000 to reserve; £4,277 carried forward.

Petters, Ltd.—Ordinary share dividend at the rate of 10 per cent. per annum, free of tax, for the year ended March, 1920. To reserve £8,000; written off expenses of issue of additional capital £5,645; carried forward £20,219.

W. & T. Avery, Ltd.—Further dividend of 10 per cent., making 15 per cent. for the year ended March. To reserve, £20,000; carry forward, £23,003.

Waygood-Otis, Ltd.—Dividend 7½ per cent. on the ordinary shares for the year ended March, 1920. Carry forward, £14,446.

Imperial Tramways Co., Ltd.—Dividend on the ordinary shares 4 per cent., less income tax, £5,600; carried forward £966.

Eastern Extension, Australasia & China Telegraph Co., Ltd.—Interim dividend for the three months ended March 31st last of 5s. per share, free of income tax.

British Electric Traction Co., Ltd.—Net profit for year ended March, 1920, £211,316, against £213,324. Dividend 4 per cent. on the ordinary stock. Carried forward £150,422, as against £130,952 brought in.

Direct Spanish Telegraph Co., Ltd.—Dividend on the ordinary 7 per cent. and a bonus of 3 per cent.; to reserve £5,000; carried forward, subject to excess profits duty £20,328.

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J. G. White & Co., Ltd.—Dividend on ordinary shares for year ended February, 1920, 7 per cent., less tax. To reserve £30,000; carried forward £15,286.

International Light & Power Co.—Dividend 1½ per cent., less British income tax, on preference shares for the quarter.

Ransomes, Sims & Jefferies, Ltd.—Dividend on the ordinary shares 5 per cent. per annum; carried forward £36,354.

STOCKS AND SHARES.

TUESDAY EVENING.

WITH the approach of the end of the first half-year, the Stock Exchange does not look for any particular increase in the volume of business, and it cannot be said that the House is disappointed. So far as the money market is concerned, New South Wales has broken fresh ground by offering 6½ per cent. stock at 100. This is the highest rate to be paid by such a borrower for a long time past, and cannot fail to have its effect upon investment securities of all kinds. The industrial markets, however, are fairly well maintained, owing to the lurking hope that the 60 per cent. Excess Profits Duty may not be imposed after all, although, seeing how far away we are from the Budget, the more cautious observers are inclined to think that the 60 per cent. will have to stand in respect of the current financial year, and that it will not be lowered until next April.

Something of a feature is the way in which Edison Swan shares have risen from 23s. 9d. to 26s. 3d. Various rumours are afloat to account for the improvement. Of two authorities who were consulted in regard to the rise, one said that there is an amalgamation scheme in the air, while the second one stoutly denied the existence of any such thing. That well-informed people have been buying is, however, indisputable, and a good deal of interest attaches as to what may be the upshot of the present advance. Other electrical manufacturing shares have hardly moved. General Electrics and Siemens, which are being closely watched, remain at 28s. 6d. (for the new shares) and 26s. respectively. Callenders new issue of preference and ordinary is out, and the ordinary shares are being offered at 22s.—not 24s. as it was originally reported that the issue price would be. The prospectus will certainly appeal to those who are connected with the industry, and in ordinary times when investors are ready to take good stock, there would be no doubt in prophesying a signal success for the issue. Sharp recovery has occurred in Home Railway stocks, in the course of which most of the steam issues have gone up from 10s. to 50s. per cent. Up to the present, however, the Undergrounds have made little advance upon their improvement of a week ago. As before indicated, however, it will require but a little increase in fares for the Underground Electric Railways of London to find all the difference between loss and profit, and, when this aspect becomes more generally recognised, the company's 6 per cent. income bonds will not remain at their present price of 59½ for long.

The American Marconi Company has notified that a further and final extension has been made to June 30th as the last day upon which certificates in the company can be received in New York for exchange into the shares of the Radio Corporation of America. It may be recalled that holders of American Marconi will receive one new ordinary and one new preferred in exchange for one American Marconi share. Moreover, the old certificates will be returned to the proprietor, to be held in case there may be any residue of assets left over in respect of matters at present in suspense. When a market starts in the new shares, it is likely that there will be active dealings in them, but further delay has occurred in obtaining permission to start transactions. The parent shares, after dipping to 3 9/16, recovered to 3 11/16. The new shares and the preference, both at 3¼, show little change on the week. Marines remain at 38s. 9d. In the cable market, the Eastern group continues to be somewhat heavy. In reply to a good many inquiries on the subject, it may be as well to point out that there is comparatively little difference, relatively speaking, between the old and the new issues of the four principal companies, though, of course, the new shares, standing at lower-looking prices, appear to be rather more attractive. The Eastern Company has declared its usual quarterly dividend of 2½ per cent., and the Eastern Extension 5s. a share. Globe preference hardened to 8¾. The company's report shows an increase of £36,000, at £264,000, in the net revenue for the year just ended.

The Mexican list is decidedly harder. Advices have been received to the effect that the Mexican Railway Company has been officially handed back to its proprietors. This gave a fillip to all Mexican issues, and most of the Government railway and utility descriptions are substantially better on the week. Business, however, is very quiet, and the improvements are the result more of sentiment than orders. Competent experts in the Stock Exchange declare that the present Mexican administration gives more substantial hopes for settlement of the country than they have seen for several years past, and it is claimed that the present governors are proceeding upon businesslike and sensible lines in the direction of restoring order in Mexico. In the circumstanes, it is not surprising to find Mexican Light and Power first bonds 3½ up at 46, while the seconds have risen to 27½ and the preferred to 21½. Pachuca bonds at 36 are 3 to the good. Mexico Tramway bonds of both classes are 3 higher. Elsewhere, British Columbia preferred and deferred are again noticeably better, there being a good deal of quiet buying of the semi-investment order. Brazilian Tractions have fallen to 47, this being due partly to financial weakness in Paris.

In the electrical supply market, Charing Cross and Kensingtons are both lower, but City of Londons hardened up a little to 24s. 4½d. The British Electric Traction report had no effect upon the price of the stocks. Some people hoped for rather better figures to be shown, but the dividend, as already mentioned, has been raised from 3 per cent. to 4 per cent., and the price of the ordinary is left at 35 middle, the 6 per cent. cumulative participating preference being 62½. The company's 5 per cent. first debenture changed hands on Monday at 67, and the 4½ per cent. second debenture stock is quoted 57½ middle. London United Tramways 4 per cent. debenture stock can be bought at 37. Armament shares are still dull. An issue of short-term notes bearing interest at 6½ per cent. is expected from the Armstrong Company, at par. Several engineering and similar issues have spurted sharply during the past few days. Babcock & Wilcox, however, remain at 2⅝. Metropolitan-Vickers preference eased off to 2½. Rubber shares are quiet, the steadiness of the raw material being put forward as the reason why the principal shares vary so little in price from day to day. Business throughout the Stock Exchange is far from active, and the tone may best be described as mixed.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1918.	Dividend 1919.	Price June 22, 1920.	Rise or fall.	Yield p.c.
HOME ELECTRICITY COMPANIES.					
Brompton Ordinary	8	12	6⅝	—	£9 8 1
Charing Cross Ordinary	4	7	8½	— ¼	10 0 0
do. do. do 4½ Pref.	4½	4½	2⅝	—	8 8 8
Chelsea	8	4	2½	—	8 0 0
City of London	8	10	1⅞	+ ⅛	8 4 0
do. do. 6 per cent. Pref.	6	6	17/-	—	7 1 1
County of London	7	8	8½	—	9 17 0
do do. 6 per cent. Pref.	6	6	8½	—	7 5 5
Kensington Ordinary	6	7	4	— ¼	8 15 0
London Electric	Nil	2½	1½	—	6 0 0
do. do. 6 per cent. Pref.	6	6	8	—	10 0 0
Metropolitan	5	6	2⅞	—	10 8 8
do. 4½ per cent. Pref.	4½	4½	2½	—	8 0 0
St. James' and Pall Mall	10	12	6¾	—	8 16 10
South London	5	6	3½	—	9 13 0
South Metropolitan Pref.	7	7	16/9	—	7 0 0
Westminster Ordinary	8	10	5	—	10 0 0
TELEGRAPHS AND TELEPHONES.					
Anglo-Am. Tel. Pref.	6	6	78½	+1	†7 13 10
do. Def.	33/6	1½	18	—	8 6 8
Chile Telephone	5	6	6½	—	†4 12 9
Cuba Sub. Ord.	7	7	9	— ½	†7 15 7
Eastern Extension	8	10	14½	—	†6 18 0
Eastern Tel. Ord.	8	10	147½	—	†6 15 7
Globe Tel. and T. Ord.	8	10	15½	—	†6 7 0
do. do. Pref.	6	6	8⅞	+ ¼	6 17 2
Great Northern Tel.	22	—	21½	—	9 16 6
Indo-European	18	10	85	—	7 2 10
Marconi	25	25	8⅛	+ 1/16	6 15 6
Oriental Telephone Ord.	10	12	2	—	†4 18 4
United R. Plate Tel.	8	8	7⅜	— ¼	†6 11 4
West India and Panama	1/8	Nil	⅜	—	Nil
Western Telegraph	8	10	15½	—	†6 9 0
HOME RAILS.					
Central London Ord. Assented	4	4	44½	—	8 19 9
Metropolitan	1	1½	20	+ ½	6 5 0
do. District	Nil	Nil	15	—	Nil
Underground Electric Ordinary	Nil	Nil	1⅛	—	Nil
do. do. "A"	Nil	Nil	4/6	—	Nil
do. do. Income	5	4	59½	—	6 14 6
FOREIGN TRAMS, &C.					
Anglo-Arg. Trams. First Pref.	Nil	5½	32	—	8 3 0
do. do. 2nd Pref.	Nil	Nil	8½	—	—
do. do. 5 Deb.	5	5	60	—	8 6 8
Brazil Tractions	Nil	—	47	—2	—
Bombay Electric Pref.	6	6	18	—	4 10 3
British Columbia Elec. Rly. Pfce.	5	5	57½	—	8 18 10
do. do. Preferrred	2½	5	53½	+8	9 7 0
do. do. Deferred	Nil	3	52½	+3	5 14 3
do. do. Deb.	4½	4½	52½	—	8 2 0
Mexico Trams 5 per cent. Bonds	Nil	Nil	31½	+3	Nil
do. 6 per cent. Bonds	Nil	Nil	25½	+3	Nil
Mexican Light Common	Nil	Nil	12½	—	Nil
do. Pref.	Nil	Nil	21½	+2	Nil
do. 1st Bonds	Nil	Nil	46	+5½	—
MANUFACTURING COMPANIES.					
Babcock & Wilcox	15	15	22/6xd	—	£5 14 6
British Aluminium Ord.	10	10	1⅞	—	9 8 2
British Insulated Ord.	12½	15	1⅝	—	8 2 6
Callenders	25	15	1⅞	—	9 12 0
,, 6½ Pref.	6½	6½	18/9	—	6 18 6
Castner-Kellner	20	17	8½xd	—	5 4 7
Crompton Ord.	10	—	22/-	—	9 1 10
Edison-Swan, "A"	10	—	1⅛	+ ⅛	7 12 4
do. do. 5 per cent. Deb.	5	5	79½	—	6 5 9
Electric Construction	10	—	21/-	—	9 10 6
Gen. Elec. Pref.	6½	6½	18/6	—	7 0 5
do. Ord.	10	—	33/6	—	£5 3 0
Henley	25	15	1¼	—	8 0 0
do. 4½ Pref.	4½	4½	8½	—	6 18 6
India-Rubber	10	—	13½	—	£7 11 0
Met.-Vickers Pref.	—	8	2½	— ⅛	7 2 8
Siemens Ord.	10	10	26/-	—	£7 13 10
Telegraph Con.	20	20	21½	—	£5 11

† Dividends paid free of Income Tax.

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POWER FACTOR FROM THE BUSINESS MAN'S POINT OF VIEW.

[SOME COMMENTS FROM A CORRESPONDENT.]

A SIMPLE explanation of a subject may contain incomplete statements, but it ought not to include any that are misleading or open to question with regard to their correctness. There are so many parts of Mr. Turnbull's article on Power Factor in the ELECTRICAL REVIEW for June 4th, 1920, that seem to be both incorrect and misleading that some comment on them is necessary. Supply companies are indeed desirous of charging for the units they deliver on a sliding scale based on power factor, but surely the difficulty is rather the lack of a meter which will register adequately according to such a scale than the impossibility of making the consumer pay for something he does not understand. We all pay for things that we neither understand nor ever think of trying to understand; we are doing so now for services alleged to be rendered in connection with cheese and coal and clothes and many other things beginning with "c," besides several that do not begin with "c." Why is wattless current any more "elusive" than any other sort of current? And does any consumer actually "understand" what he is paying for, even in the simplest case? If wattless current is explained so that it is "elusive," it is not necessarily the fault of the consumer or of the current.

For wattless current, in spite of what Mr. Turnbull suggests, has a useful function. The analogy of the bank is almost altogether fallacious. The £30 that is bandied about is of no use either to the bank or to the customer, but the "oscillating current," to use Mr. Turnbull's good and illuminating phrase, is of so much use to the motor that it would not be a motor at all without it. It is, in fact, its magnetising current, and is, therefore, absolutely essential to its working. So it is not correct to write of a motor drawing more current from the mains than it requires. It draws all the time just what it needs, neither more nor less. It is perfectly true that, other things being equal, an alternating current motor will take more current from the mains, the lower its power factor is, but the whole problem is one of compromise, and is solved by answering the question whether it is cheaper to put copper in the mains and elsewhere to accommodate the larger current, or to provide a more expensive motor which will work with less current? And the fact that induction motors without power factor correction are so largely used seems to show that that is, on the whole, the cheapest practice in the case of alternating current supply. But if certain consumers are utilising an undue share of the mains and plant by having motors with an abnormally low power factor, they should be asked to pay something towards the cost of the plant that they use more than their neighbours. Even then, it may be cheaper for them to do so than to improve their power factor.

There is apparently some confusion between horse power and current in parts of the article. An "ordinary measuring instrument," presumably an ammeter, would show a greater current than would be taken at unity power factor, but what "ordinary measuring instrument" will show a consumption of 130 H.P. in a circuit using only 100 H.P.? If it does, its place is in the repair shop or on the scrap heap. An indicator diagram taken from the engine driving the generator would not show it, except that a little extra power is used to supply the losses due to the additional current. The article describes a motor which takes 130 H.P. from the mains, and returns 30 H.P. to the mains as an "oscillating power." But it is not correct to say that the motor takes 130 H.P.; its continuous demand from the mains is for just enough power to keep it doing its required work. The reference is, no doubt, to a motor which, if it had a 100 per cent. power factor, would take a certain current, say, 100 amperes, but actually takes 130 amperes, because its power factor is less than 100 per cent. Mr. Turnbull seems to suggest at several points that 30 amperes is the value of the "oscillating current" in such a case; it is, however, really 83.1 amperes.

It is perfectly true that means can be used to prevent the "oscillating currents" in the supply mains; but "oscillating currents" must be provided somewhere, to act as magnetising currents, and if they are not in the supply mains they must be elsewhere. Here is the crux of the whole matter: Mr. Turnbull says that while these correcting devices "cost money, they bring about a great saving in the cost of supply, which is naturally beneficial to users of electric motors." But no: it is not "naturally" beneficial. It is beneficial only if the cost of the improvement is less than the cost of doing without it. Had these correcting devices been as cheap as Mr. Turnbull suggests, would not supply companies have provided them to counteract the baleful effects of these horrid motors? And is there not at least a case for examination, in view of the fact that the supply companies have not made a general provision of them, whether the additional plant and mains that are required to supply current to "imperfect" motors are not cheaper than smaller plant and "perfect" motors? Of course, if the consumer is going to pay for the improvement the supply company will no doubt be able to make a joyful noise and say, "Behold the cheapness of our power!" But if I were to say to Mr. Turnbull, "Here is some excellent coffee. It costs but one penny a pound, but you will never taste coffee as good as this anywhere except here. Only, you must provide a solid gold cup to drink it from, as otherwise it will poison you." I believe Mr. Turnbull, being human, would prefer the old-fashioned coffee in the old-fashioned cup, and think it good enough; and he would be right. So let him tell the business man the whole story, lest the business man some day, with foaming mouth, turn and rend him, and his last state be worse than his first.

Even if a system had a 50 per cent. power factor, the cost of plant would not be doubled on account of the doubled current. The prime mover would be practically the same size, and an alternator does not double its price when its K.V.A. output is doubled; the estimate is, therefore, hopelessly fallacious. It is unfortunate to use the word "efficient" as it is used at the end of the article, because "efficiency" in connection with a motor has a special technical meaning that is wholly apart from the idea of power factor. But, even admitting that the "efficient" motor results in cheap energy, I do not want cheap energy unless I can use it cheaply; and I do not find any help in the article towards a decision as to the total cost to me of the energy I am going to use. In fact, I think Mr. Turnbull's method would leave the consumer in as dense a fog, though possibly a different kind of fog, as any of the alternative technical explanations he rejects as useless.

And now, as fools rush in where angels fear to tread, I have my own suggestion to make. Were I the business man, without expert knowledge, to whom Mr. Turnbull was explaining things, I should be very content if he just said this to me: "It pays us, as a supply company, to use what is known as alternating current. Motors which use this current demand rather a large amount of it, but the current they take really represents less power than it would do if it were put into certain other kinds of apparatus, and the amount required by your motor of 100 H.P. on our system depends on the design of the motor. If we put in an ordinary meter, that meter will register, and you will pay for, just the power you actually use, and the amount of your bill will be practically the same, therefore, however your motor be designed in respect of its demand for additional current, so long as we decide to charge you

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exactly on the indication of your meter. I can prove this to you experimentally, if you doubt it, but I am sure you will take my word for it as an expert. Only remember this: Although the meter will register according to the real power you take, and not according to the additional current I have told you of, we have to provide means to carry the additional current, and so we have to lay out more capital, and you, as a business man, know what that implies; we must have more revenue because of it. Now, the motor that demands less additional current is more expensive to buy than the motor that demands more; if, therefore, you like to put in the more expensive motor, and so really allow us to increase the capacity of our plant without increasing its size, we shall ask you to pay us less per unit than your neighbour, whose motor requires more current for the same power, even though his meter registers the same as yours, because he has used more of our plant in doing the same work. The total cost to you, allowing for the interest on your additional outlay, will be about the same, but you will be helping us, and I am sure you will be glad to do that." Then I, as a plain business man, should say to Mr. Turnbull: "You, too, are evidently a business man, and I understand clearly what you have told me. I am perfectly willing to help you, especially if it is going to cost me nothing." So I should get from him his tariffs, and ask the manufacturers for comparative prices for different designs of motors, on the lines of Mr. Turnbull's explanation; and I should strike a nice balance between debit and credit, and might even feel the richer because of the glow of satisfaction within my bosom that at last this matter was clear to me. So we should all be happy; and blessed above all men would be Mr. Turnbull, who had shed light on my darkness, and yet had never once mentioned power factor in all that he had said.

FRENCH RAILWAY ELECTRIFICATION.

THE French Minister of Public Works formed in November, 1918, in accordance with the upper chamber of Public Works, a committee to examine the propositions submitted by the railway systems of the Paris-Lyons-Mediterranean, the Orleans, and the Midi for the electrification of about 10,000 km. of the lines of their systems. The committee sent a commission of Government and railway engineer specialists to the U.S.A. in order to study American practice. Apart from the general duty of the Mission, consisting of collecting documents on railway electrification and the distribution of electricity at high pressure, its principal duty was to find out, on summing up all the information gained by study of the Swiss and Italian electric railways on one side and the American on the other, if a system of electric traction existed for large railways distinctly superior to all others, and able to be adopted to the exclusion of all others by all the different companies interested for the projected electrification in the centre and South of France.

From the four systems in operation, *i.e.*, single-phase, 3-phase, single-to-3-phase, and H.T., D.C., the 3-phase had already been studied in Italy, where it is largely used, but not to any appreciable extent elsewhere. The single-phase had been equally studied in operation in France on the Midi railway and in Switzerland on the Loetchberg lines, and in construction on the Swiss Federal Railways, which have adopted this system for the gradual electrification of all their systems, and in course of construction, for the Gothard railway. The single-to-3-phase and the H.T., D.C. systems are used mostly in the U.S.A., and so became the principal object of the Mission's work. At the same time the examination of American single-phase installations (25-cycle, while the analogous French installations are 16-cycle) completed the study of monophase installation.

Information gathered in the U.S.A. forms the subject of a detailed report by M. Manduit, secretary of the Mission, and Professor of the Faculty of Science of the University of Nancy, France, of which a translated summary from the *Journal Official de la Republique Francais*, August 13th, 1919, is given in the *General Electric Review*. Briefly, the chief points set out are as under:—

The principal lines equipped with monophase current in America are suburban lines, but the system is applicable to larger lines, and is the same as that of the French Midi, save that the frequency is 25 instead of 16 cycles. The American monophase installations, especially on account of the high frequency adopted, and the employment of motors often not so good as those found on the Midi and in Switzerland, showed an installation less perfect than similar ones in Europe. At the same time the struggle against interference with telephone and telegraph lines has been carried to considerable perfection; also the trolley lines with catenary suspension are remarkably well made. The assembled experience of France, Switzerland, and America points to the conclusion that the monophase system is still far from presenting the solution to a number of problems insufficiently solved in actual practice, notably the production of a motor capable of exerting a heavy torque for a considerable time without rotating in order to be able to start heavy trains on important grades, and of regenerative braking. Furthermore, the system leads to complicated equipment for the protection of neighbouring telephone circuits, which considerably augments the cost of installation. Without this consideration the cost would be distinctly less than similar costs with the 3-phase and H.T., D.C. systems. The expenses of maintenance of the rolling stock are always higher than in the latter two systems, and the motors are less rugged and capable of less overload.

The single-to-3-phase, or split-phase, system is only employed on one line, namely, from Bluefield to Vivian on the Norfolk and Western Railway in the Appalachian mountains in Virginia, U.S.A., for a length of 48 km., with two or three tracks, and numerous curves and grades reaching 20 mm. per metre. The locomotives are flexible and robust, but their operation brings out mechanical and electrical faults which have not been corrected up to the present in an adequate fashion, and on account of which the installation may be considered to be as yet only in the test period. The maintenance expense of the rolling stock is greater than that of other systems. The system, which on first sight appears very interesting, has not yet fulfilled the hopes that were held out at the commencement.

The greater part of the inter-urban lines in the U.S.A. operate at 1,200 volts D.C. with an overhead trolley wire, and many of them are really railways with both passenger and freight traffic, and speeds of 60 to 80 km. P.H. are attained. The equipment for this voltage is now as standard as that for tramways. Equal success has attended the use of 2,400 and 3,000 volts. All members of the Commission were unanimous in considering that the Chicago, Milwaukee, and St. Paul electrification, by far the most important in the world, was at the same time greatly superior to all others on account of the excellence of its technical operation from all points of view.

Three-phase power at 100,000 volts is converted by motor-generators, each of which consists of a synchronous motor and two D.C. generators mounted on the same shaft and coupled electrically in series in such a manner that each produces only 1,500 volts at the commutator. The sub-stations are the most delicate and the most costly part of this traction system, but they only number 14, about one to every 50 km., and they operate excellently, requiring only three men each for continuous operation with capacities of from 4,000 to 6,000 KW. By the use of flash barriers on the commutators and of high-speed circuit breakers in the main line accidents resulting from flash overs have been eliminated. The excellence of the installation of these sub-stations accounts for a good deal of the success obtained by the H.T., D.C. project.

At the relatively low pressure of 3,000 volts on the trolley wire experience shows that with a double trolley wire and a pantograph trolley with a double shoe and quadruple contact a current of 2,000 amperes is easily obtainable at a speed of 80 to 95 km. P.H., and 4,000 amps. at 25 km. P.H., which is more than sufficient for the heaviest trains and the highest powers. The locomotives are very easy to run and operate perfectly, the series D.C. motors being the ideal type for traction purposes. They are capable of regenerative braking, marvellously regulated, which assures the most flexible progress on down grades and occasions an important economy of power, wheel tires, and brake shoes. A single armature winder with an assistant assures the operation of the 336 motors of the 42 locomotives in the service. A single locomotive is sufficient to haul passenger trains of 1,000 American tons, even on grades of 20 mm. per metre. Freight trains of 2,800 American tons are hauled by a single locomotive on grades of 10 mm., the tractive effort being then 32.8 metric tons. In trains hauled by two locomotives, the second machine is placed in the middle of the train and not at the end; in America all freight trains, like the passenger trains, are provided with an automatic air brake on every car. A considerable advantage of the D.C. system is that the interference with telegraph and telephone lines is insignificant. In spite of the losses due to conversion from 3-phase to D.C., the efficiency of the system is good; 27 watt-hours per metric ton km., which corresponds to an over-all efficiency of 50 per cent. from the point of purchase from the producer up to the point of consumption.

With regard to the conclusions come to relative to the choice of an electric traction system, the writer of the report, on account of the remarkable results in America with 3,000-volt D.C., "does not hesitate to formally conclude in favour of the adoption of this system," and he believes it to be "actually the only system suitable for the electrification of heavy traction lines." The D.C. system presents the inconvenience of being a little more expensive in first cost, on account of the rotary sub-stations required, but this is balanced by the fact that frequency changers would have to be employed if the single-phase system were adopted in France.

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So far as the expense of operation is concerned, the difference would not be great, and would not come into consideration in the choice of the system.

It is possible that with the single-phase system, which at the first glance shows the advantage of lending itself to a large variety of combinations, satisfactory operation may some day be obtained, but it is, without a doubt, a fact that the actual practice is far from being desirable at the present time.

Despite certain advantages obtained in Italy with the 3-phase system, it is the opinion of the Mission that it should be rejected, especially in consequence of the complexity and of the high price of installation and maintenance of the two trolley wires.

WATER POWERS OF BRITISH COLUMBIA.*

THIS is one of the most remarkable of the series of official publications yet issued by the Canadian Commission of Conservation, a series which deserves to be more widely known than is at present the case. It is now just over ten years since the Commission commenced its investigation of the character and extent of the various natural resources of Canada. A preliminary report in 1911 merely made evident the paucity of information concerning the water power resources of Manitoba, Saskatchewan, Alberta, and British Columbia. The deficiency so far as concerned the first-named three provinces was made good by a report published in 1916, and the present volume (which completes the programme undertaken in 1910) is a compendium of data relating to the water power resources of British Columbia. The physical difficulties of investigating streams in this province are immense, and the season available for useful reconnaissance is very short, since the work has to be performed when the streams are neither approaching nor at their floor. The greater credit is consequently due to the engineers responsible for collecting the data presented.

The opening chapters comprise a statement of guiding principles which should govern the conservation and utilisation of water power, and a description of the more important features which should characterise reliable water power data. This information is of quite general applicability, and experience has shown that loss of time and waste of effort have resulted from ignorance or imperfect knowledge of these fundamentals. The abnormal price and short supplies of coal during recent years have aroused widespread interest in water-power possibilities. In so far as the latter are technically and commercially sound propositions, this awakening of interest is all to the good, but the idea is still too prevalent that wherever there is running water there is boundless energy to be had at next to no cost. Mistakes of this nature are by no means confined to the general public; for instance, during ten or twelve years preceding 1915, eighteen large hydroelectric plant in the U.S.A.—totalling over 600,000 developed horse-power, and involving about $125,000,000 investment—proved financially unprofitable. It is stated that most of these failures have resulted from mistakes of engineers, especially in estimating the quantity of water available (the errors ranging from 30 to 200 per cent.), and in estimating the cost of development (some of the projects costing nearly twice the sum estimated). The possibilities of power development from coal must always be considered, both as regards direct competition with hydroelectric energy and as a means of supplementing the latter during periods of low water.

Naturally it is the low water flow which determines the maximum output which can be supplied continuously by a water-power station. Estimates should be based on records extending backwards for as many years as possible, and the normal ratio of flood to minimum flow must be determined. Owing to the vast natural storage capacity of the Great Lakes, the St. Lawrence river has a more uniform flow than any other large river in North America or probably in the world, the ratio of flood to minimum flow being only 2 to 1. On the Winnipeg river, above English river, the ratio is about 6 to 1; on the Ottawa river and on the Pend d'Oreille river (B.C.) it exceeds 15 to 1; on the Delaware river at Port Jervis (N.J.), it is 375 to 1; and there are, of course, many streams draining quite large watersheds which dry up during the summer. The importance of studying records relating to as long a period as possible is illustrated by the fact that the ratio of flood to minimum flow in the Columbia river at Dalles (Oregon) was 28 to 1 average for 37 years, and only 15 to 1 during the five-year period ending 1915. Obviously it would be easy to make serious mistakes even by the conservative application of data collected during a period of five years. Similarly a single century-old instance of backflooding may condemn a proposal to dam a stream. Another point which is emphasised in the present report is the importance of making the preliminary installation of dams and other main works with regard to the possible future development of more power than is at first required. Often a partial development unwisely planned has made subsequent full-development impossible save at prohibitive cost. The data and explanations given in this report make it easy for the engineer, and even for the non-technical financier, to determine how much useful information there is available concerning a proposed development, and to check the fundamental figures of flow, head, and storage on which depends the possible success of the scheme. Reliance should be placed only upon actual measurements, and great caution is needed if meteorological records are not available for a period of at least ten or fifteen years.

The voluminous data concerning the principal streams of British Columbia are, naturally, quite unsuitable for treatment in abstract. The province is divided into five main divisions, viz., t heColumbia river and its tributaries; the Fraser river and its tributaries; Vancouver island; the mainland Pacific Coast north of the Fraser (including the Skeena, Nass, and Stikine); and tributaries of the Mackenzie river. For each river and its chief tributaries, tables are presented specifying the watershed, head, and probable horse-power, and giving notes concerning the character of the ground and the probable method of development. In addition, there is a large number of tables of meteorological and hydrometric data and others referring to publications of all sorts bearing on water-power development in this district. In round figures there is from 2 to 3 million 24-hour horse-power available in the province, but this total must be considered in relation to a great number of factors and conditions which are enumerated in the report.

Needless to say, the report is absolutely indispensable to anyone concerned with hydroelectric projects in British Columbia and with the related subjects of domestic and municipal supply, agriculture and irrigation, navigation, fisheries and riparian rights. The report has also a wider function in that its preliminary chapters deal so admirably with general questions of water power legislation and policy, with the importance of maintaining the balance of Nature, and with the fundamental distinctions between water and water power. No pains have been spared to prevent the inexperienced or the unscrupulous promoter from foisting upon the public, projects which are commercially or both technically and commercially unsound. Whilst there are enormous quantities of water power still undeveloped in various parts of the world, it is also a fact that a large percentage of this power cannot be developed economically under conditions existent now, or likely to be existent, within the next century or so. It is desirable that water power be developed fully wherever this is economically possible, but, on the other hand, it must be remembered that "most of the best sites are already developed or held by various interests for future development," and that the residual power available for development with undoubted profit is strictly limited. Water-power rights should, therefore, be granted with circumspection and under proper safeguards. The dissemination of generalities concerning enormous amounts of potential water power is too often part of a plan to make easy the acquisition, by interested parties, of the most coveted privileges.

* "Water Powers of British Columbia." By A. V. White and C. J. Vick. 644 pp, 46 plates, 3 maps. Commission of Conservation, Ottawa, Canada. (1919.)

HYDROELECTRIC POWER TRANSMISSION FROM SWITZERLAND TO FRANCE.

IN the *Revue Générale de l'Electricité* for May 1st an account is given of a scheme which was carried out in 1918-19 to enable the Compagnie Lorraine d'Electricité to receive a supply of energy from the power station of the Société Motor de Baden, at Goesgen, on the river Aar. The distance is 185 km. (115 miles), and the pressure adopted was 110,000 volts, though provisionally the service is being carried on at 70,000 volts. The project was formulated under the pressure of war requirements at the beginning of 1918, by the Compagnie Générale d'Electricité, at the request of the Ministry of Munitions, and took the place of a previous scheme which had become unrealisable owing to the war; the frontier was to be crossed at Delle, near Belfort. The French and Swiss constructors were helped in obtaining the necessary material by the Motive Power Department of the Ministry, which enabled them to secure uniformity and quick delivery. The work was begun in July, 1918, and was completed in one year, the line being put into use on August 10th, 1919. The power to be transmitted was 20,000 H.P., necessitating a pressure of 110,000 volts, in order that with a power factor of 0.8 at Pouxeux, the transformer station of the Lorraine Co., the ohmic losses on the 185-km. line should not exceed 10 per cent., or the pressure drop 15 per cent., and the line was built for that pressure; but in order to supply the 70,000-volt network of the company without delay, the latter voltage was adopted for the time being.

The power station employs a fall of 17 m. (56 ft.) and a flow of 350 m.³ (12,360 cu. ft.) per second; it contains six sets of 7,600 H.P. each, out of eight provided for, and generates at 8,000 volts, 3-phase, 50 cycles per sec.

The line traverses mountainous and wooded districts, with about half its length in each country; at the frontier post at Delle the energy is metered. The highest point reached by the line is at Belfahy, in France, 825 m. (2,700 ft.) above sea-level, but it attains nearly the same elevation in Switzer-

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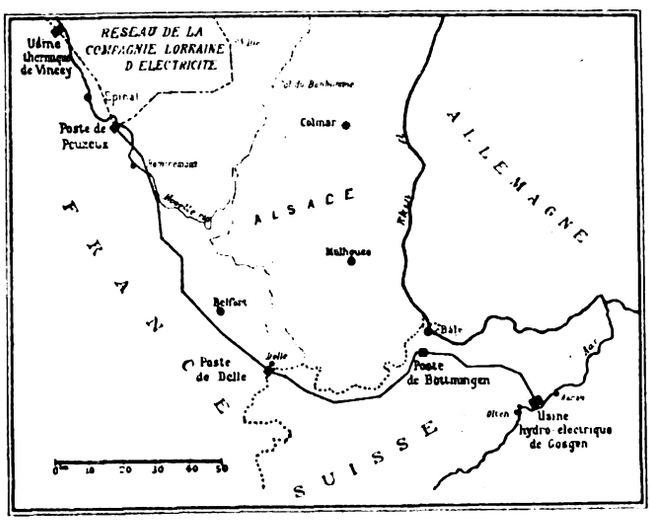
land. It is carried on steel towers, and consists of three copper cables of 78 mm.² (0.12 sq. in.) cross section, supported by suspension insulators. A steel cable of 40 mm.² (0.062 sq. in.) cross section is suspended above the line and earthed at the masts. On the ground that the insulators are the weak points of a high-pressure line (45 per cent. of line faults are due to them) long spans were adopted, the most economical being found to be 180 to 200 m. (600 to 650 ft.); in some cases it was necessary to use a span of 300 m. (1,000 ft.), and on the Swiss side even upwards of 500 m. (1,600 ft.).

Two types of towers were used, one for straight runs and the other for anchoring and angles. The former has a safety factor of over 3, but at road crossings the span is shortened to give a factor of safety of 5; the weight of this tower is 1,300 kg. (2,866 lb.). The anchor tower weighs 2,500 kg. (5,512 lb.), and in both cases the tower is constructed in three sections bolted together. The height of the towers is 19.7 m. (64.6 ft.), and the lowest conductor is slung at 14 m. (46 ft.), so as to give a clearance of about 7 m. between the lowest point of the span and the ground. All the towers are fixed into concrete foundations. The conductors are suspended at the corners of a triangle measuring 3.25 m. (10.7 ft.) vertically, and 4.5 to 4.75 m. (15 to 15.6 ft.) on the other sides. To avoid possible contact between the cables, the supports of the two on the same side are staggered 500 mm. (20 in.). Each tower is provided with a copper earth-plate 400 by 300 by 2.5 mm. (16 by 12 by 0.1 in.). At railway crossings the cables are supported inside a rectangular lattice frame, with double chains of insulators.

Each chain consists of eight porcelain disk elements as a rule, but a ninth is added at anchor or angle towers; each disk is 250 mm. (9.84 in.) in diameter and weighs 3.6 kg. (8 lb.). The complete chain is 1.3 m. (4.26 ft.) in length. The breaking strain is 4.200 kg. (9,260 lb.), and brush discharge commences (over one element) at 50 kv.; sparking-over



Map showing the Route of the Line.

takes place dry at 70 kv., wet at 47 kv., and piercing under oil at 90 kv. With six elements, wet, sparking-over commences at 173 kv., and a complete chain of eight elements withstands over 350 kv. dry.

The copper cables have a resistivity of 1.78 microhms per cm. at 20 deg. C., and a breaking-stress of 36 kg./mm.² (51,000 lb. per sq. in.). The working stress does not exceed 8 kg./mm.² (11,400 lb. per sq. in.). The Schlick coupling sleeve is used for joints.

Anchor towers are provided at intervals of 1,000 to 1,200 m. Clearance avenues have been cut through the woods, so that a tree cannot fall on the line.

The line on French territory required 850 tons of steel in 542 towers, &c., of which 434 were of the straight-run type; 200 tons of copper, 29 tons of steel cable, 19,000 insulator elements, and 1,200 tons of cement. In the early stages the line was built by the labour of Kabyles and Moroccans, until demobilisation took place.

Sectioning stations are provided at four points, dividing the line into sections of about 20 km. (12 miles). At the receiving station, Pouxeux, electrolytic lightning arresters are installed in the open air. At the connecting station, at Delle, provision is made for putting in parallel the water-power station at Goesgen and the steam-power station of the Lorraine Co. at Vincey, for breaking the circuit, and for measuring the energy transmitted. The lines first pass through reactance coils combined with horn arresters, with three spark gaps, and a resistance of 10,000 ohms per phase. These are mounted on an external terminal derrick. Inside the station, on the upper floor are reactance coils, isolating switches and cut-outs for the instrument transformers. On the ground floor are the circuit-breakers, and instrument transformers.

Telephonic communication is provided at all terminal and sectionising stations.

It is interesting to note that parallel running between the steam station at Vincey and the plant at Goesgen, 230 km. apart, is effected without any difficulty.

AUTOMATIC TRAIN CONTROL.

An initial installation of automatic train control has recently been completed on the main line of the C.R.I. & P. Railway between Blue Island and Joliet, Ill., U.S.A., 21 miles of double track in dense passenger and freight traffic territory. The apparatus was designed and manufactured by the Regan Safety Devices Co. (Inc.), of New York and Chicago.

According to the *Railway Review*, the control system consists of two elements; the locomotive and tender equipment includes a shoe mechanism, speed controller, electro-pneumatic valve, relay, battery, and release switch. The roadside apparatus consists of a ramp located by the side of the track, battery, and relay, connecting the existing signal system.

The system embraces automatic speed control, as well as automatic stop features. It is of the intermittent electrical contact type, but arranged to carry continuous speed control through caution territory. In other words, having been actuated to provide speed control, it operates to restrict the speed of the train to a predetermined rate until conditions again necessitate unlimited speed or the train to stop, as the case may be, depending upon the position of the next signal. The speed controller is rigidly bolted to the end of the axle of the pony truck wheels and is contained in a dust-proof housing. It consists of a centrifugal governor arranged to open and close a circuit at any predetermined speed, which is set depending upon the class of traffic to which the locomotive is assigned. Connection is made to the controlling circuit through a stationary junction box to which is connected a flexible conduit; a ball bearing is provided to reduce friction to a practicable degree and to permit free movement of the condulet.

The electro-pneumatic valve, located at a point convenient for connection to the air brake system, operates in response to an electro magnet, and controls the brake pipe pressure and the reservoir supply to the engineman's brake valve. When the magnet is de-energised, the valve reduces the brake pipe pressure to ensure a service application of the brakes; at the same time it restricts the reservoir supply, so that the brakes cannot be released by the engineman's brake valve. The brake pipe pressure may, however, be still further reduced by the engineman in the same manner as with the conductor's emergency valve.

The shoe mechanism consists of a stem, a circuit controller and a cylinder housed in a substantial steel case which is rigidly bolted to the arch bar of the tender truck or to the trailer truck of the locomotive, as the case may be. The shoe is held in position and in contact while moving over a ramp by means of brake pipe pressure in the stem cylinder, to which the brake pipe is connected. The stem is cored, so that should it be broken, a service application of the brakes would result. The shoe circuit controller operates to substitute, in a normally closed circuit, energy from the roadside battery for that from the storage battery carried on the locomotive, also to transmit current of the proper characteristic from the roadside battery to actuate the locomotive apparatus and control the train consistent with the indication displayed by the block signal.

The storage battery is of the portable lead type and consists of five cells of 80 ampere-hours capacity, operating through resistance.

The relay is of a 3-position type connected into the circuit so as to repeat the position of the signal by means of electric currents of the several characteristics as may be transmitted by the roadside and locomotive apparatus.

The ramp is made up of angle iron, with a copper insert, suitably mounted upon cast iron supports which are rigidly bolted to the standard cross ties, a wood block separating the ramp iron from the support castings. This ramp is patented and very different from any ramp used elsewhere. It is 120 ft. long, and is located approximately 160 ft. in front of each signal. The ramp and the track are so connected with the signal system as to cause the signal to assume the stop position in case, for any reason, the ramp circuit is de-energised.

The signal system with which this train control system is operated is of the 3-position, D.C., upper quadrant, bottom-post mechanism, semaphore type operated by polarised line circuits. The relays and terminals for the ramp circuits are housed in the signal case or in a special relay box bolted thereto. Connection from the mechanism to the ramp is made through conduits.

In the operation of this system an application of the brakes is made by the automatic control apparatus when any of the following conditions exist: (*a*) When a train passes a signal in the caution position at an excessive speed. (*b*) Whenever a train exceeds a predetermined speed while running in a caution block. (*c*) At a stop signal, or when a block is occupied.

When an application of the brakes is made by the automatic control apparatus, release may be made with the system in service only:—

1. By automatic release, as in caution block territory, when the speed is below a predetermined point.

2. By automatic release, as when passing from caution block territory to a clear block.

3. By the engineman operating the release switch to pass a stop signal.

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In the third case the train may then proceed, but only under automatic speed control, until the next block signal is encountered, when, if the block be clear, unlimited speed will be automatically restored.

No part of the automatic train control system is located in the engine cab, its operation being entirely independent of the engineman. It does not in any way interfere with the control or operation of the train by the enginemen so long as he obeys signal indications. It is intended to operate if, for any reason, the engineman fails.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

The Glory of the Day's Work.

Will you kindly allow me to say how very much I appreciate the article by "Femina" in your issue of June 11th, 1920, on "The Glory of the Day's Work."

If the sentiments therein expressed were firmly implanted in the hearts of everyone taking any part in the industrial life of our nation, and if one and all could realise the value of a day's work conscientiously accomplished, both to themselves and the community at large, most of our labour troubles would vanish, and a spirit of contentment with "our daily round and common task," would prevail.

I consider the article to be of great value in view of the present unrest prevailing.

Jay Gee.

June 16th, 1920.

The Electro-deposition of Iron.

My attention has been called to the article on the electro-deposition of iron appearing in your paper.

I should like to point out that the process originated in my works here. Some undersized gauges for tail shafts for the Admiralty were built up here, with very satisfactory results. This was communicated to the Air Board, with the result that a number of officials visited my works at Sunbury, and the process was taken up by them and developed for a variety of purposes during the war.

Sherard Cowper-Coles.

Sunbury-on-Thames.
June 9th, 1920.

Single-phase Meters on Three-phase, Three-wire Systems.

With reference to the article in the REVIEW of June 11th re "Single-phase Meters on Three-phase, Three-wire Systems," Mr. Solomon states a fact which ought to be well known to all qualified engineers who have to deal with measurement of A.C. power. He points out that the proper method is to use two single-phase meters connected on the two-wattmeter principle, or a three-phase two-element meter. He omits to mention the fact that three-phase power in a balanced three-phase three-wire circuit can be measured by creating an artificial neutral point by means of a star resistance and the use of a single-phase meter having a constant of 3.

If E is the star voltage and I the current in the corresponding meter element, the single-phase meter will read $E I \cos \phi$.

The total power will be $3 E I \cos \phi$.

Hence if the meter is geared so that the dial reads three times the power actually measured, the total three-phase power will be registered.

J. Henderson.

Glasgow.
June 15th, 1920.

A Technical University.

Your editorial comment on the recent meeting for the formation of a technical university in London calls for some reply.

I will say little with reference to your views on the meaning and function of a university, except that these views are slowly dying out, but the point that I do wish to raise is in what manner the University of London fulfils your ideal. Where in this University "itself" is "*the polish which is imparted by constant association with one's fellows in the atmosphere inherent to a university*"? It may be found in some of the recognised schools of which the Imperial College is one group.

The degrees of London have been maintained at the highest standard, and are everywhere accepted as second to none, yet however highly one values the London degree, one cannot but remember that it may only represent a series of examinations without the solid background of a college training. In my early days, we at the Royal College of Science were taught, I think wrongly, to undervalue these diplomas, and some of us only regarded the University as a store for serving out degrees.

The present need is to provide a technical degree on a par with the bachelor, master, and doctor's degrees of the ordinary universities and known by these names and abbreviations, so that the ordinary commercial man and the man about town can understand something of the training of the holder without having to carefully obtain information of the relative merits of the A.R.C.Sc., A.K.C., B.Sc., &c. In provincial centres, as far as I know, the modern universities fulfil the needs of the times, but in London the case is wholly different, for here we have a large group of colleges combined for the purpose of technical education, more powerful than the University, and yet without the special privileges of a university.

Now, sir, having shown that the University of London (*fait accompli*) does not fulfil your own ideals as a university, I hope you will give the Imperial College of Science your influential support in its claim for a charter.

F. Peake Sexton.

Westminster.
June 15th, 1920.

[We refer to this subject in our leading columns.—EDS. ELEC. REV.]

What is the Contractor Doing?

I have read with great interest the article which, under the above heading, appeared in your issue of June 4th, and from many years' experience can fully endorse the remarks of your contributor.

"Electra," in his reply last week, agrees that there is every prospect of a great boom in electric cooking, but prefers to wait until the manufacturer has created the demand before doing anything himself to foster it.

This sums up the situation exactly, both are waiting for each other, with the result that much profitable business is lost. Have neither of them heard of "Co-operation"?

If this can be accomplished there will then be no need for further articles like the above, and I venture to suggest that their various associations could do much good by putting this subject on their agenda for discussion.

In the meantime the manufacturer can greatly help matters forward by providing the contractor with attractive showcards and non-technical pamphlets. He needs these to make sales as much as a miner does his pickaxe to obtain gold.

The contractor for his part must carry stocks, for it is most essential he should be in the position to satisfy his customer immediately, otherwise the opportunity may be lost.

With only these two things accomplished, sales will flow faster, but it still needs the high explosive of organised publicity to create the mighty volume, and this, in my opinion, can only be done by the co-operative efforts of the various associations.

What have they to say on the matter?

A. G. Blake.

June 21st, 1920.

Your articles headed "What is the Contractor Doing," and the subsequent correspondence interests us very greatly.

We feel that the contractor has, in the past, developed the wiring and engineering side of the business only, for the reason that the necessity of electric labour-saving appliances in the home was not apparent in view of the fact that domestic labour was plentiful and inexpensive. *Now* conditions have changed—domestic help is scarce and costly—those fortunate enough to secure any, must do as our American cousins have done in necessity, viz., purchase electric labour-saving appliances to retain the help—those less fortunate must have similar appliances to get along without it. In view of this "double market" which is crying out for appliances to aid domestic conditions, we are absolutely confident that the contractors will not fail to reorganise and develop the *commercial sales side* of their business, even more energetically than their friends in the States, who a few years ago, utilised their shop windows as more or less "rubbish dumps," but are now second to none as merchandising display windows. We, as manufacturers realise that without co-operation nothing worth while can be accomplished; hence our reason for having representatives continually in America keeping up with the times, and profiting by what has already been done. Now we have ready some of our co-operative sales help for the contractors' use, which will enable them to make good window shows of labour-saving appliances which will appeal to the womenfolk of this country.

It may interest your readers to know that we have complete window display material, showcards, life-size cutouts; also we are willing to loan electros to assist their local advertising, and supply advertising folders for distribution. This is only the beginning of what we intend to do to assist our contractor friends in their task of building up a sales organisation, which most certainly is necessary to them if they are to do their part in supplying the existing demands. The electrical contractor is as shrewd a business man as there is, and will most certainly profit by the unexpected opportunity which has arisen, and he *will do his share* and thoroughly.

L. G. Hawkins & Co.

London, W.C.
June 21st, 1920.

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Non-Union Labour and Supply Undertakings.

On behalf of the Rochdale Branch of the E.T.U., I am pleased to note that District Council, No. 10 Area (Greater London), is taking the same standpoint as we did on March 1st, 1920, and may say that it has been a great advantage to our membership, since our members on the supply staff refused to connect any job or installation done by plumbers and non-unionists. As noted in another part of your valuable journal, the Rochdale supply undertaking has established a record in lighting consumers during the year, and placed £5,000 to relieve the rates. We hope every E.T.U. branch will adopt this stand, which will guarantee quality and workmanship to consumers.

H. Turner,
Secretary.

Rochdale.
June 19th, 1920.

Technical Works.

Referring to the article of Mr. Purday, which appeared in your issue of April 30th, pressure of business at that time caused that particular issue to be put aside for later consideration; if not too late, I would like to make a few comments.

I fully appreciate Mr. Purday's feeling in the matter, having myself helped to get out technical work.

Generally speaking, when searching through technical books for any special information, one obtains, say, one ounce of hard fact out of 4 or 5 lb. of extraneous matter, which causes the cost to be considerable.

There are several books which, although very valuable in themselves, are too expensive to purchase for the small amount of special information in each.

Some works also which come out annually should be re-edited, and if before they were issued, the editor or compiler of such books would communicate with engineers (dealing practically with the various subjects) he would often obtain valuable assistance.

I know of one book which I sent for, and after some difficulty I found one paragraph dealing with the particular subject in which I was interested. This paragraph was incorrect and out of date.

There are very few books dealing specifically with one subject or branch of engineering, probably because the demand for them would not be satisfactory. Even when such a book is compiled, it is very advisable to carefully consider every page before issuing a new edition, as during the past five or six years there have been many changes.

For instance, in 1914, a technical book dealing with a certain speciality was issued, and a surplus stock of matter printed (but not bound up) ready to make up another edition in the following year, but in 1919, when a new issue was imperative, the surplus sheets were found to be very troublesome, owing to altered conditions, and it was necessary, for the time being, to insert a supplement; it now means an entire revision, and practically a new book.

Mr. Purday's suggestion that the date should always be inserted is very necessary. I adopted the plan of printing the year of issue on the cover.

I enclose copy of the technical book referred to, which perhaps you will forward to Mr. Purday.

Fred Bland.

Sheffield.
June 21st, 1920.

Government Waste.

In the Press at the present moment public attention is being directed to a series of articles under the above heading. While these are drawing forth criticisms from all quarters it would be entirely misleading for the public to consider that such wilful waste takes place in all Government departments, regarding the wages of their employés.

Some time ago an article in the REVIEW drew attention to the fact that certain individuals employed by the War Department in their power stations had not received any benefit under the E.P.E.A. Award No. 9,281. However, after more than 12 months' delay, these individuals were put in receipt of the above.

It would be interesting to know whether the Minister of Labour is aware of his sanction of an additional £30 per annum to be added to the above award. Up to the present it is a minus quantity, as far as the W.D. stations are concerned.

The same article also made reference to the workers now coming under the Whitley Council scheme.

The previous increases of 5s., 3s. and 3s., granted to these men has in practically all other concerns been paid, but not so to the workers of the War Department, as will be seen from the following.

Some weeks ago a conference was held between delegates of a certain union and a representative of the War Office to settle the question of wages. However, after the representative was informed that certain parts of the district had recognised the claim, the conference closed, the only result being a waste of time on both sides, as nothing is forthcoming.

It is argued that the party which approves and sanctions these awards cannot take the lead, therefore, the humble employés must sit tight and "wait and see" if there is anything left after the squandering is finished. The upset and discontent in various central stations between employer and employed cannot be wondered at when the very thing we are striving to conquer in this country at the present time is being put into practice by these Government departments.

But there is an end to everything, the inevitable clash is bound to come sooner or later, and the Government, as in the majority of cases, must be considered as the ringleaders of the present dissatisfaction amongst workers.

Otozel.

Distribution Mains for new Housing Schemes.

The article in your issue of the 18th inst., by Mr. Wilson, mains superintendent of Maidstone, is most valuable and timely.

The very arrangement of the new colonies, giving as it does more space between the houses and more irregular outline than the stereotyped form of street, increases the cost of service work, and consideration of this distribution problem to small properties is urgently required.

Some years ago an opportunity arose for providing electricity supply to a new and comparatively large estate of small villas, built, however, on comparatively old-fashioned lines; that is to say, in rows, and with small gardens.

In this case the supply was distributed in the form of single-phase A.C., and the method adopted—which proved inexpensive and satisfactory—was to lay down each side of each road one lead-covered armoured cable consisting of four cores, two outers and one neutral for balanced three-wire single-phase supply, and in addition one switch wire for public lighting.

This cable was not looped into the houses, services being put on in the old-fashioned manner with "T" joints.

The public lamps were also connected in the same way, but through the switch wire so that a large number could be turned "on" and "off" in groups from a central point.

At the junctions of roads a public lamp was fitted, the post having a special and enlarged base containing simple link gear to which the various cables at that point were brought, constituting in fact a small feeder pillar.

This arrangement worked very well, permitting services to be put on from time to time with minimum expense, made sectionising and testing easy, and provided for an inexpensive form of street lighting control.

The provision of a small switch wire in the main cable was probably not new, but is certainly worthy of attention even if public lighting is not immediately required, as the extra cost is very small. There are perhaps manufacturing difficulties in including the small switch wire in a cable of which the other cores are relatively large, but for the requirements of the ordinary housing colony, runs of ¼ to ½ mile from transformer kiosks, and work of that kind, the method offers many advantages.

The British Electrical Development Association, Inc.

London, W.C. 2.
June 21st, 1920.

Situations Vacant.

With reference to the correspondence appearing in the ELERTRICAL REVIEW with regard to the use of box numbers by advertisers, I think that it will interest your readers to consider the question from the advertiser's point of view.

I wish first of all to state that I am not an employer, but an employé (also a trade unionist) engaged by a large firm of engineers. Amongst my duties for my principals I have to engage assistants for various positions.

During the past years, having read many letters in the ELECTRICAL REVIEW on the much-debated subject of using box numbers by advertisers, I sided with the views expressed by your many correspondents, that this system of advertising vacant positions was a pernicious one. I therefore determined when advertising to use my firm's name and address; but after a few trials I had to revert to the box number again, as the results obtained by giving a name and address can hardly be credited. In reply to an advertisement, I have received at times hundreds of applications for a job, and then the trouble commences. Customers and friends will telephone or write asking that their friend Mr. So-and-So should be given the appointment, rarely discriminating whether the man's qualifications are suitable or not. I am not exaggerating when I state it is the rule rather than the exception to get a large number of these appeals, and in addition, although an advertisement may distinctly state that application is to be made by letter only, applicants from near and far will persistently call, resulting in a great loss of time to themselves and the advertisers. Now, most of the firms that use a box number are manufacturers, and from the above facts one can easily realise it would not be good policy on their part to risk the goodwill of various customers and their friends by creating disappointment.

Again, on the question of "state salary," I am afraid that this is primarily attributable to certain applicants, who, when applying for a position, and where a definite salary is offered, endeavour to secure the job by offering to take it at a lower

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figure. I am sorry to state that in my experience I have had such offers. Needless to state, with any reputable firm these applications find their way to the waste-paper basket. However, in these days, there should not be any trouble in the question of "state salary," as every staff engineer should join either the E.P.E.A. or the S.T.E., whose officials will assist them in every way on this particular point. My view is, that where an applicant replies to an advertisement under a box number he is fairly sure of a square deal, since his application is considered on his merits alone.

Resident Engineer.

[This correspondence is now closed.—EDS. ELEC. REV.]

Staff Salaries and Conditions of Service.

In the ELECTRICAL REVIEW of June 4th appeared a leading article headed "Situations Vacant," which, after commenting pithily on some of the practices of certain employers, issued an invitation to the Society of Technical Engineers to abandon its secretive attitude. In the same week's issue of *The Electrician* there appeared two leaderettes referring to the recently-made agreement between the employers and staffs of the electrical supply industry. The latter of these two articles sounded a note of warning about the dangers of standardisation of salaries.

During the last few months such comments, usually brief, and directed towards one particular section of the general problem, have become increasingly common, but so far no general résumé of the whole subject covered by the title above has appeared in any of the technical papers concerned.

I think we are justified in assuming from the evidence that the engineer, both electrical and mechanical, long-suffering though he may be, is at last becoming vocal under the pressure of conditions which, bad as they have been during the last two decades, are fast becoming almost intolerable.

There is a deal of confused thinking about the subject, and it will be my attempt in this article to focus attention upon what appear to be the fundamental points requiring consideration.

I think that the following summary will meet with the agreement of all concerned:—

1. That in relation to other professions and businesses demanding the same degree of education, training and sense of responsibility, the electrical engineer was very poorly paid even before the war, and his conditions of service were often unnecessarily harsh.

2. That advances of salary, especially in the higher grades, during the last five years, have been totally disproportionate to the increase in cost of maintenance of a home and family, and conditions of service have deteriorated rather than improved.

3. That only by raising the remuneration and improving the conditions of service of the *average* man shall we obtain a contented staff fitted to give its whole mind to its special task of increasing the efficiency of the joint action of Capital and Labour.

4. That whatever the defects and dangers of association may be it is an incontrovertible fact that association with other individuals and groups is usually necessary before any improvement in the conditions of the general mass of those affected can be secured.

5. That failing the central station staffs, which are represented by the E.P.E.A., no section of the industry has a staff association which is of the slightest use to it.

It may be said that the S.T.E. represents other sections of the industry, but it is at least doubtful whether this is really the case or not. In the opinions of many engineers who have watched the operations of this concern, both from the inside and the outside, it seems clear that as at present constituted and directed, this society is likely to be of very little use. I would go further, and would say that personally I have come to the conclusion that the symptoms indicate that it has fallen a victim to an infantile form of that most insidious of all association diseases, namely, paralysis.

In evidence of this, I call attention to the apparent abandonment by its Council of all attempts to adequately control the actions of its paid servants, and its failure to publicly proclaim a definite policy and secure the help of the technical journals and friendly employers.

The Society's public, or rather semi-public utterances, are chiefly noticeable for their contradictory character, and the fact that they never by any chance indicate that there is any real guiding principle or inspiration behind its efforts. At one of the propaganda meetings which I attended, the speakers, almost without exception, voiced adherence to a policy which it is complimentary to describe as wholly opportunist and unworthy of any association with any real idea of its own dignity or that of its members.

I fear that at present the S.T.E. is not merely useless, but is actually dangerous, because it is still occupying the time of men who might more usefully help a real and progressive association, and it is at the same time making enemies even amongst those employers who sympathise with the legitimate aims and objects of the profession as a whole.

In this connection it must not be forgotten that whilst many employers show that they fully appreciate the position, they, after all, are in the minority, and are restricted from giving full effect to their views by the force of competition, and occasionally by the operations of their various employers' associations.

The central station staffs agreement referred to above, should be welcomed by all electrical men, for the reason that if salaries and conditions can be improved in this branch, bound down as it is by limitations on its charges for services rendered, &c., these improved salaries will eventually form the base for further improvement in the other branches of the industry which are not so bound.

It may be argued that this will further increase the cost of manufacture, and contribute to the much talked of forthcoming "slump," but it does not seem to be generally realised that the increases of "staff" pay in electrical manufacturing industries have had only a microscopic effect upon the total cost of production.

The Electrician, in the article referred to above, drew attention to the dangers of standardising salaries, but surely this danger only exists if an attempt is made to bind down members of the association not to take more than the basic salary. I cannot, in the published reports referring to the agreement in question, find any indication that this stupid policy of the workmen's trade unions has even been contemplated. Provided that there is no such limitation it is obvious that the man above the average will still be able to command a higher salary than the basic rate, but whereas, if the normal rate were £500 he would have to consider himself well paid at £750, he would probably have no difficulty in obtaining £1,100 to £1,200 if the basic rate became, say, £800 to £900, and so on throughout all the grades.

I contend that wha tis required is a real live association governed and directed by men of reasonable but determined character, who could earn and maintain the respect of the employers' representatives, and who would be able to command the allegiance of their fellow employés. They must be men to whom principle means more than opportunism, and to whom secrecy as regards policy and negotiations is abhorrent.

Further, I think that the efforts of all men who have the interests of the industry at heart should be directed towards making both employés, staff, and what is usually called Labour, realise that the technical and management staffs in the engineering industry (and for that matter in all industries) are, and must remain, a *third party* in industry.

They cannot exist without Capital on the one hand, and Labour on the other; but nevertheless it is true that neither Labour nor Capital can produce anything without them except where the capitalists themselves possess both the necessary ability and time to direct their own businesses. Such cases are becoming more rare every year, although many cases of partial direction still exist.

The staffs cannot ally themselves entirely with Capital because they are after all in the position of workers, and they cannot ally themselves definitely with Labour, because they must stand as representatives or judges between Capital and Labour.

They cannot serve the best interests of either Capital or Labour unless they are impartial and free to form and voice independent opinions, and they cannot be impartial if they are members of an association controlled by either Labour or Capital. Nor, being sufficiently conscious of their own strength and requirements, need they take up any such false position.

Garton Le Roet.

June 20th, 1920.

[We regret that pressure upon our space compels us to hold over several letters until next week.—EDS. ELEC. REV.]

Oversea Transmission.—Mr. Aarstad, chairman of the Norwegion Waterfall Commission, has been asked about the standpoint he had assumed concerning the possible transmission of electrical energy from Norway to Denmark. In reply, he is reported to have stated that the question had been put before the Commission for the expression of an opinion, and they had recommended the dispatch of a friendly reply to Denmark's application for the appointment of a joint committee. There was no doubt, he said, that Norway could give a supply to Denmark, and the committee would have to consider the extent of such transmission, both technically and economically. He apprehended that the power would be very costly on reaching consumers in Denmark.

Electrical Workers and the Military.—Our Dublin correspondent writes: In connection with the decision of Dublin dockers not to handle military munitions or equipment, the North Wall electric crane men last week refused to work the crane for assisting the military in the discharge of stores which had arrived from Southampton by the s.s. *Agnes Duncan*. The military then commandeered the electric power house belonging to the Dublin Port and Docks Board, but the employés there refused to work the plant, and it was intimated that if the military themselves attempted to do so, the entire electric power at the port would be stopped by the men, all the other crane-drivers refusing to work. This would have led to general dislocation. Ultimately the military withdrew from the power house, and the employés resumed work there as usual. Later, the military discharged the cargo of the *Agnes Duncan* with the aid of the ship's steam winches and derricks.

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NEW PATENTS APPLIED FOR, 1920.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by MESSRS. SEFTON-JONES, O'DELL AND STEPHENS, Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

15,316. "Electric signalling systems." WESTERN ELECTRIC CO. June 7th.

15,317. "Electrode-locking devices for electric welding machines." J. Ledwinka. June 7th. (United States, May 19th, 1919.)

15,326. "Switch for electrical circuits." A. Messinger and L. Pap. June 7th.

15,335. "Electrical fuses of the cartridge type." METROPOLITAN-VICKERS ELECTRICAL CO. June 7th. (United States, July 5th, 1919.)

15,336. "Automatic spark advance for magnetos." G. B. Gousset. June 7th. (France, June 20th, 1919.)

15,337. "Contact-breaker for ignition magnetos." G. B. Gousset. June 7th. (France, June 20th, 1919.)

15,338. "Collector ring for four-cylinder engines without commutator." G. B. Gousset. June 7th. (France, June 20th, 1919.)

15,344. "Generation of alternating current." BRITISH THOMSON-HOUSTON Co. June 7th. (United States, October 29th, 1913.)

15,346. "Electric meters." BRITISH THOMSON-HOUSTON Co. and A. P. YOUNG. June 7th.

15,347. "Electric lamps." BRITISH THOMSON-HOUSTON Co. (General Electric Co.). June 7th.

15,348. "Mercury, &c., vapour electric lamps." SILICIA SYNDICATE. June 7th.

15,349. "Manufacture and production of graphite electrodes." UNITED ALKALI CO., C. L. HIGGINS and D. A. PRITCHARD. June 7th.

15,350. "Piezo-electric device." A. F. R. COTTON and E. W. C. RUSSELL. June 7th.

15,358. "Arc lamps." F. PORTER and J. W. SMITH. June 7th.

15,378. "Transmission of messages, &c., by electrical means." EVERSHED & VIGNOLES and A. G. MOORE. June 7th.

15,380. "Tubular electric condenser and method of manufacturing same." G. GILES. June 7th. (Switzerland, June 16th, 1919.)

15,399. "Electrical power transmission systems." A. M. TAYLOR. June 8th.

15,434. "Ignition apparatus for internal-combustion engines." H. V. CHANDLER. June 8th.

15,441. "Electric furnaces." B. E. D. KILBURN (Norske Aktieselskab for Elektro-kemisk Industri Norsk Industri-Hypotekbank). June 8th.

15,449. "Electrical signalling-apparatus." W. L. WALKER. June 8th.

15,468. "Multi-phase machines." SIEMENS SCHUCKERTWERKE. June 8th. (Germany, December 14th, 1917.)

15,478. "Coupling for magnetos of internal-combustion engines." F. M. PADIAN and F. K. RAM. June 8th.

15,485. "Vibrating-apparatus for sound-signalling." SIGNAL GES. June 8th. (Germany, October 23rd, 1915.)

15,498. "Storage battery plates." J. F. MONNOT. June 8th.

15,517. "Apparatus for electric transmission of angular indications." A. L. RAWLINGS and S. WARD. June 8th.

15,544. "Electrically-operated curtain-controlling mechanism." F. E. CLIPSTONE. June 9th.

15,570. "Electro-magnetic drill stand." L. R. HORNE. June 9th.

15,572. "Overhead trolleys for electric tramways, &c., vehicles." T. BLANEY and D. WILLIAMS. June 9th.

15,576. "Electric push-button switches." E. N. BRAY & BRAY, MARKHAM & REISS. June 9th.

15,587. "Electric heating apparatus." SOC. ANON. DES ETABLISSEMENTS L. BLERIOT. June 9th. (France, February 5th, 1919.)

15,590. "Sparking plugs, couplings, terminals, &c." J. I. D. and K. D. STEVENSON. June 9th.

15,593. "Electro-deposition of metals." R. W. LAWSON and A. I. G. WARREN. June 9th.

15,596. "Combined electrical conductors and casing therefor." N. PRENTICE. June 9th.

15,599. "Device for supporting receivers of desk telephones." D. R. LOCH. June 9th.

15,601. "Sound producers and receivers." SIGNAL GES. June 9th. (Germany, March 9th, 1916.)

15,602. "Electric lamps." BRITISH THOMSON-HOUSTON Co. June 9th. (United States, November 30th, 1917.)

15,631. "Electrical measuring-instruments." A. COPELIN and EDISON SWAN ELECTRIC Co. June 9th.

15,632. "Wireless telegraph valves." F. A. COULDING and EDISON SWAN ELECTRIC Co. June 9th.

15,646. "Manufacture of thermo-electric metals and alloys." W. C. HERAEUS GES. June 9th.

15,655. "Electro-magnetic clutches and change-speed gearing." Sir C. S. FORBES. June 9th.

15,659. "Telephone apparatus." P. J. HACKETT. June 9th.

15,660. "Signalling circuits." P. J. HACKETT. June 9th.

15,668. "Electrical alarm clock." C. C. BROUGH. June 10th.

15,673. "Portable electric dust exhauster." G. R. BIMM. June 10th. (France, January 17th, 1914.)

15,679. "Electric step-by-step, &c., motors." C. L. WALKER. June 10th.

15,687. "Electrical contacts for fuse boards, distribution boards, &c." B. QUARMBY. June 10th.

15,692. "Electro-magnetic mechanism." C. L. WALKER. June 10th.

15,700. "Electric switches." A. CHRISTIE and R. METCALFE. June 10th.

15,704. "Electric switches." E. BOLTON and the COVENTRY MOVEMENT Co. June 10th.

15,706. "Electrical appliance for cleaning and polishing." I. D. ORR. June 10th.

15,717. "Vacuum tubes, &c." RADIO COMMUNICATION Co. and J. SCOTT-TAGGART. June 10th.

15,726. "Electrical indicators." J. C. WRIGHTON and EDISON SWAN ELECTRIC Co. June 10th.

15,727. "Telephone transmitter." WESTERN ELECTRIC Co. June 10th. (Norway, June 22nd, 1914.)

15,728. "Electric lighting apparatus for cycles, &c." SOC. ANON. DES AUTOMOBILES ET CYCLES PEUGEOT. June 10th. (France, June 13th, 1919.)

15,731. "Telephonic call systems." R. C. M. HASTINGS. June 10th.

15,734. "Electrically-operated implement for cutting crops." G. FRYER. June 10th.

15,740. "Electric lamps for motor vehicles." P. FRANK and KYNOCH LTD. June 10th.

15,746. "Electrical precipitation of solid materials from gases." J. E. LILIENFIELD and METALLBANK UND METALLURGISCHE GES. June 10th. (Germany, March 6th, 1916.)

15,775. "Electro-osmotic separation of substances." ELEKTRO-OSMOSE AKT. GES. (Graf. Schwerin Ges.). June 10th. (Germany, April 8th, 1918.)

15,791. "Spark plugs." W. HOUSMAN. June 10th. (United States, November 26th, 1917.)

15,792. "Systems of electrical distribution." A. E. WHITE (U.S. Light & Heat Corporation). June 10th.

15,797. "Sparking plugs." H. WILLIAMS. June 10th.

15,812. "Handle for electric arc welding." J. DOOLEY. June 11th.

15,814. "Electric switch." A. G. BULLEN, A. G. BULLEN & Co., and R. L. JENKINSON. June 11th.

15,850. "Electric wiring." G. F. A. STONE. June 11th.

15,857. "Telephone systems." WESTERN ELECTRIC Co. June 11th.

15,861. "Process for manufacture of metallic diaphragms of electrolytic cells." R. PECHKRANZ. June 11th. (Switzerland, June 12th, 1919.)

15,862. "Conversion of continuous or direct currents into alternating currents." F. BREISIG. June 11th. (Germany, March 11th, 1919.)

15,872. "High-voltage electric installations." SIEMENS SCHUCKERTWERKE. June 11th. (Germany, July 30th, 1919.)

15,888. "Means for preventing actuation of electric switches, gas cocks, &c." G. FINLAY. June 11th.

15,902. "Apparatus for protection of three-phase current circuits." C. ZORZI. June 11th.

15,905. "Electrical insulating bushings." F. M. DENTON. June 11th.

15,909. "Electrical transformers." E. DE H. DUVAL. June 12th.

15,912. "Device for aligning trolley wheels with overhead transmission wires." H. GEORGE. June 12th.

15,924. "Primary galvanic batteries and electrodes and manufacture of such electrodes." E. W. JUNGNER. June 12th. (Sweden, June 17th, 1919.)

15,935. "Electrical transmission systems." A. M. TAYLOR. June 12th.

15,936. "Electric lamp holders." A. B. GOLDSMITH. June 12th.

15,947. "Electrical transformers." G. SCHROEDER. June 12th.

15,957. "Tuning-instruments for wireless telegraphy and telephony." H. P. REES. June 12th.

15,986. "Systems of electric ship propulsion." BRITISH THOMSON-HOUSTON Co. and D. E. JEWETT. June 12th.

15,987. "Dynamo-electric machines." BRITISH THOMSON-HOUSTON Co. and H. W. TAYLOR. June 12th.

15,995. "Leading-in insulators." G. V. TWISS. June 12th.

15,997. "Starting, generating and ignition apparatus for internal-combustion engines." W. B. MOSES. June 12th. (United States, June 29th, 1917.)

16,008. "Multiple twin telephone and telegraph electric cables." C. R. BOLTON and BRITISH INSULATED & HELSBY CABLES, LTD. June 12th.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1916.

1,434 MULTI-SPEED ALTERNATING-CURRENT MOTORS. British Thomson-Houston Co. (General Electric Co.). January 29th, 1916. (143,272.)

1918.

7,309. MACHINE-SWITCHING TELEPHONE EXCHANGE SYSTEMS. Western Electric Co. and L. Polinkowsky. May 1st, 1918. (143,277.)

11,478. ELECTRIC INSULATION. Elektro-Material Ges. April 11th, 1918. (143,280.)

1919.

3,693. ELECTRIC FURNACES. W. E. Moore. February 14th, 1919. (143,292.)

4,057. COUPLINGS FOR PROTECTED OR ARMOURED ELECTRIC CABLES FOR USE UNDER WATER AND ELSEWHERE. V. C. H. Gibson. February 18th, 1919. (143,308.)

4,065. REDUCTION OF DISTORTION OF HIGH-FREQUENCY CURRENTS PARTICULARLY APPLICABLE TO WIRELESS TELEPHONY. Western Electric Co. February 18th, 1919. (143,309.)

4,387. ASSEMBLING OF ELECTRIC BATTERIES. London Battery Co. and E. W. Clarke. February 21st, 1919. (143,322.)

4,509 ELECTRICAL ACCUMULATORS. C. H. Worsnop. February 24th, 1919. (143,327.)

4,579. ARRANGEMENT AND CONNECTOR FOR JOINTING OF ELECTRICAL WIRES. J. S. Mollerhoj. February 24th, 1919. (143,328.)

4,745. ELECTRIC CONNECTORS. G. Duveau. March 18th, 1914. (123,770.)

5,185. CUTTING AND WELDING METALS BY THE ELECTRIC ARC. C. G. Conradi. March 3rd, 1919. (143,331.)

8,943. ELECTRIC-LIGHTING SETS MORE ESPECIALLY FOR USE WITH MOTOR-CYCLES. Efandem Co., W. Owen and F. E. Cutler. April 9th, 1919. (143,358.)

10,197. MACHINES FOR MAKING BOBBINS FOR ELECTRIC BATTERIES. National Carbon Co. January 10th, 1918. (125,991.)

10,198. MACHINES FOR MAKING BOBBINS FOR ELECTRIC BATTERIES. National Carbon Co. January 10th, 1918. (125,992.)

10,644. ELECTRICAL TRANSMISSION DISENGAGING LOCK-SWITCH. J. J. Wheatley. April 30th, 1919. (143,372.)

11,123. CONTROLLING AND REGULATING SYSTEMS FOR DYNAMOS, APPLICABLE ALSO AS MOTOR-STARTING SYSTEMS. W. J. Rickets. May 5th, 1919. (143,378.)

12,613. PORTABLE ELECTRIC LAMP SPECIALLY ADAPTED FOR USE BY POLICE OFFICERS ON DUTY. F. W. Dowty. May 20th, 1919. (143,387.)

13,527. SPARKING PLUGS FOR INTERNAL-COMBUSTION ENGINES. L. Macquaire. May 28th, 1919. (143,395.)

14,464. SUPPORT FOR ELECTRIC INCANDESCENT LAMPS. J. P. Johansson. June 6th, 1919. (143,404.)

14,977. WIRE COUPLINGS FOR SPARK-PLUGS. Soc. Anon. des Automobiles et Cycles Peugeot. July 23rd, 1918. (130,321.)

15,080. REGULATING-SYSTEMS FOR DYNAMO-ELECTRIC MACHINES. W. J. Rickets. June 16th, 1919. (143,413.)

15,116. ELECTRIC SWITCHES. Benjamin Electric, Ltd. September 13th, 1918. (132,492.)

18,637. TRAFFIC-CONTROLLING APPARATUS FOR RAILWAYS AND THE LIKE. McKenzie, Holland & Westinghouse Power Signal Co., H. H. Dyer and R. G. Davey. July 28th, 1919. (143,437.)

18,711. METHOD OF AND APPARATUS FOR RECOGNISING AIRCRAFT BY ACOUSTIC MEANS AND FOR ACOUSTIC-TELEGRAPHY BETWEEN AIRCRAFT AND THE EARTH. A. Bernini. July 27th, 1918. (130,605.)

20,830. EXTENSIBLE ELECTRIC LAMPS FOR MOTOR AND OTHER VEHICLES, BOATS, AND THE LIKE. B. J. Grigsby. August 12th, 1919. (143,448.)

21,586. ELECTRIC MINER'S LAMPS. O. Schneider and F. Schlegel. November 9th, 1918. (135,163.)

22,127. ELECTRO-MAGNETIC WAVE NAVIGATIONAL SYSTEMS. W. F. Thompson (J. Bethenod). September 9th 1919. (143,455.)

22,173. APPARATUS FOR DIMINISHING THE INJURIOUS EARTHING CURRENTS IN EARTHED HIGH-PRESSURE NETS HAVING A CAPACITY THAT IS NON-SYMMETRICALLY DISTRIBUTED OVER THE PHASES OF THE NET. Akt. Ges. Brown, Boveri et Cie. December 23rd, 1918. (137,032.)

25,302. ELECTRIC PUSH-BUTTON SWITCHES. A. Cesaro. February 8th, 1912. (138,854.)

28,388. FIXING-ARRANGEMENT FOR ELECTRIC MEASURING INSTRUMENTS. Siemens & Halske Akt. Ges. August 23rd, 1918. (135,219.)

1920.

579. MAGNETO-ELECTRIC MACHINES WITH OSCILLATING ARMATURES. O. Imray (Eisemann Magneto Corporation). January 7th, 1920. (143,480.)

1,570. METHODS OF PROTECTING ELECTRIC NETWORKS COMPRISING ARMOURED CABLES WITH MULTIPLE CONDUCTORS. P. M. J. Boucherot and Soc. Alsacienne de Constructions Mecaniques May 1st, 1914. (138,075.)

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